

**RIS3CAT**

**Research and Innovation Strategy  
for the Smart Specialisation  
of Catalonia**

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## Executive summary

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The Europe 2020 Strategy for smart, sustainable and inclusive growth sets out the targets that the European Union is to meet by the year 2020 in the fields of research and innovation, climate change and energy, employment, education and reducing poverty. The strategy also includes seven flagship initiatives that form the framework in which the EU and the Member States governments are to join forces and mutually strengthen each other in areas related to the Europe 2020 Strategy priorities.

For the 2014-2020 period, the European Commission has designed an integrated focus that brings together all the cohesion policy funds in a common strategic framework, clearly establishing the priorities and the results to be achieved. Moreover, the European Commission has made smart specialisation a prior condition for investment in research and innovation cofinanced by European funds. The Member States and the regions are required to draw up research and innovation strategies for smart specialisation (RIS3 strategies). In accordance with the methodology established by the European Commission, these strategies should support those economic and knowledge specialisations that best match their potential for innovation, based on the resources and capabilities in the territory.

In this context, the Strategy for the Smart Specialisation of Catalonia (RIS3CAT) defines the framework within which the Catalan Government establishes research and innovation (R&I) actions and programmes over the 2014-2020 period and provides support for the generation and development of innovative projects. Moreover, the Digital Strategy of Catalonia for 2020 establishes the framework for investment and action in the ICT field.

The RIS3 methodology establishes that strategic prioritisation should be based on evidence and, more specifically, on studies that take into account economic specialisation, research specialisation, global trends (regarding both technology and markets), the presence in international value chains, cluster initiatives and the history and potential for cooperation amongst stakeholders (from both the inter-sector and intra-sector perspectives).

RIS3CAT was formulated in accordance with in-depth analysis of the strengths, weaknesses, opportunities and threats of the Catalan economy taking into account the different sectors and technological capabilities. This analysis identifies three main vectors that provide the structure for the activities that will enable the Catalan economy to successfully tackle the major social and economic challenges of the 21st century:

1. The legacy of the great Catalan industrial tradition. In the 21st century, the development of the Catalan industry should place the emphasis on key competitive factors such as innovation, technology, design and training.

2. The wellbeing of people in such spheres as food, health, leisure and lifestyle, in which R&I generates economic opportunities and direct benefits for both individuals and society as a whole.
3. The global challenges posed by climate change, the impact of human activity and shortages of natural resources.

Taking all these considerations into account, RIS3CAT establishes a shared vision of the country for 2020:

Catalonia is a country with an industrial base and an open, competitive and sustainable economy that combines talent, creativity, a diversified business fabric and its own excellent research system within the framework of a dynamic, enterprising and inclusive society. The country is home to both multinational enterprises and local companies, both consolidated industries that have become international leaders and emerging technological sectors.

To advance towards making Vision 2020 a reality, RIS3CAT establishes four strategic objectives and four pillars of action.

### RIS3CAT: Strategic Objectives and Pillars

Strategic objectives	Pillars	
To modernise the business fabric by improving the efficiency of production processes, internationalisation and the reorientation of consolidated sectors towards activities with greater added value	<b>Pillar 1</b>	Leading sectors
To promote new emerging economic activities through research and innovation to create and develop new market niches	<b>Pillar 2</b>	Emerging activities
To consolidate Catalonia as a European knowledge hub and link technological and creative capacities to existing and emerging sectors in the territory	<b>Pillar 3</b>	Cross-cutting enabling technologies
To improve the overall Catalan innovation system, increasing the competitiveness of companies and steering public policies towards promotion of innovation, internationalisation and entrepreneurship	<b>Pillar 4</b>	Innovation environment

Pillar 1 focuses on seven leading sectors whose importance and potential enable them to act as cornerstones for economic recovery and to reorient the Catalan economy towards a growth model that is smarter, more sustainable and more inclusive.

Pillar 2 identifies new economic opportunities in emerging sectors, based on technological capabilities (new activities generated through technological change and cutting-edge innovation) and the synergies between related sectors. Pillar 3 focuses on cross-cutting enabling technologies, the main tools for transforming the production system and generating new scientific, technological and economic opportunities. Finally, Pillar 4 focuses on improving the innovation environment.

### RIS3CAT Structure: Pillars and Tools

Pillar 1	Pillar 2	Pillar 3	Pillar 4
Leading sectors	Emerging activities	Cross-cutting enabling technologies	Innovation environment
<ul style="list-style-type: none"> <li>Food</li> <li>Energy and resources</li> <li>Industrial systems</li> <li>Design-based industries</li> <li>Industries linked to sustainable mobility</li> <li>Health industries</li> <li>Cultural and experience-based industries</li> </ul>	To be identified in the entrepreneurial discovery process	<ul style="list-style-type: none"> <li>ICTs</li> <li>Nanotechnology</li> <li>Advanced materials</li> <li>Photonics</li> <li>Biotechnology</li> <li>Advanced manufacturing</li> </ul>	<div>Public policies</div> <ul style="list-style-type: none"> <li>Digital agenda</li> <li>Entrepreneurship</li> <li>Eco-innovation (green economy)</li> <li>Non-technological innovation</li> <li>Training and talent</li> </ul>
<div>Tools</div> <ul style="list-style-type: none"> <li>RIS3CAT communities</li> <li>Emerging activities</li> <li>Development of key technological capacities</li> <li>Research and technology transfer infrastructure</li> <li>Collaborative R&amp;D projects</li> <li>Technology valorisation and transfer</li> <li>International cooperation</li> <li>Innovative public procurement</li> <li>Specialisation and territorial competitiveness projects (PECT)</li> </ul>			

The strategy seeks to combine R&I tools consolidated in Catalonia with new instruments in order to promote major collaborative initiatives involving quadruple helix stakeholders (R&I system, companies, government and innovation users). These projects form joint R&I agendas to transform sectors (RIS3CAT communities) and the territory (territorial specialisation and competitiveness projects, PECT) and to support emerging activities. By establishing these sectoral and territorial agendas, R&I system stakeholders will gradually define the smart specialisation of Catalonia.

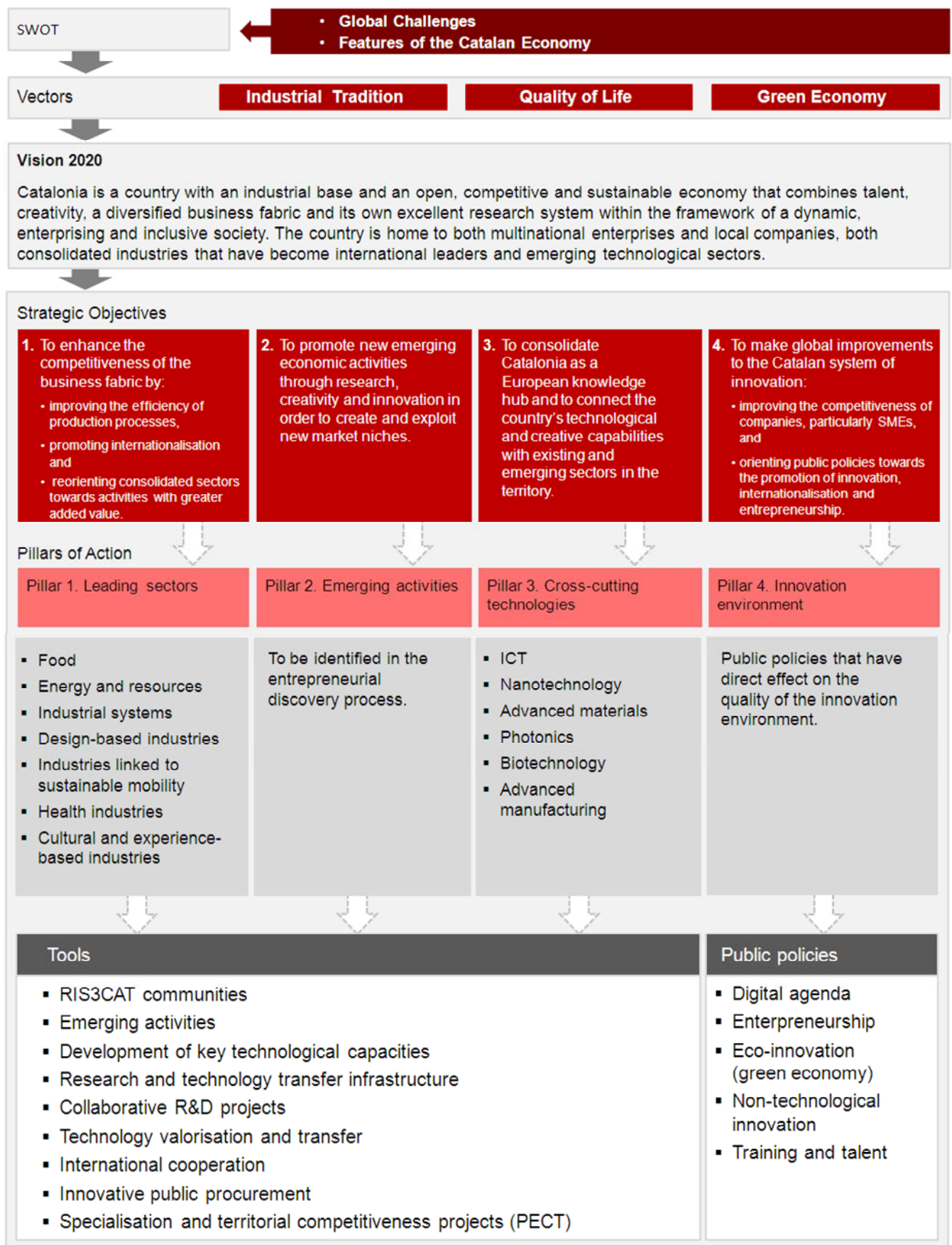
Although the RIS3CAT strategy is led by the Government, research and innovation stakeholders play the main role in its development. RIS3CAT governance establishes a results-oriented, continuous monitoring, evaluation and review system for the objectives established and the tools employed in the strategy.

This document is divided into four sections. The first places the RIS3CAT strategy within the European and Catalan context. The second describes the RIS3CAT structure. The strategy is structured around four pillars (leading sectors, emerging activities, cross-cutting technologies and innovation environment) so as to advance towards achieving the four strategic objectives that will make “Vision 2020” a reality in Catalonia. The third section introduces the tools and policies that affect the four pillars and, finally, the fourth section describes the system of governance, which provides a framework for continuous review of RIS3CAT based on the evolution of monitoring indicators and environmental factors.

This document is completed by a further five reports:

- Analysis of the Catalan economy: strengths, weaknesses, opportunities and threats.
- Analysis of the leading sectors and capacities in cross-cutting enabling technologies.
- Process of drafting RIS3CAT.
- RIS3CAT Action Plan (document at the draft stage in January 2014).
- Digital strategy for Catalonia towards 2020.

## RIS3CAT: Overview



## 1. Framework

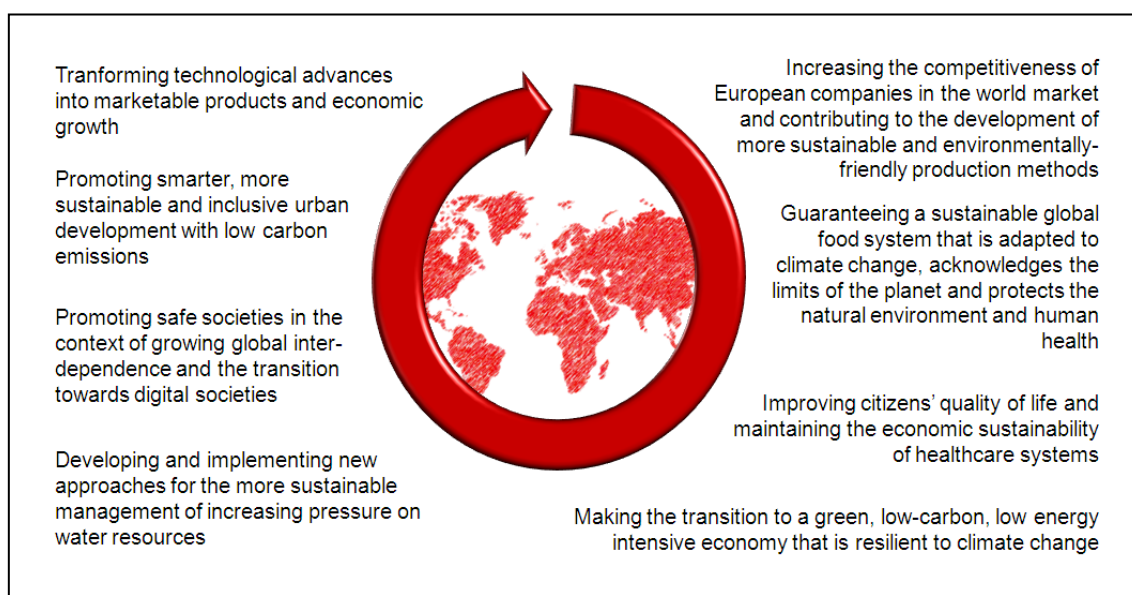
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## 1.1. The European Union Strategy

### 1.1.1. The EU Response to Global Challenges: Europe 2020

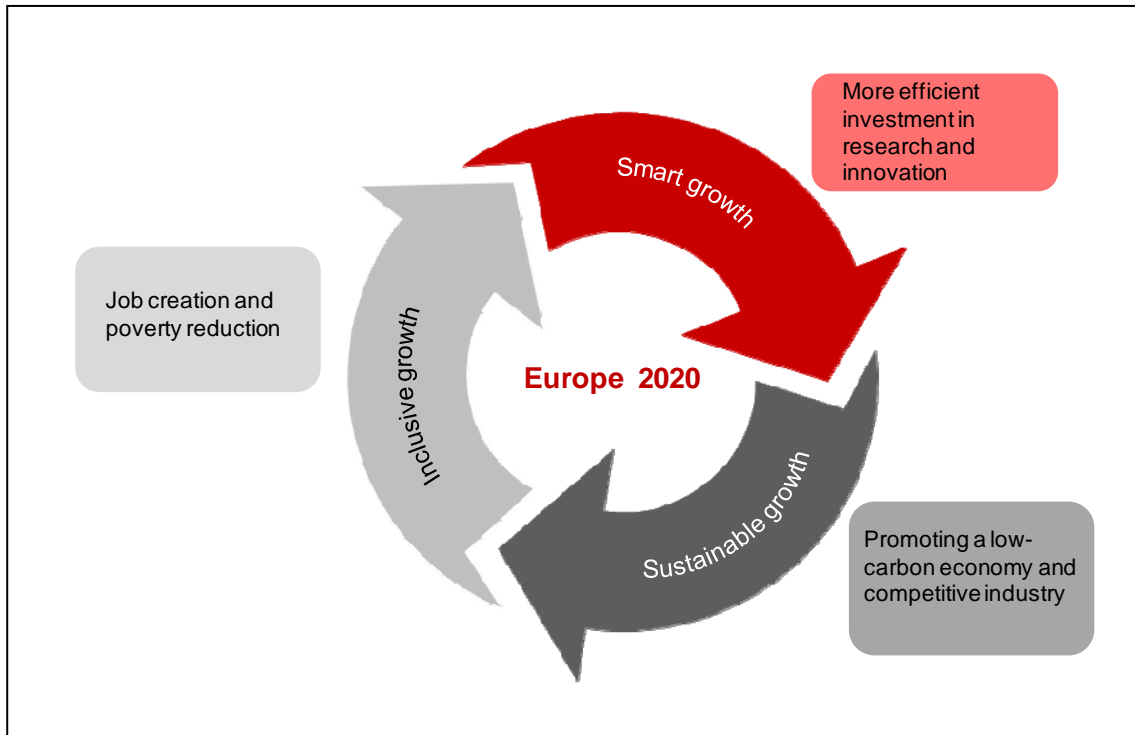
The European economies face major challenges, in both the short and long terms. The immediate priority is a return to growth and job creation, whilst the mid- and long-term challenges include increasing global competition, population ageing, climate change and pressure on resources, particularly the gradual depletion and rising prices of fossil fuels.

**Figure 1. Global Challenges Facing the European Economies**



Budgetary consolidation and structural reforms are necessary conditions to ensure the competitiveness of the European economies, but they are not sufficient. The European Union (EU) response to the major challenges posed takes the form of the Europe 2020 Strategy, which proposes a growth model that is smart (based on knowledge and innovation), sustainable (efficient in the use of resources and environmentally-friendly) and inclusive (creating employment and guaranteeing social and territorial cohesion).

**Figure 2. Europe 2020 Strategy: Priorities**



The Europe 2020 Strategy places industry and innovation at the heart of the new growth model. One in four jobs in the private sector in the EU is in the manufacturing industry, and at least another one out of four is in associated services that depend on industry as supplier or client. The nature of industry is changing as a consequence of competition from the emerging nations, rising transport costs, increasing energy and raw material prices, technological advances, shorter production cycles, and demand for customised products and services and more environmentally-friendly products.

The concept of innovation is also developing, in a context in which the information and communication technologies (ICT), eco-innovation and key enabling technologies (KETs) are all changing companies' business strategies and models and the way in which they innovate. In order to compete in a global market, companies must adapt to the new environment, engaging in open innovation and creating value by improving and generating new processes, products and services.

Within this framework, Innovation Union, one of the seven flagship initiatives in the Europe 2020 Strategy, establishes that Research and Innovation (R&I) will be the main driver behind the economic transformation of the production fabric, leading to the establishment of a competitive and sustainable model that will promote employment and social cohesion. Open innovation and cooperation amongst the quadruple helix stakeholders (universities, industry, governments and innovation users) is key to generating new opportunities, creating wealth and employment and providing a response to the major social challenges.

### **1.1.2. Horizon 2020**

Horizon 2020, the European Union's framework programme that will provide support for research and innovation in the EU over the 2014-2020 period, takes a broad approach to innovation, encompassing processes and systems, and recognises Europe's potential in such spheres as innovation in design, social innovation and innovation in services. Horizon 2020 resources focus on three priorities, which are as follows:

#### *a. Excellent science*

One of the priority objectives of Horizon 2020 is to extend the excellence of the Union's science base and to ensure a steady stream of world-class research to secure Europe's long-term competitiveness.

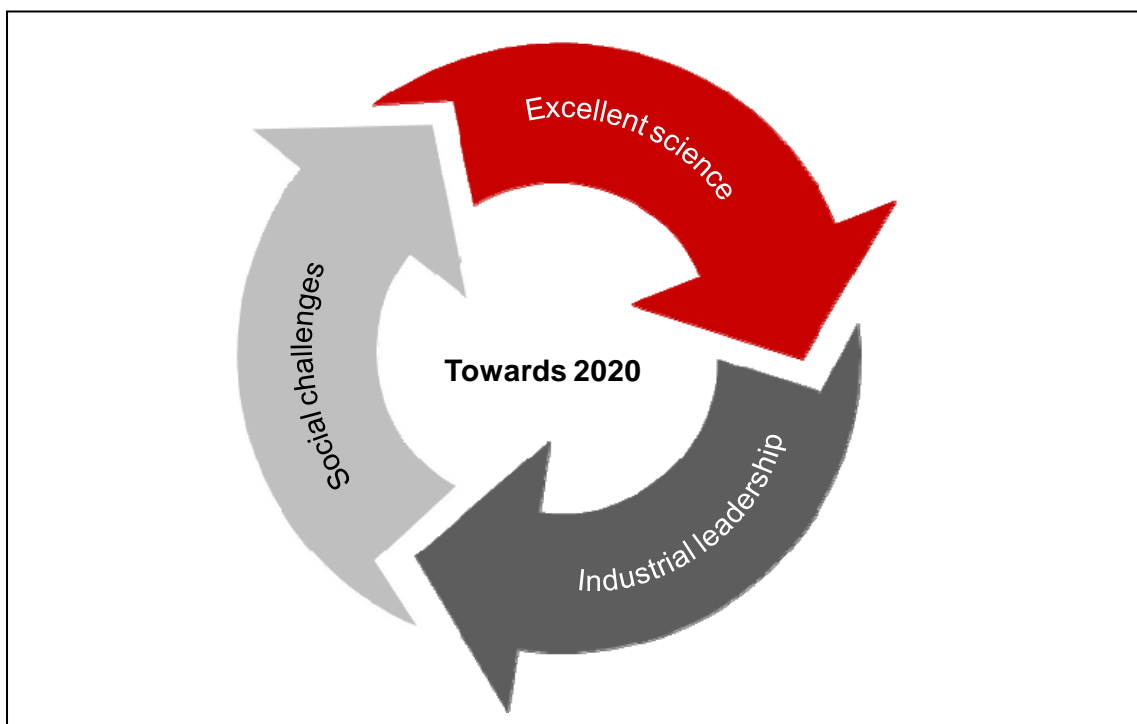
#### *b. Industrial leadership in enabling and industrial technologies*

Horizon 2020 provides specific support to ICT and to key enabling technologies (photonics, micro- and nanoelectronics, nanotechnologies, advanced materials, biotechnology and advanced manufacturing and processing), as cross-cutting technologies that help to strengthen and modernise the industrial base and drive the development of new industries.

*c. Societal challenges*

Horizon 2020 financing focuses on challenges concerning health, demographic change and wellbeing; food security, sustainable agriculture, forestry, marine and maritime research and the bioeconomy; secure, clean and efficient energy; smart, green, integrated transport; climate action, resource efficiency and raw materials; and inclusive, innovative and secure societies.

**Figure 3. Horizon 2020: Priorities**



**1.1.3. Cohesion Fund Policy 2014-2020**

Over the 2014-2020 period, the EU will implement an integrated approach for all cohesion policy funds, clearly establishing priorities and targets far removed from the culture of acquired rights. The European Commission requires Member States and regions to change the way in which they prioritise and manage cohesion policy funds:

- Integrated, results-oriented approach aimed at optimising the combined effect.

- Planning and implementation that breaks artificial administrative borders and enables a solid, integrated focus to mobilise synergies and ensure maximum impact.
- Thematic concentration to increase the efficiency of public interventions and to achieve the critical mass necessary to make a real impact on socio-economic conditions in the country.
- Support for financial instruments to boost private investment and multiply the effects generated by public funds.

According to the regulations governing the operation of cohesion funds policy, over the 2014-2020 period the structural funds will provide an essential tool for reorienting the European economies, focusing on the following thematic objectives:

1. Strengthening research, technological development and innovation.
2. Enhancing access to, and use and quality of ICT.
3. Enhancing the competitiveness of SMEs.
4. Supporting the shift towards a low-carbon, low energy-intensive economy in all sectors.
5. Promoting climate change adaptation, risk prevention and management.
6. Protecting the environment and promoting resource efficiency.
7. Promoting sustainable transport and removing bottlenecks in key network infrastructure.
8. Promoting employment and supporting labour mobility.
9. Promoting social inclusion and combating poverty.
10. Investing in education, training and vocational training for skills and lifelong learning.
11. Enhancing institutional capacity of public authorities and stakeholders and efficient public administration.

Moreover, in more less developed regions, at least 80% of European Regional Development Fund (ERDF) resources must be concentrated on measures that focus on research and innovation, ICT, SME competitiveness and promoting a low-carbon and low energy-intensive economy (thematic objectives 1, 2, 3 and 4), and at least 20% on Objective 4.

**Figure 4. Concentration of European Funds on Thematic Objectives**

Thematic objectives of the CSF	ERDF	ESF	EAFRD	EMFF
1. To strengthen research, technological development and innovation	At least 80% of ERDF resources			
2. To enhance access to and use of ICTs				
3. To enhance the competitiveness of SMEs				
4. To support the shift towards a low-carbon and energy-intensive economy in all sectors				
5. To promote climate change adaptation and risk prevention and management				
6. To protect the environment and promote resource efficiency				
7. To promote sustainable transport and remove bottlenecks in key network infrastructure				
8. To promote employment and support labour mobility		At least 80% of ESF resources		
9. To promote social inclusion and combat poverty				
10. To invest in education, skills and lifelong learning				
11. To enhance institutional capacity and ensure an efficient public administration				
The structural funds for the 2014-2020 period will concentrate on these 11 objectives in order to achieve the Europe 2020 objectives	1+2+3+4 ≥ 80% 4 ≥ 20% in the State overall	8+9+10+11 ≥ 80% 4 ≥ 20% in the State overall	Only in the field of rural development	Only in the field of fishing and fish-farming

European Social Fund (ESF) regulations establish that measures cofinanced by this fund must cohesively tackle the challenges identified in the Europe 2020 Strategy on employment, education and combating poverty.

Finally, the European Agricultural Fund for Rural Development (EAFRD)) focuses on six priorities whose goals are to foster smart, sustainable and inclusive growth in the agriculture, food and forestry sectors and in rural areas as a whole. Moreover, under the reformed Common Fisheries Policy, the priorities of the European Maritime and Fisheries Fund (EMFF) focus on viable and competitive fisheries and aquaculture and on ensuring environmental sustainability.

A new element introduced into cohesion policy for the 2014-2020 period is the requirement to make smart specialisation a prior condition for investment in research and innovation cofinanced by European funds.

### **1.1.4. Strategies for Smart Specialisation**

Research and innovation strategies for smart specialisation (RIS3 strategies) are a key element in the Europe 2020 Strategy for smart, sustainable and inclusive growth. In its decided commitment to prioritising knowledge and innovation, the EU requires governments (as a prior condition for access to European funds in the 2014-2020 period) to draw up RIS3 strategies in order to ensure the coherence of investment in research and innovation and to optimise the impact on economic and social development in the regions and in Europe as a whole.

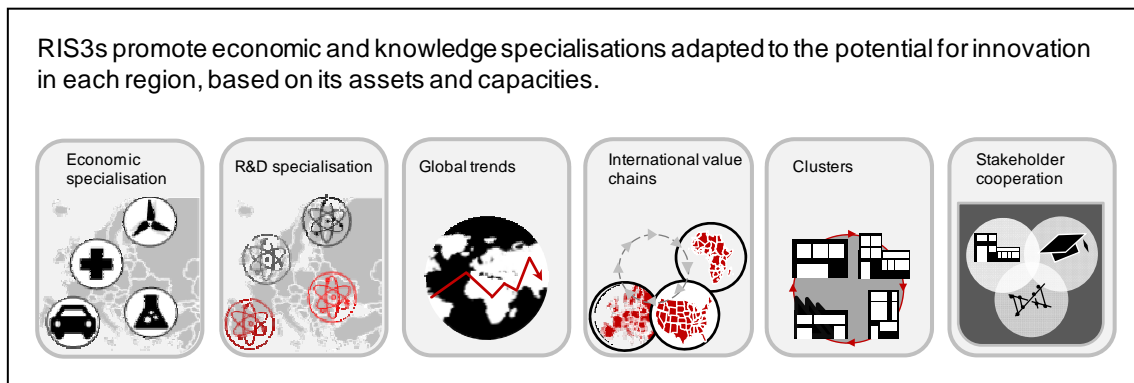
RIS3 strategies are agendas for economic transformation driven by innovation and knowledge. They are characterised by four main elements:

1. Choices: the selection of a limited number of priorities according to strengths and international specialisation.
2. Building competitive advantages, mobilising talent and matching R&I capacity to the needs and capacities of the business fabric.
3. Critical mass of resources and talent and cross-sector and interregional cooperation to foster specialised diversification and avoid duplication and fragmentation.
4. Collaborative leadership, involving all quadruple helix stakeholders in efficient innovation systems that generate synergies between financing instruments (European, state and regional).

Within this framework, the Member States and the regions should identify the knowledge specialisations that best match their potential for innovation, based on their resources and capabilities. This simple idea leads, in practice, to a complex process. The difficulties are, firstly, to identify the areas of future specialisation and, secondly, to

resolve any coordination problems that may prevent emerging trends from becoming real, solid drivers for economic growth.

**Figure 5. Parameters for Defining RIS3 Choices**



Governments are required to draw up a document setting out their regional strategies and research and innovation (both technological and non-technological) investments and activities planned for the 2014-2020 period, particularly those to be cofinanced by ERDF resources.

## 1.2. The Catalan Strategy

Catalonia has adopted Europe 2020 priorities through the Catalonia 2020 Strategy (ECAT 2020), which is the Catalan Government's roadmap for relaunching the economy and reorienting the production sector towards a smarter, more sustainable and more inclusive economic model.

ECAT 2020 sets out a series of public policies aimed at improving competitiveness and creating employment. The strategy focuses particularly on measures that have a direct and quantifiable impact on priority areas: employment and training, social cohesion, innovation and knowledge, entrepreneurship, internationalisation and the green economy.

Within the ECAT 2020 framework and based on a shared vision of the country towards the year 2020, RIS3CAT promotes:

- R&I as a driver for the economic transformation of the production system towards a competitive and sustainable model that fosters employment and social cohesion.
- Cooperation amongst the quadruple helix stakeholders to generate new opportunities for the creation of wealth and employment and to provide a response to the challenges facing society.

In a context characterised by public spending restraints, in order to respond to new social, economic and environmental challenges the Administration needs to change its way of doing things. Government needs to base its actions on criteria of efficacy and efficiency and providing new solutions to current demands. To this end, RIS3CAT promotes a cross-cutting vision that seeks synergies and complementarities between actions in the public and private sectors with the objective of optimising the economic and social added value generated by public resources.

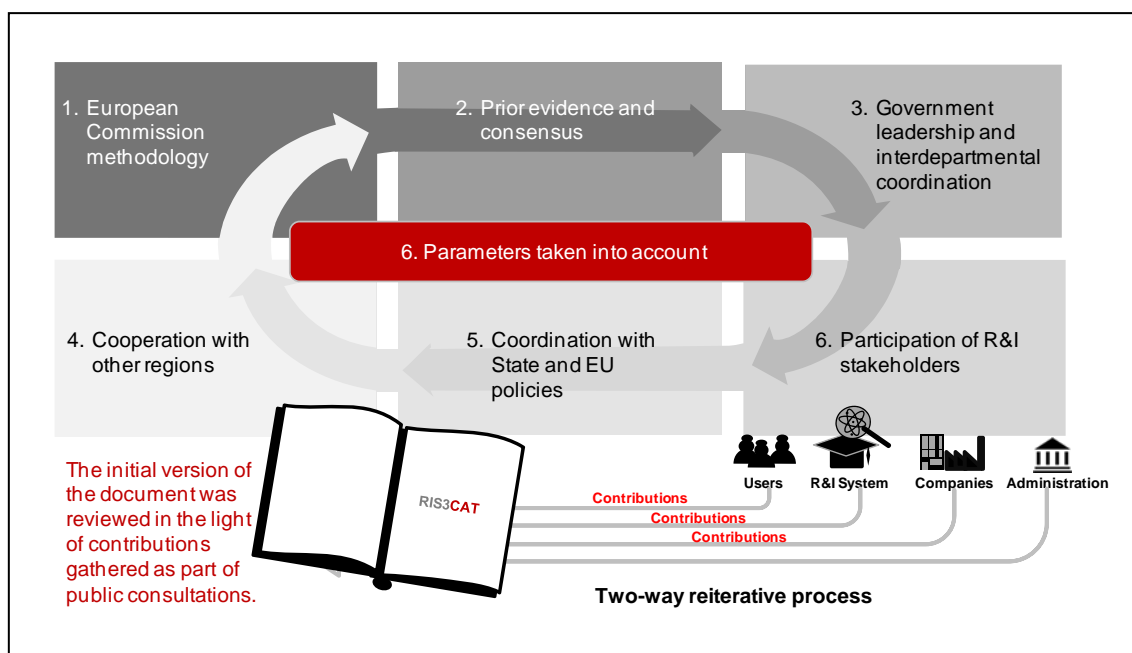
RIS3CAT was drawn up in accordance with the following six principles:

1. Implementation of the European Commission methodology (RIS3 guide).
2. Strategy design based on evidence and prior agreements.

## 1. Framework

3. Government leadership and interdepartmental coordination.
4. The participation of R&I stakeholders and companies.
5. Coordination with State and EU policies.
6. Cooperation with other regions.

**Figure 6. The Process of Drafting RIS3CAT**



The work of drafting RIS3CAT was promoted and coordinated by a Steering Committee formed by representatives from the ministries of Economy and Knowledge and Business and Labour (see Section 4, Governance). The document was produced in a two-way, iterative process that combined both top-down and bottom-up approaches, as established in the European Commission's RIS3 Guide.

The starting-point was an analysis of the strengths, weaknesses, opportunities and threats to the Catalan economy based on SWOT analyses carried out previously in Catalonia and on which there is broad agreement amongst stakeholders in the research and innovation system. The participatory process that took place in 2008 and

led to the drafting of the Catalan Agreement on Research and Innovation also played an important role in formulating RIS3CAT.

In July 2013, an initial draft of the RIS3CAT strategy document was submitted to stakeholders and civil society in general in an online public consultation process. This consultation attracted considerable participation (176 contributions), mainly from the fields of universities, research and business.

In the second half of 2013, this draft version was revised to incorporate the suggestions received. For further information about the process of drafting the RIS3CAT strategy and the public consultation, see the document “Process of Drafting RIS3CAT”.

## 2. Structure

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### 2.1. Vision 2020

As can be observed from the description of the distinctive characteristics of the Catalan economy and the analysis of its strengths, weaknesses, opportunities and threats (see the document “Analysis of the Catalan economy: strengths, weaknesses, opportunities and threats”), the Catalan economy is highly diversified and open with a large industrial base. Within a context of globalisation and recession, the Catalan production system is undergoing a process of structural change: on the one hand, the business fabric is being destroyed, and the resulting job losses are causing high social and economic costs; on the other, many Catalan companies have successfully implemented strategies to strengthen their position on the global market through innovation.

Within this context, the research and innovation system and cooperation amongst the different stakeholders (research centres, technology centres, knowledge-intensive industrial and service companies —engineering, design, etc.— administrations and users) are key to reorienting the production system towards activities with higher added value and to creating new spaces for activity with high potential for generating jobs through new combinations of existing know-how, technologies and activities.

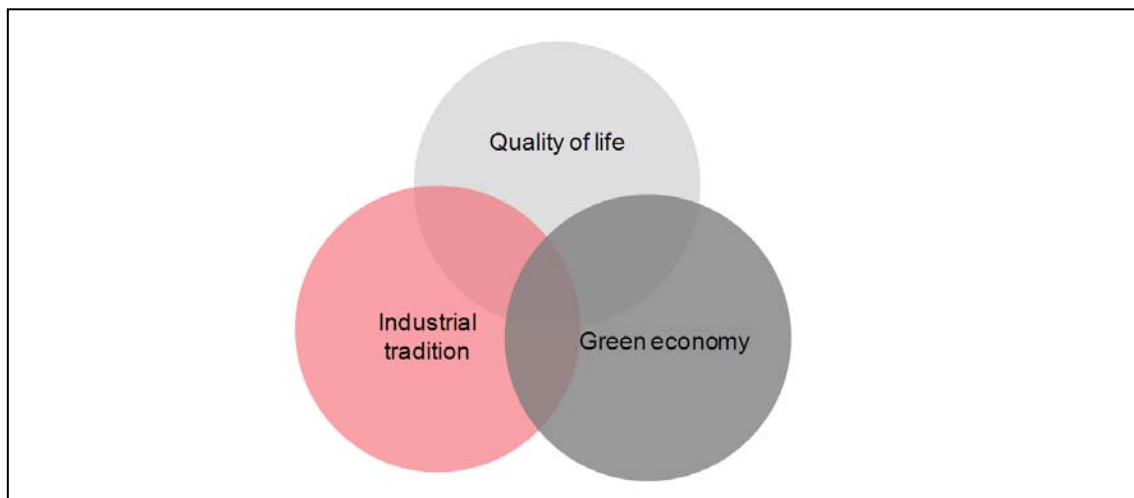
Analysis of the Catalan economy has led to the identification of three key vectors that will enable Catalonia to successfully tackle the great social and economic challenges of the 21st century.

1. The first vector is the legacy of the great Catalan industrial tradition —driven in the 19th century by the textile, chemicals and iron and steel industries, and the railways, and in the 20th century by the electrical industries (energy generation and machinery production) and the automobile, pharmaceutical and agri-food sectors— which, as they have developed, have placed the emphasis on competitive factors such as innovation, technology, design and training.

2. The second vector focuses on people’s wellbeing and concerns food, health, leisure and lifestyle. Here, R&I generates, not only economic opportunities, but also direct benefits for individuals and society as a whole.

3. The third vector is the firm commitment to transforming the Catalan economy towards a green economy. In response to the global challenges caused by climate change, the impact of human activity and scarcity of natural resources, the green economy offers promising niches for specialisation and generates opportunities to improve and enhance efficiency in all economic sectors.

**Figure 7. Vectors Driving the Transformation of the Catalan Economy**



The shared vision for the country towards 2020 takes into account all these elements.

### **Vision 2020**

Catalonia is a country with an industrial base and an open, competitive and sustainable economy that combines talent, creativity, a diversified business fabric and its own excellent research system within the framework of a dynamic, enterprising and inclusive society. The country is home to both multinational enterprises and local companies, both consolidated industries that have become international leaders and emerging technological sectors.

## 2.2. Strategic Objectives

In order to advance towards Vision 2020, RIS3CAT establishes four strategic objectives:

1. To enhance the competitiveness of the business fabric by improving the efficiency of production processes, promoting internationalisation and reorienting established sectors towards activities with greater added value.
2. To promote new emerging economic activities through research, creativity and innovation in order to create and exploit new market niches.
3. To consolidate Catalonia as a European knowledge hub and to connect the country's technological and creative capabilities with existing and emerging sectors in the territory.
4. To make global improvements to the Catalan system of innovation, improving the competitiveness of companies, particularly SMEs, and orienting public policies towards the promotion of innovation, internationalisation and entrepreneurship.

Each of these objectives corresponds to a pillar of action.

## 2.3. Pillars of Action

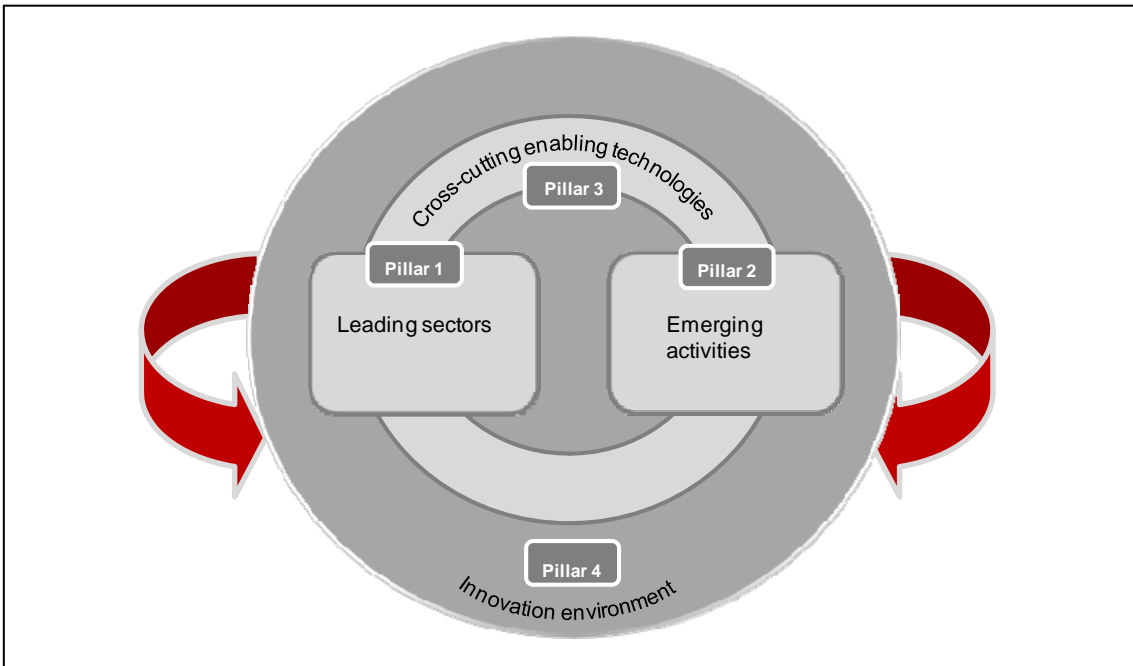
RIS3CAT is structured into four pillars of action, which generate four strategic objectives and enable precise focus to be combined with a broader, cross-cutting approach:

- Pillar 1. Leading sectors.
- Pillar 2. Emerging activities.
- Pillar 3. Cross-cutting technologies.
- Pillar 4. Innovation environment.

Figure 8. Relationship Between Strategic Objectives and Pillars

Strategic objectives	Pillars	
To modernise the business fabric by improving the efficiency of production processes, internationalisation and the reorientation of consolidated sectors towards activities with greater added value	Pillar 1	Leading sectors
To promote new emerging economic activities through research and innovation to create and develop new market niches	Pillar 2	Emerging activities
To consolidate Catalonia as a European knowledge hub and link technological and creative capacities to existing and emerging sectors in the territory	Pillar 3	Cross-cutting enabling technologies
To improve the overall Catalan innovation system, increasing the competitiveness of companies and steering public policies towards the promotion of innovation, internationalisation and entrepreneurship	Pillar 4	Innovation environment

Figure 9. RIS3CAT Structure: Four Interrelated Pillars



These four pillars are described as follows.

### 2.3.1. Leading Sectors (Pillar 1)

Catalan industry is highly diversified (there is no clearly predominant sector) and, as in all other developed countries, is more than ever before closely interrelated with production services. Moreover, Catalonia enjoys competitive advantages in certain industries (such as tourism, health and culture) that represent significant added value for the smart specialisation strategy.

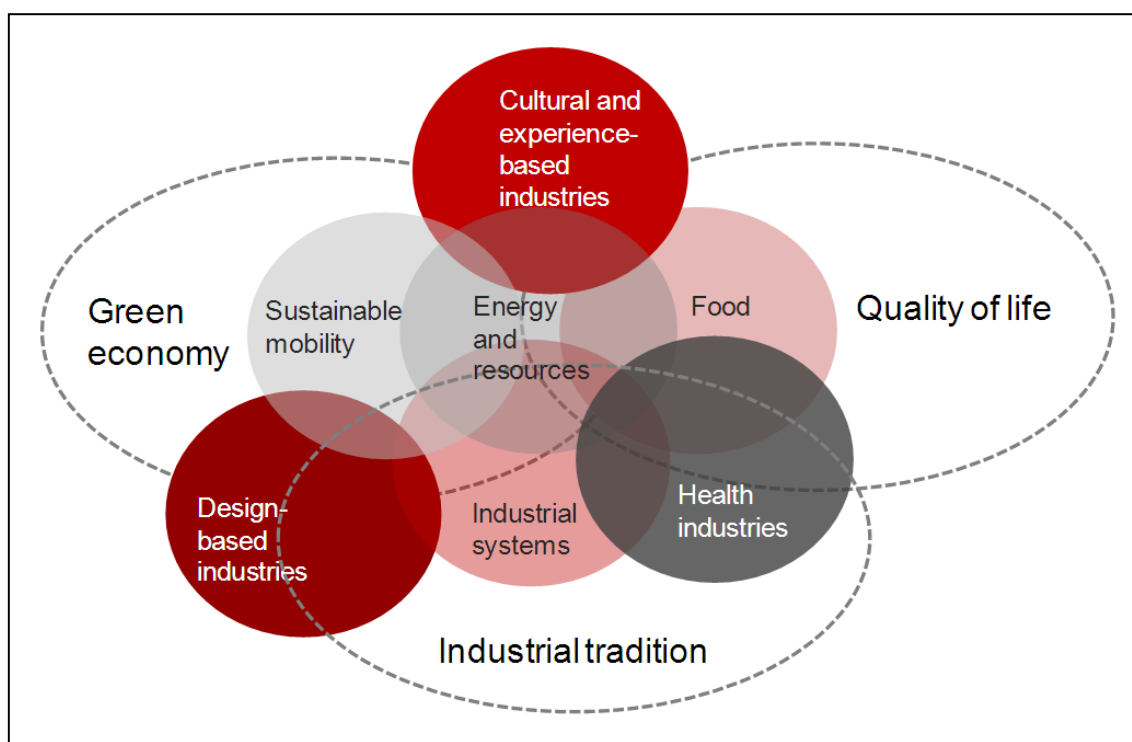
The three vectors that drive the transformation of the Catalan economy (industrial tradition, quality of life and the green economy) and the implementation of the seven criteria listed below enables the identification of seven leading sectors in which Catalonia has competitive advantages, critical mass and future opportunities.

1. Critical mass in different sectors, measured in terms of number of companies, employment and gross added value, taking into account that the available statistical classifications do not always reflect the changing reality of business strategies.
2. Internationalisation, measured by export indicators such as proportion of total Catalan exports or turnover, as well as analyses of the presence of foreign multinationals and potential for internationalisation.
3. Capacity of the sector to act as a driver for other activities. Existence of unique or particularly outstanding competitive advantages in a given sector (fairs, internationally prestigious activities, companies recognised internationally for their successful strategies, etc.).
4. Potential to generate new economic activity and employment, based on such factors as intensive use of labour and current growth of leading companies.
5. Global sector trends (estimates of world demand, supply, prices, Community policies, etc.) to analyse future potential.
6. Tradition of cooperation amongst quadruple helix innovation stakeholders, evaluated according to several indicators: technology transfer, formalised clusters, expenditure on innovation, etc.

Figures 10 and 11 present, schematically, the seven major leading sectors (food, energy and resources, industrial systems, design-based sectors, sectors related to sustainable mobility, health industries and experienced-based cultural industries). In all these sectors, the Government promotes strategic plans, and there are knowledge hubs (universities and technology and research centres) which foster innovation.

For more detailed analysis, see the document “Analysis of Leading Sectors and Capabilities in Cross-Cutting Technologies”.

**Figure 10. Leading Sectors**



**Figure 11. Description of Leading Sectors**

<b>Food</b>	Agri-food industry and other links in the value chain: primary industry, distribution, packaging, machinery for the food&drink industry, additives and raw materials, cuisine and restaurants.
<b>Energy and resources</b>	Management of energy and natural resources, the water cycle and waste treatment and recycling (energy saving and efficiency, new, more efficient materials, CHP, automation, energy control and management, renewable energy, organic chemistry, nuclear fusion...). This also includes innovative materials and technological solutions that enable substantial energy savings to be made in such activities as the construction of buildings and the management of cities.
<b>Industrial systems</b>	Activities focused on the management and development of efficient industrial systems (plant and machinery; robotics; data-processing, electronic and optical products, and electrical material and equipment), particularly related to process engineering and advanced manufacturing, in which ecodesign plays a key role.
<b>Design-based industries</b>	Industries closely linked to design as a key cross-cutting factor: textiles, garment making, leather, footwear, jewellery, furniture, and perfume and cosmetics, amongst others.
<b>Industries based on sustainable mobility</b>	Management systems for mobility, public transport and infrastructure; automobile industry and related activities; electrochemistry, nanomaterials, Internet, mobile telephony...
<b>Health industries</b>	Fine chemicals, pharmaceutical preparations, medical technology industry, insurance industry and hospital system.
<b>Cultural and experience-based industries</b>	Creative and cultural industries and key services for Catalonia, such as tourism and sport.

### 2.3.2. Emerging Activities (Pillar 2)

One of the challenges that RIS3CAT seeks to address is that of identifying and promoting new economic opportunities in emerging sectors based on technological capabilities (new activities generated by technological change and the latest innovations) and synergies between related sectors (between a firmly established branch and a new branch still at the development stage). RIS3CAT includes formulae to provide tools to explore new economic activities based on a market opportunity, a technological need or new knowledge generated through cooperation by stakeholders in different sectors.

The process of drawing up RIS3CAT revealed several areas of emerging activity, such as mobile applications, printed electronics and biomass.

### 2.3.3. Cross-Cutting Enabling Technologies (Pillar 3)

Cross-cutting enabling technologies are essential for the development and manufacture of future products. They make intensive use of knowledge and R&I and are applicable to and have the capacity to transform products and processes in a wide range of sectors of activity.

According to the four strategic objectives of RIS3CAT, one of the main challenges is to improve the connection between technological capabilities and production sectors. The technical know-how and capabilities of technology and research centres play a leading role in the emergence of new economic activities, improving the efficiency of production processes and reorienting the production system towards segments of greater added value and potential to generate employment.

RIS3CAT focuses on the six cross-cutting enabling technologies that are presented in Figure 12 and described in greater detail in the additional documentation. These six cross-cutting technologies are: ICT (in a broad definition including microelectronics and nanoelectronics); nanotechnology; photonics; advanced materials; industrial biotechnology; and advanced manufacturing technologies.

**Figure 12. RIS3CAT Cross-Cutting Enabling Technologies**

ICT	The technologies used to digitally process, transmit and store information.
Nanotechnology	The study, design, creation and application of materials, equipment and functional systems through control of matter at the nanometric scale, and the use of phenomena and properties that are generated in this state.
Advanced materials	The application of know-how and technology to produce new materials and matter that generate new properties and reductions in production costs and environmental impact.
Photonics	A multidisciplinary scientific field based on know-how and applications related to light, basically the generation, control, treatment and detection of photons in the visible and non-visible ranges of the spectrum.
Biotechnology	The use of living organisms, biological systems or their derivatives to create or modify products or processes. Biotechnology is based on such knowledge areas as microbiology, biochemistry and genetics.
Advanced manufacturing	The application of innovative know-how and technologies to optimise production systems in order to obtain new products, reduce time and energy, water and material costs in processes, improve precision, quality and safety and reduce environmental impact.

#### **2.3.4. Innovation Environment (Pillar 4)**

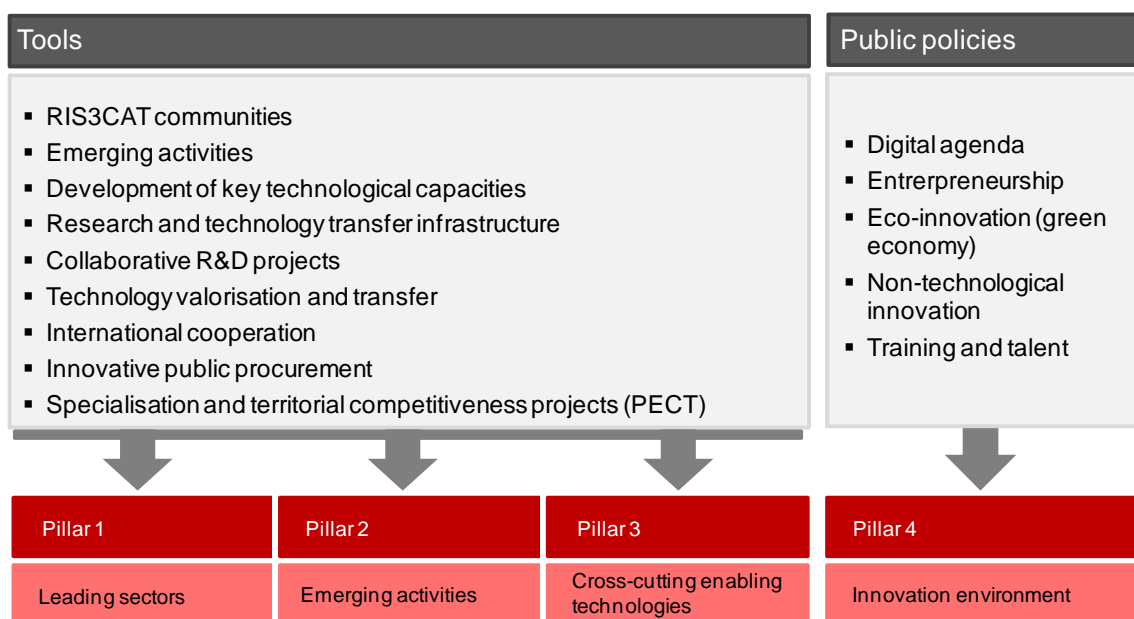
The competitiveness of companies (particularly SMEs, which often lack the capacity to develop their own R&D) in the global market depends on their capacity to absorb, combine and apply know-how to commercial purposes. Elements such as quality of training and education amongst the population, the provision of infrastructure, organisational and company management capacity and the existence of an institutional framework to support innovation and its dissemination in the economic system are, therefore, key to the competitiveness of companies in a given territory. RIS3CAT identifies and strengthens those public policies that most directly affect the quality of the innovation environment.

### **3. Tools and Policies**

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RIS3CAT identifies the tools that enable direct action to be taken in order to match technology supply and demand. As a result, the R&I system fosters the evolution of the economic base towards activities that generate greater added value, wealth and employment. The framework provided by pillars 1, 2 and 3 combines consolidated R&I tools with new instruments to promote major initiatives and support and promote cooperation amongst stakeholders in the research and innovation system, enhance the competitiveness of the production system and find solutions to respond to new needs in society. Moreover, RIS3CAT also identifies those public policies that have the most direct effect on the quality of the innovation system (Pillar 4).

**Figure 13. RIS3CAT Tools and Policies**



RIS3CAT tools are guided by the following principles:

- R&I as a driver for economic growth.
- Quadruple helix public-private cooperation.
- Critical mass.
- International competitive advantage.
- Sectoral or technological commitment.

- Strategic change oriented towards strategic objectives and Vision 2020.
- Generation of new opportunities for economic activity and employment.
- Efficient use of resources (green economy).

There follows a description of the general characteristics of each of these tools (T) and the public policies that directly affect the innovation environment (P).

#### T.1. RIS3CAT Communities

RIS3CAT communities are voluntary associations of companies and stakeholders in the Catalan R&I system that work in coincident sectors and cooperate to incorporate R&I into production activities in the leading sectors. These communities are an essential and innovative element of RIS3CAT. As active stakeholders in the Catalan innovation ecosystem, they ensure the participation of companies and stakeholders from the system in defining, monitoring and evaluating the priorities for R&I programmes. Their multidisciplinary profile and bottom-up focus make them leading players in entrepreneurial discovery processes that lead to increasing specialisation, as they identify and generate projects related to specific topics in the leading sectors.

The most recent precursors of RIS3CAT communities are European Technology Platforms (ETPs) and the Connect-EU groups. ETPs are industry-led forums of stakeholders that develop short- and long-term R&I agendas and European and national action plans that may be financed by either the public or the private sector. ETPs help to establish strategic agendas and to establish the priorities of R&I programmes. In the Horizon 2020 programme, ETPs provide external consultancy services and social connection.

For its part, the objective of the Connect-EU network of groups is to safeguard the research and innovation interests and needs of the sectors they represent, defending them before the European Union and lobbying European research programmes. The fifteen Connect-EU working parties are all open groups formed by public and private stakeholders (companies, business associations, universities, etc.) that are representative of the outstanding science and technology sectors in Catalonia.

RIS3CAT communities, which continue the spirit of their precursors and are selected by open calls for proposals, implement agendas for the economic transformation of production activities through the incorporation of R&I. Within the sectors they represent, the members of the communities must generate critical mass and be representative and multidisciplinary, as well as featuring considerable private sector involvement.

#### Objectives

- To group together R&D&I companies and stakeholders working in Catalonia in coinciding sectors or technological spheres in order to establish the RIS3CAT process of progressive specialisation.
- To establish agendas for economic transformation by integrating R&D&I into production activities in the leading sectors.
- To promote medium- and long-term action programmes to develop joint R&D&I projects based on the detection of common opportunities and needs that are key to the economic transformation of the production fabric.
- To generate new economic and job creation opportunities.

3. Tools and Policies

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Main stakeholders	Financing
Companies, business associations, cluster organisations, universities, research centres, technology centres, foundations and institutions linked to R&D&I, associations and other organisations that are users of technology.	Government of Catalonia, European funds and other public/private sources of finance.

#### T. 2. Emerging activities

RIS3CAT promotes new, emerging economic activities based on market opportunities, technological need or new knowledge generated through cooperation amongst stakeholders from different sectors. Once identified, opportunities must be included in an action plan that establishes business initiatives to successfully capitalise on economic potential through research and the creation of emerging companies.

The emerging activities selected (no more than four in each different time period), organised into clusters, receive technical and financial support over the course of two or three years, enabling them to develop work programmes and consolidate their business activity in the global market. Clusters are established by groups of research and innovation companies and stakeholders with capacity for international leadership that present an action plan for cooperation, innovation and investment and are engaged in emerging technological sectors or unexplored market niches.

Action plans can be very different in type, but must always follow the principles established for RIS3CAT tools. They must define quantifiable objectives and impact indicators that enable the results of their actions to be evaluated.

#### Objectives

- To increase the importance of activities with high technological content and added value within the production system.
- To generate business activity in emerging sectors with high growth potential based on technological capacity and the capacity of the production system.

#### Main stakeholders

Business groups and research and innovation enterprises with capacity for international leadership in emerging fields of activity.

#### Financing

Government of Catalonia, European funds and other public/private sources of finance.

#### T.3. Development of Key Technological Capabilities

The RIS3CAT strategy promotes the generation and exploitation of unexplored scientific and technological opportunities whose applicability is still undefined. This promotion takes the form of structural support for emerging processes and the construction of capabilities related to basic science and technology that can be applied in the mid-term and that, initially, do not converge directly with the sectors concerned in pillars 1 and 2.

The support is provided according to technological prospecting, in accordance with the Catalan science technology system and the RIS3CAT communities, and with scientific excellence criteria at the technological frontier. In the mid- and long-term, these projects may generate new economic opportunities in leading sectors or generate new emerging activities.

##### Objectives

- To establish a broad base of excellent science and technological resources and capacities.
- To enable frontier know-how and the new technologies to promote and support innovative new systems.
- To turn the R&D system into one of the leading players in the transformation processes of the business fabric.
- To support cooperation and innovation initiatives and projects amongst RIS3CAT communities.

##### Main stakeholders

Technology centres, research centres, hospitals and associated foundations, university groups and other public or not-for-profit organisations in the science and technology system, and companies.

##### Financing

Government of Catalonia, European funds, State and other public/private sources of finance.

#### T. 4. Research and Technology Transfer Infrastructure

The excellent infrastructure base that exists in Catalonia should act as a driver for the research and innovation system and promote the necessary interdisciplinary approach for frontier research and socio-economic valorisation of such activities. However, there is little infrastructure and few platforms for technological services situated between research and industry. In this area of activity, it is necessary to review the current map of infrastructure and science and technology platforms in order to identify shortcomings, possible improvements and synergies. It is also essential that scientific, technical and support personnel at these facilities should have the highest qualifications in order to provide the best services to stakeholders and support for processes involving valorisation and know-how transfer to companies, and industrialisation.

Support for technology centres focuses on industrial research projects with the aim of generating differential technology that Catalan companies can then adopt in order to become more competitive (through agreements, patent licenses or the establishment of new, technology-based companies).

Support for university groups focuses on marketing their technological services and the results of their research, with the goal of promoting the third and fourth university missions, capitalising on public investment in the research system and promoting its transfer to the economic system.

The RIS3CAT framework supports platforms specifically designed to implement the technologies generated by the research system in the Catalan business fabric. This type of infrastructure provides services to the industrial fabric at the pre-marketing stage (to obtain prototypes and pre-series models in order to confirm that products are feasible in terms of manufacturing and design) and enables costs to be shared the success of projects to be optimised.

Incentives are also provided for digital infrastructure and services for research and innovation, to enable participation in European networks, which are becoming ever more integrated.

#### Objectives

- To set the productive transfer of R&D investment in Catalonia.
- To provide the Catalan transfer system with specific infrastructure in accordance with companies' needs.
- To increase public-private cooperation and forge closer ties between science and business.
- To increase the efficiency of pre-competitive industrialisation processes.
- To increase the number of technology-based companies through the results obtained from research.

#### Main stakeholders

Universities, research centres, technology centres, companies and business associations.

#### Financing

Government of Catalonia, State, European funds and other public/private sources of finance.

#### T.5. R&D Cooperation Projects

Companies face challenges linked to the need to continuously generate new products and differential processes in order to compete globally. Catalonia is home to a powerful basic research system capable of regularly generating new knowledge in a variety of thematic fields. However, there exists a problem of connection that makes it more difficult for knowledge gathered at universities and research centres to be transferred to the business fabric.

The RIS3CAT strategy provides incentives to encourage business demand to adopt differential technology, that is to say, that projects driven by the production sector should take global and sector strategic challenges into account and benefit from the resources generated by basic research.

The objective of collaborative R&D projects is to ensure that frontier research carried out by research bodies is made available to the Catalan business fabric and benefits from the experience and know-how generated by the network of clients of technology centres and the network of innovation centres. The transfer of scientific knowledge to the industrial sector is promoted by effective public-private cooperation between companies (local or international consortia) and scientific stakeholders. This generates new products and services with high added value that represent a substantial technological challenge and are unlikely to be completed exclusively in the private sector due to the high technology risk associated.

Business consortia and consortia in which technology stakeholders participate ensure that the challenges posed by a given critical mass can be met, because they share risks and can undertake larger projects than a company would be willing to embark on alone, as well as fostering the transfer of results from research work to the business fabric.

Within the context of the global economy and the knowledge society, it also becomes essential to strengthen the international dimension of business innovation. Catalonia should promote the attraction and consolidation of technology research and transfer structures and the R&D centres of multinational companies in its territory.

#### Objectives

- To introduce integrated vocational training generally.
- To increase success at school.
- To encourage the integration of young people into the employment market.
- To improve English skills amongst the population.
- To help adapt university degrees to the needs of the production system.
- To increase the number of researchers of excellence in the R&D&I system.
- To increase the number of PhDs in industry.
- To enhance capacity for innovation within the business fabric.

3. Tools and Policies

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Main stakeholders	Financing
Universities, research centres, Catalan public authorities, the education system, business associations and other organisations.	Government of Catalonia, European funds and other public/private sources of finance.

#### T. 6. Technology Valorisation and Transfer

The technology market should act as a driver to differentiate Catalan companies. Research is the necessary source of knowledge, and collaborative projects enable it to be guided by market pull mechanisms.

The investment and knowledge of universities and research and technology centres can be capitalized through technology mechanisms such as the establishment of new, technology-based firms, licensing and operating new industrial property and cooperation contracts and agreements.

The valorisation of technology or the transfer of research results to the market can help to modernise the business fabric and support new emerging sectors, particularly in environments, such as the Catalan, with large, internationally recognised scientific production.

Public administrations provide economic support, under the principle of shared risk, to actions aimed at increasing the market value of technologies identified as marketable. Such actions may take the form of technical trials to demonstrate the viability of technology; drawing up the technology business plan; producing prototypes and pre-series; carrying out concept or market tests; preparing market studies, business plans and operating plans; marketing patents; etc.

##### Objectives

- To contribute to the growth of new emerging sectors and the modernisation of industrial sectors established in Catalonia.
- To contribute to increasing the market value of research, making this a useful technology for companies.
- To establish new, technology-based companies based on research results.
- To translate the results of research into patents.

##### Main stakeholders

Research centres, technology centres, hospital research and valorisation units and university groups.

##### Financing

Government of Catalonia, State, European funds and other public/private sources of finance.

#### **T .7. International Cooperation**

The globalisation of value chains in many businesses obliges firms to cooperate with international partners that often operate in clusters. Within the cluster framework, companies cooperate with each other and with other stakeholders to develop business and internationalisation strategies, which often take the form of establishing international ties and relations with potential clients, partners or competitors.

In its support for internationalisation, RIS3CAT focuses on:

- The internationalisation of cluster initiatives and cooperation with clusters in other countries and regions.
- Promoting horizontal transnational cooperation projects at the precompetitive stage.
- Benefitting from the opportunities offered to Catalonia by the Horizon 2020 European programme and other international and state programmes.
- Strengthening ties with other complementary regions through networks or bilateral agreements, especially in the fields of research, innovation and business relations.

R&I processes are becoming ever more open: a range of different stakeholders (companies, technology centres, universities and R&D centres) take part in such processes, which often acquire a global dimension. Companies and R&D stakeholders can engage in this type of cooperation privately, but public funds are also used to cofinance collaborative and international R&I projects.

In this context, actions relating to the Horizon 2020 European programme and other international programmes (Eka, INCO, etc.) focus on the following spheres of activity:

- Supporting the active participation of Catalan stakeholders and the Catalan Government in regional networks (such as ERRIN, the European Regions Research and Innovation Network) and European technology platforms.
- Training and professionalisation to enable stakeholders to work in a global environment and on international projects.
- Optimising the impact of European and international projects in Catalonia: capitalising on project results by Catalan companies, greater leadership of major initiatives and projects (such as those of the ERC, knowledge and innovation communities promoted by the EIT, FET initiatives, joint technology initiatives and public-private initiatives).
- Promoting the Horizon 2020 programme in Catalonia and strengthening its awareness-raising effects.
- Participation of the Catalan Government in European international cooperation projects generated by bilateral agreements signed by the government with other countries or regions to strengthen cooperation and mobility (for example, BILATS, INCO and ERA-NET).

### 3. Tools and Policies

The Government of Catalonia is a member of such interregional networks as the Four Motors for Europe (with Baden-Württemberg, Germany; Lombardy, Italy; and Rhône-Alpes, France), the Pyrenees Mediterranean Euroregion, which includes the Balearic Islands, Languedoc-Roussillon and Midi-Pyrénées, and the Working Community of the Pyrenees, which embraces all the Pyrenean territories.

In recent years, the Government of Catalonia has signed bilateral cooperation agreements with other regional governments: the State of Massachusetts, in the USA; Santa Caterina state in Brazil and the Province of Quebec, in Canada. The Catalan Agency for innovation has also signed an agreement with MATIMOP, the Israeli Government's industry centre for R&D for the joint promotion of industrial R&D.

Within the RIS3CAT framework, cooperation should be strengthened with other countries or regions (through networks or bilateral agreements) in the fields of research and innovation and business relations.

#### Objectives

- To increase the internationalisation of cluster initiatives and companies.
- To increase the number of horizontal cooperation projects at the pre-competitive stage with international partners.
- To increase the participation of Catalan companies in European and international projects.
- To boost cooperation with other regions (through participation in networks and signing bilateral agreements) in the fields of research, innovation and business relations.

#### Main stakeholders

Catalan public authorities, universities, research centres, technology centres, companies and business associations.

#### Financing

Government of Catalonia, State, European funds and other public/private sources of finance.

#### T.8. Innovative Public Procurement

The public administration needs to innovate in order to respond to citizen demands in a complex and changing society. Innovation in the public administration can be defined as the process of generating and implementing new ideas to improve processes, products, services and management models in order to improve effectiveness, efficiency and the positive perceptions of users.

Innovative public procurement is an administrative action whose goal is to promote innovation, aimed at developing new markets by generating demand through such public procurement. The objective is to make public procurement a strategic activity to respond to the needs and challenges that face the public sector and society as a whole.

According to international evidence, innovative public procurement has considerable impact on the development of solid innovation systems at regional and national scale. It also enables the services provided to citizens to be improved (especially in the fields of health, education and social wellbeing) whilst also encouraging technology development at companies in the territory, promoting their growth and industrialisation and generating business opportunities in future sectors.

##### Objectives

- To increase the efficiency and quality of public services through innovation.
- To promote innovation.
- To offer SMEs new business opportunities.

##### Main stakeholders

Catalan public authorities, research centres, technology centres and companies.

##### Financing

Government of Catalonia, European funds and other public/private sources of finance.

#### T.9. Territorial Specialisation and Competitiveness Projects (PECT)

Within the framework of the Europe 2020 Strategy and the 2014-2020 cohesion policy, the European Commission promotes an integrated focus on territorial development that enables territorial stakeholders to play an active role in designing and implementing original and innovative economic development strategies in accordance with the needs and potentialities of the territory.

RIS3CAT promotes territorial specialisation and competitiveness projects, which are smart specialisation initiatives for economic transformation based on R&I. These initiatives promote and strengthen cooperation amongst the quadruple helix stakeholders to generate innovative and original responses to needs and challenges in the territory. They also reinforce the role played by universities as drivers for development in the territory. Such actions focus on:

- Identifying a smart specialisation opportunity based on differential assets in the territory.
- A vision of future opportunity shared by stakeholders in the territory.
- The commitment to smart specialisation in the territory aligned with the RIS3CAT thematic specialisation objectives and priorities and also highlights the importance of its assets.
- An action plan including coherent programmes, projects and actions that enable the initiative to be brought to fruition, contributing to the 2020 targets.

##### Objectives

- To organise the participation of the territory in RIS3CAT.
- To promote cooperation amongst quadruple helix stakeholders in the territory in order to strengthen business fabric competitiveness.
- To strengthen the universities' fourth mission.
- To generate new economic and job creation opportunities in the territory.

##### Main stakeholders

Local authorities, companies, business associations, cluster organisations, universities, research centres, technology centres and other bodies in the territory.

##### Financing

European funds and public/private sources of finance.

#### **P.1. Digital Agenda**

ICT are key tools for strategically reorienting companies, improving their competitiveness and enabling cooperation amongst stakeholders in the research and innovation system.

The objective of the Digital Agenda of Catalonia for 2020, which was developed in line with the European Digital Strategy and Europe 2020, is to generate a digital innovation hub in Catalonia to promote economic growth, enhance business competitiveness and generate quality employment. Support for businesses and job creation are, therefore, the central pillars of the Catalan Digital Agenda, which provides for actions in a wide range of fields.

##### **P.1.1. Smart Cities, Smart Regions**

The rapid development of the information and communication technologies makes it possible to manage cities and services for citizens in a more efficient and sustainable way, whilst also generating the emergence of new, highly innovative production activities. In recent years, a large number of territorial initiatives related to smart cities have been promoted in Catalonia through bottom-up participatory processes involving public administrations, companies, and research and technology centres. These initiatives, which mainly focus on such areas as mobility, public lighting, waste management and the water and energy cycles, may be local (concerning a city) or regional (larger territories).

##### **P.1.2. Promoting Digital Innovation**

Catalonia's commitment to mobile technologies was reaffirmed by Barcelona's designation as mobile world capital. The World Mobile Congress has generated a growing community of start-up companies that develop mobile solutions, mainly in the following four areas:

- Smart cities (particularly urban mobility and energy efficiency, within a framework of close public-private cooperation).
- Content, in such sectors as tourism, culture, education and games.
- Marketing (applications for the financial and commercial sectors).
- Health and quality of life (medical technologies applied to telemedicine and telecare).

##### **P.1.3. Broadband Deployment**

The deployment of industrial broadband is essential to ensure that companies located on industrial sites around the country have access to high-capacity infrastructure. The Industrial Ring project uses broadband infrastructure to connect companies and institutions in sectors of economic activity that use advanced ICT services within their process value chains to generate added value and develop their respective industries through cooperative projects.

#### **P.1.4. SME Digitisation**

In order to increase the use of information and communication technologies by small and medium-sized enterprises, essential actions in project implementation include awareness-raising, information and guidance. It is also important to promote spaces where ICT supply and demand can meet, along with digitisation drivers, such as e-commerce and e-invoicing.

#### **P.1.5. Digital Skills amongst Citizens**

In the knowledge society, it is vital to provide citizens with the appropriate tools for their professional development. Public administrations promote actions aimed at improving citizens' digital skills and promoting ICT use. They also promote accessibility and the development of new multi-directional channels to enable communication and information sharing.

#### **P.1.6. E-government**

ICT are also an essential tool for modernising the public administration. E-government generates improved quality in the provision of public services, particularly those that affect citizens most directly (such as health, education and justice).

Open government is a new way of understanding the role of citizens who, through the new communication and participation media, play an ever more active part in decision-making and the development and control of government processes. Open government also implies making public information more freely available to facilitate decision-making and the generation of new products and services.

#### **Objectives**

- To strengthen the international position of Barcelona and Catalonia as a smart city and a smart region, respectively.
- To turn Barcelona and Catalonia into a digital innovation hub in Europe.
- To improve the competitiveness and capacity of innovation of the industrial system through the use of ICT.
- To promote social innovation.
- To develop e-Government.
- To promote the opening up of data.

#### **Main stakeholders**

Catalan public authorities, technology centres, companies, business associations and organisations.

#### **Financing**

Government of Catalonia, State, European funds and other public/private sources of finance.

#### **P.2. Entrepreneurship**

The establishment and growth of new companies is a source of economic development and expansion for the production system. It needs willing and competent people; a specialised ecosystem to provide support (finance, legal advice, mentoring, acceleration, internationalisation, etc.); the promotion of entrepreneurial culture throughout society as a whole; and a legal and regulatory framework to facilitate the creation and expansion of new companies and the exploration of new market niches, new technological opportunities and new ideas. People; environment and finance; regulation; and opportunities: these are the four basic areas in which action is required to promote the founding of companies and their growth into important economic players. Measures to support entrepreneurship are many and varied.

##### **P.2.1. Culture, training and talent**

Measures to promote entrepreneurship and attract international entrepreneurial talent. For example:

- To bring the world of business and entrepreneurship to secondary and tertiary education in order to encourage entrepreneurial vocations amongst young people.
- To improve the training received by entrepreneurs.
- To raise awareness about the value of business and entrepreneurship as a source for the generation of wealth and employment.

##### **P.2.2. Legal and Regulatory Framework**

The difficulties in establishing companies and obtaining, within a reasonable timeframe and without additional costs, the various permits required for business activities, create a barrier to entrepreneurship. Moreover, certain regulations (on safety, labour, etc.), whose requirements increase as companies become larger, also discourage growth. RIS3CAT will help to improve this legal and regulatory framework, particularly within the Catalan Government Administration and local authorities, and will also promote improvements to Spanish legislation. Moreover, it is vital to establish —at universities, research and technology centres, etc.— a framework of regulations and preliminary agreements to facilitate the creation of companies, the provision or sale of assets and human resources and participation in shares in order to speed up and increase the number of spin-off companies at knowledge centres.

##### **P.2.3. Entrepreneurial and Financial Ecosystem**

Entrepreneurship and business growth are complex functions that require knowledge and skills both inside and outside companies. It is also essential to develop connections amongst start-ups and between these new companies and knowledge centres, more firmly established businesses and specialist services. Within this context, the RIS3CAT strategy pursues the goals of increasing

### 3. Tools and Policies

the density and connectivity of the entrepreneurial ecosystem and facilitating the establishment and improvement of specialised stakeholders (business angels and risk capital, consulting, technical and technological mediation services, legal advice, companies specialising in human resources, training, mentoring and accelerating, etc). It is vital to provide the greatest possible incentives for investment in new companies through financial instruments that reduce the risk to which entrepreneurs and investors are exposed.

By implementing technology differentiation strategies, companies whose activities are based on differential knowledge acquire high potential for growth and wealth generation. However, due to the inherent risks (technological, operational and market) that they face, it is difficult for them to gain access to traditional sources of finance and capital funds. Moreover, other similar instruments do not usually invest in projects at such an early stage. Public support for newly-founded technology companies is key to alleviating the lack of finance available to this type of business initiatives.

New enterprises generated within existing companies or led by professionals with long experience in the particular sector of activity achieve above-average success and growth rates. However, this phenomenon occurs considerably less frequently in Catalonia than in international reference territories. For this reason, it is vital to promote incentives to enable workers at existing companies and those on vocational training programmes that include practical training at companies to set up new enterprises.

#### Objectives

- To increase entrepreneurial vocations amongst students and recent graduates.
- To raise social awareness of the entrepreneurial phenomenon.
- To attract international entrepreneurs.
- To encourage transfer and use of tacit knowledge acquired by workers.
- To decrease legal barriers to entrepreneurship.
- To simplify legal and contractual procedures for entrepreneurship in knowledge centres.
- To increase connections within the entrepreneurial ecosystem.
- To improve the opportunities for newly established companies to obtain financing.
- To mobilise private financing for new business initiatives.
- To make public investment in the research system profitable.

#### Main stakeholders

Catalan public authorities, companies, business associations, financial institutions, science and technology parks and the education system.

#### Financing

Government of Catalonia, State, European funds and other public/private sources of finance.

#### **P.3. Eco-innovation (Innovation at the Service of the Green Economy)**

Eco-innovation includes all innovations that reduce the use of natural resources and emissions of hazardous or pollutant substances over the entire life cycle of products and processes.

Eco-innovation generates benefits in the following areas:

- Environmental (reduction in the use of natural resources, pollution and waste generation, minimising the ecological footprint and supporting action to combat climate change).
- Economic (reduction in the costs of energy and raw materials through more efficient use of resources, the creation of opportunities in new markets and the generation of new jobs linked to the green economy).
- Social (sustainable practices and changes in people's lifestyles contribute to social cohesion and wellbeing).

There are many different measures to promote the transition towards a green economy:

- Technical and financial support for research and development, pilot tests and dissemination and marketing of sustainable technologies, products and services (for example, technologies to improve water, energy and waste management, to reduce emissions or to create new recycled materials with low environmental impact).
- Promotion of the efficient resource use and pollution reduction through dissemination and training.
- Support for networks and associations that promote technology and know-how exchanges amongst stakeholders in the environmental and energy industries.
- Support for ICT uses that benefit the green economy (smart electricity networks and transport systems).
- Guidance for companies to promote more efficient use of resources and reductions in pollution and greenhouse gas emissions (ecodesign, innovative clean technologies, improved technologies, processes, etc.).
- Support for systemic eco-innovations featuring global solutions based on innovative new business models (smart cities, sustainable mobility, industrial symbiosis, models based on pay per use, collaborative consumption models, models that increase product repairability, etc.).
- Support for regulations and standards that incentivise eco-innovative products, services and technologies. For example, through the application of best available technologies and the EU's REACH Regulations.
- Introduction of innovative and sustainable public procurement programmes and systems for eco-labelling and certifying products and services.
- Stimulating private demand for environmentally-friendly products and services (tax reductions, vouchers and programmes to increase consumers' knowledge and awareness about eco-innovative products and services, and integrated product policies that reduce environmental and social impact throughout the life cycle).

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- Measures to promote renewable energy sources and saving and efficiency in the use of resources (energy, water and raw materials).

#### Objectives

- To reduce the use of natural resources and the ecological footprint.
- To reduce waste generation, greenhouse gas emissions and pollution.
- To improve companies' competitiveness through a more efficient use of resources.
- To gain competitive advantages by introducing eco-innovations that can open up new markets, create jobs and give competitive advantages to SMEs in the territory.
- To spread more sustainable practices and changes in citizens' lifestyles.

#### Main stakeholders

Catalan public authorities, universities, companies, business associations, organisations and research and technology centres.

#### Financing

Government of Catalonia, State, European funds and other public/private sources of finance.

#### **P.4. Non-technological Innovation**

The introduction of new organisational models based on professionalisation and improving business management with a focus on productivity, flexibility in work time management and opening up to new markets or responding to new social needs is key to generating new business opportunities and, thereby, enhancing competitiveness.

##### **P.4.1. Business Innovation**

Companies need to innovate constantly in order to compete successfully in the world market. Non-technological innovation, linked to responses to new organisational and process challenges, enables companies to make strategic and structural changes that can generate new business opportunities. Such innovation is, therefore, a source of competitiveness.

Commercial or marketing innovation, based on improved design, packaging, positioning, promotion, price policy or sales channels, is strategic for increasing sales. For its part, organisational innovation, based on reducing administrative costs, improving job satisfaction and access to non-commercial goods (such as external, uncatalogued knowledge) or reducing supply costs, is essential for improving company performance.

SMEs often do not have access to training or the necessary tools to adapt to a rapidly changing, ever more competitive environment. In response to this, the Government promotes strategies to foster cooperation between companies in the framework of clusters and strategic plans. Such initiatives enable firms to become oriented towards activities that generate greater added value and viable and sustainable future strategies.

##### **P.4.2. Internationalisation**

Although Catalan industry is highly internationalised, there are many companies with the potential to export that only do so occasionally. In many cases, SMEs fail to take the decision to export because they do not have the necessary know-how or resources. Government support is vital in order to promote the internationalisation of the business fabric and, particularly, SME access to new markets.

Direct foreign investment has traditionally been an important source of innovation and improved productivity in Catalonia, and this should continue to be the case over the coming years. In this regard, emphasis should be placed on public actions aimed at strengthening Catalonia's position as a place for business, helping new, knowledge-intensive companies to become established here and attracting entrepreneurial profiles and potential creators of international enterprises in cooperation with universities and business schools.

#### P.4.3. Social innovation

Social innovation can be defined as a series of cooperation processes aimed at improving or changing certain social situations through the joint design and proposal of solutions. Social innovation involves the end beneficiary (often the citizen) in a process whose objective is to find new ways of meeting social needs not adequately covered in order to generate the necessary behaviour changes and resolve the main challenges facing society (such as ageing, climate change and the transition towards the energy model of the future) or detect future needs.

Besides providing a response to citizens' needs and tackling the challenges that face society, social innovations empower citizens and modify social relations by introducing new models based on cooperation. The processes involved in social innovation result in learning, commitments and transformations that affect the local sphere, and the construction of processes should be based on the participation of local stakeholders, empowerment and citizen engagement.

The open innovation model enables citizens to access the public innovation system and support social innovation as a driver to generate economic and social value. New forums are needed at which citizens can take part in the innovation process in cooperation with companies, administrations and universities.

#### Objectives

- To support strategic change in companies.
- To promote business and public-private cooperation.
- To increase the export base and, especially, exports to emerging markets.
- To raise the number of knowledge-intensive foreign companies in Catalonia.
- To increase the number of born global firms.
- To advance towards an inclusive, cohesive knowledge society that is open to the participation of all citizens.

#### Main stakeholders

Catalan public authorities, companies, business associations and organisations.

#### Financing

Government of Catalonia, European funds and other public/private sources of finance.

#### **P.5. Training and Talent**

Within the framework of a society based on knowledge and intensive technology use, a good education system is an essential requirement for economic competitiveness. Professional profiles and training facilities must match the needs of the production system whilst, at the same time, the education system should also ensure good science- and technology-based training.

The education system should guarantee everyone the opportunity to develop their personal capabilities, and should enable young talent to be discovered and trained ready to enter the employment market.

Attracting and retaining talent within the research system and incorporating highly-qualified personnel into the production system are also essential requirements for strengthening the competitiveness of the Catalan economy.

##### **P.5.1. Matching the Education System to the Needs of the Production System**

Training is an essential element for enhancing innovation culture in companies. Innovation must be present in curriculums for vocational training, university degrees and MA courses related to the production sector, so that future professionals can internalise innovation as a habitual process for improving companies' competitiveness.

Intermediate-level vocationally trained technicians play an important role in developing the business fabric and, therefore, to generate employment and economic recovery. Vocational training should be the tool used to professionalise people and help them to obtain and retain employment. To this end, we need to advance towards a quality, flexible, integrated vocational training model (in coordination with the jobs market) that provides training throughout people's working lives.

Company-university and company-vocational training centre cooperation programmes enable students to develop projects with companies, promote business innovation, build channels for knowledge transfer, foster transversal skills amongst students and improve their prospects of integration into employment.

##### **P.5.2. English Learning**

English has become the language of global communication, and is present in all spheres (the economy, the media, the new technologies, higher studies, etc.). For this reason, to improve the English skills of today's pupils is to train the workers of the future. Public actions to promote English learning should be intensified.

##### **P.5.3. Attracting and Retaining Talent**

Attracting and retaining talent in the R&I system must be a priority. In order to recruit the most outstanding talent, it is essential to ensure that the environment is favourable for R&I activities and

### 3. Tools and Policies

that research professionals can pursue attractive professional careers and achieve international projection. Public action should continue in this sphere with the objective of consolidating Catalonia as a European knowledge hub.

Further advances should also be made in the process of modernising the universities so that they adapt to the knowledge society, match the needs of the production sector and the territory and provide a response to the social and environmental challenges of the future.

There are fewer PhDs at companies and in the sector public in Catalonia than in other European countries. The incorporation of PhDs into the production system is key to improving knowledge management in organisations and advancing towards a socioeconomic model that is smarter, more sustainable and more inclusive. To this end support for doctoral studies at companies should continue to be provided.

#### Objectives

- To introduce integrated vocational training generally.
- To increase success at school.
- To encourage the integration of young people into the employment market.
- To improve English skills amongst the population.
- To help adapt university degrees to the needs of the production system.
- To increase the number of researchers of excellence in the R&D&I system.
- To increase the number of PhDs in industry.
- To enhance capacity for innovation within the business fabric.

#### Main stakeholders

Universities, research centres, Catalan public authorities, the education system, business associations and other organisations.

#### Financing

Government of Catalonia, European funds and other public/private sources of finance.

## 4. Governance

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The implementation of RIS3CAT requires strong, multi-level governance to ensure the following:

1. Government leadership and public policy coordination. It is to this end that the Catalan Government has established the RIS3CAT Steering Committee as a collegiate body to formulate, promote and coordinate the RIS3CAT strategy.
2. Effective and efficient use of public resources. To this end, the Government has established mechanisms to ensure the coordination of resources from the European Union's multi-annual financial framework programme 2014-2020 in Catalonia. Moreover, RIS3CAT also promotes an integrated focus on results-oriented projects aimed at achieving the critical mass necessary to generate real impact on the socioeconomic situation.
3. Active participation by the quadruple helix. This is one of the guiding principles underlying the RIS3CAT tools.
4. Permeability of RIS3CAT to determining factors in the environment and to the changing needs of society in general and the quadruple helix stakeholders in particular. This is ensured by a system for monitoring and evaluating actions and their impact. This system provides information and qualified, consistent data to enable the review, if necessary, of RIS3CAT programmes, initiatives, instruments and investment.

### **4.1. RIS3CAT Steering Committee**

The RIS3CAT Steering Committee de RIS3CAT, established by Government Agreement of 17 December 2013, is the body designated by the Catalan Government to formulate, promote and coordinate the RIS3CAT strategy. It is a collegiate body formed by the representatives of: the Directorate General for Economic Policy and Promotion, attached to the Ministry of Economy and Knowledge; the Directorate General for Research, also attached to the Ministry of Economy and Knowledge; and the Secretariat for Business and Competitiveness (Ministry of Business and Labour).

The main functions of the RIS3CAT Steering Committee are:

- To submit the RIS3CAT document to the Government for approval.
- To approve the annual RIS3CAT strategic priorities.
- To ensure the coherence of RIS3CAT with the budget policies of the Catalan Government, ECAT2020 and Government plans.
- To promote coordination with other administrations linked to RIS3CAT, particularly the European Commission, the Central Administration and local authorities.
- To promote coordination and cooperation between ministries and other administrations and stakeholders in the research and innovation system in all actions related to RIS3CAT.
- To define and manage internal and external monitoring of RIS3CAT.
- To approve the annual RIS3CAT implementation and monitoring report.
- To appoint the members of the RIS3CAT Technical Committee.
- To approve the RIS3CAT Communication Plan.
- To share information, experiences and best practices in RIS3 with other European regions.

The RIS3CAT Steering Committee is assisted in its tasks by a Technical Committee.

## **4.2. Coordination of European funds**

In accordance with the agreement published on 23 December 2013, the Government of Catalonia has established two commissions to coordinate resources from the European Union's multi-annual financial framework 2014-2020 in Catalonia and to optimise their absorption and application:

1. European Fund Coordination Commission of the Common Strategic Framework, which ensures coherence between European funds and RIS3CAT operational programmes.

2. The Interdepartmental Commission for European Union Financial Resources, which works to optimise the system for financing Government initiatives with European funds and to identify new areas for cooperation within the framework of the priorities that the European Commission establishes.

### **4.3. Participation of the quadruple helix**

The exercise in specialisation launched by the establishment of the RIS3CAT strategy entails a fundamental transformation in the orientation of public policies in the spheres of research, innovation and competitiveness in Catalonia. These policies have historically been transversal in nature. Due to reasons of strategy and government practice, this reorientation must be gradual and based on a process of analysis and reflection involving the stakeholders involved and the territory.

The RIS3CAT strategy focuses on combining firmly established R&I tools with new ones in order to promote major collaborative initiatives enabling progress to be made in the field of smart specialisation in Catalonia. The main tools established to promote cooperation amongst the quadruple helix stakeholders are the RIS3CAT communities (T.1) and the territorial specialisation and competitiveness projects (PECT, T.9).

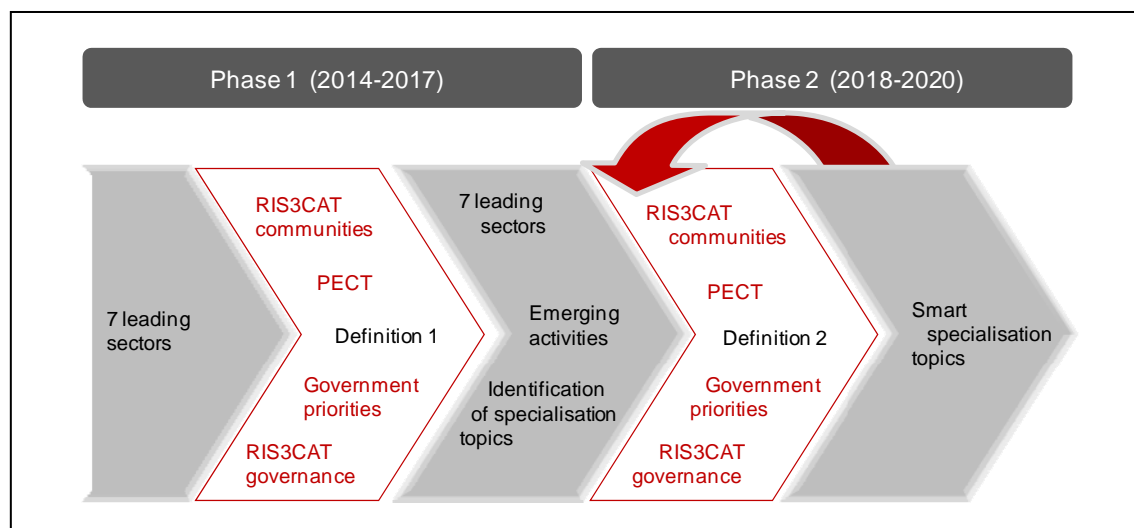
The objective of RIS3CAT communities, which are formed by quadruple helix stakeholders representative of a particular sector, is to develop and implement agendas for economic transformation in the leading sectors through the incorporation of R&I.

The objective of PECT, which are formed by quadruple helix stakeholders representative of a territory, is to promote medium- and long-term action programmes to develop joint R&I projects based on identifying opportunities and needs for the smart transformation of the territory.

As Figure 14 shows, the process of establishing the priority projects, both present and future, for the RIS3CAT communities and the PECT constitutes the basis for gradually

identifying, in each sector, the subsectors or topics in which Catalonia enjoys competitive advantages and is well positioned in Europe.

**Figure 14. Process of gradually establishing specialisation**



### 4.4. Monitoring, evaluation and review system

Public policies and the competitiveness of Catalan companies are conditioned by globalisation, the international recession and the change in economic model generated by the great challenges that face society and the climate of economic uncertainty. All this, in a context of high debt and public spending cuts, as well as rising financial costs in both the public and private sectors.

Based on the SWOT analysis of the Catalan economy, RIS3CAT defines four strategic objectives and four pillars of action that structure public policies aimed at advancing towards Vision 2020.

In order to ensure the adaptation of the RIS3CAT tools to changes and new needs, the RIS3CAT strategy must be permeable to determining factors in the environment and to the changing needs of research and innovation system stakeholders. For this reason, it is essential that the monitoring and evaluation system established for actions launched under the strategy and for their impact should provide qualified and consistent

information and data. Continuous evaluation mechanisms, along with evaluation of real results and impact, provide basic information for monitoring the implementation of the strategy, enabling constant improvements to be adopted in order to enhance the impact of the strategy.

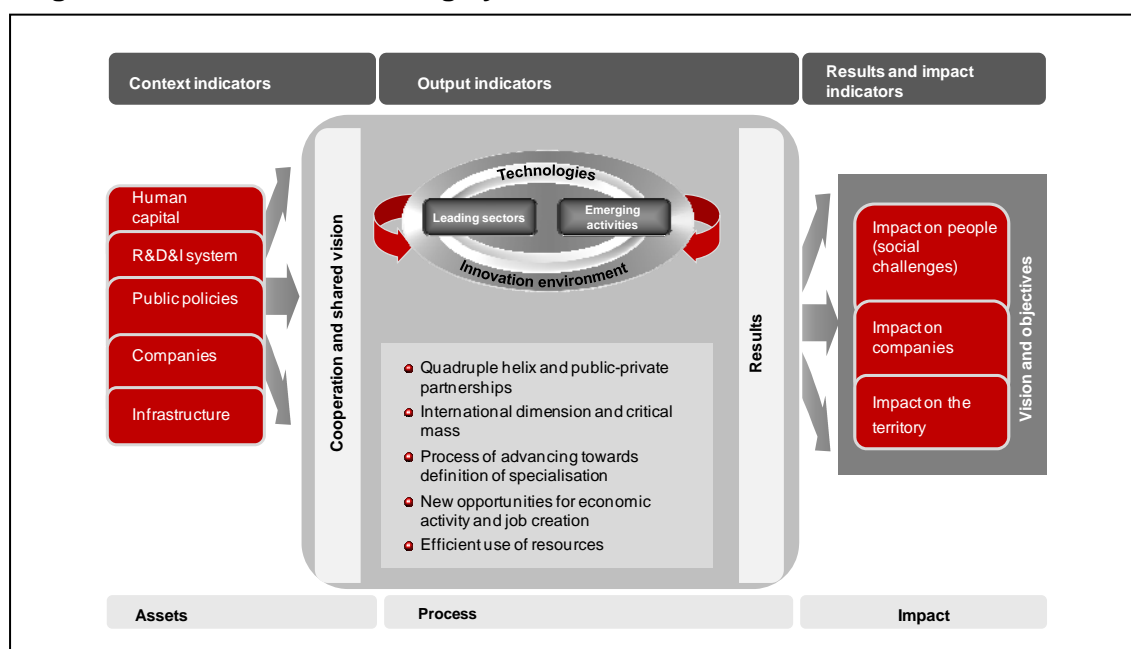
### 4.4.1. Monitoring

The RIS3CAT Steering Committee is responsible for defining the internal monitoring system for the strategy and for approving the annual implementation report.

The Technical Committee carries out the regular monitoring of RIS3CAT actions in order to verify that these are planned, that the funds are allocated properly and that results indicators evolve in the desired direction. The Technical Committee also draws up the annual implementation and monitoring report on the strategy.

Three types of indicators are defined in the RIS3CAT monitoring system: context; output; and results and impact.

**Figure 15. RIS3CAT monitoring system**



### 4.4.2. Evaluation

Evaluation involves systematically measuring the results generated by RIS3CAT and comparing these with the objectives of the strategy.

The functions of monitoring and evaluating actions are attributed to the entities or units that are directly responsible for them, and to the RIS3CAT Steering Committee.

Evaluation always involves the participation of independent experts.

Catalonia has acquired experience and best practices in evaluating the impact of R&I tools. The methodology used to evaluate technology centres and the technology evaluation programme is considered to be a good practice by the American Evaluation Association. The Agency for Management of University and Research Grants, which is responsible for distributing funds for research through public and competitive calls for proposals, uses evaluation systems that conform to international standards. Moreover, scientific activity at research centres is subject to periodical evaluation processes in which expert international independent scientists take part.

Regarding the RIS3CAT strategy as a whole, interim evaluation is planned for the year 2017, whilst the final evaluation will take place at the end of the 2014-2020 period. Quadruple helix stakeholders will also take part in these evaluations, which will be carried out by independent experts.

### 4.4.3. Review

The RIS3CAT system of governance provides for continuous review based on the evolution of monitoring indicators and conditioning factors in the environment. The Technical Committee is responsible for this monitoring and, when appropriate, for drafting proposals for the review of actions to be submitted to the Steering Committee.