

A summary of the preliminary report

# Catalonia Research and Innovation 2020.

## Orientation of research and innovation

INTERMINISTERIAL COUNCIL FOR RESEARCH AND TECHNOLOGICAL INNOVATION  
DEPARTMENT OF INNOVATION, UNIVERSITIES AND ENTERPRISE

This paper introduces a summary of an analysis and participation process fostered by the Government of Catalonia based on its engagement in the **National Pact for Research and Innovation (NPRI)** on what areas research and innovation should focus in Catalonia in the next years, with the purpose of creating a high degree of prosperity and welfare in an advanced society living under sustainable environmental conditions.



The analysis was made with a methodology based on international expertise and with the support of experts, agreed with the NPRI signatories.

The tools used to carry out this survey have been the NPRI technical secretariat, electronic advice from researchers and professionals in Catalonia, the project panel, the society-business-public authorities panel workshop, international and national reports and surveys as well as analysis done by different departments of the Catalan government.

There were three stages within this process of analysis:

- a) Analysis of research and innovation challenges to be addressed with an outlook from a Catalan viewpoint.
- b) Summarisation and inclusion of challenges in wider terms with an adequate focus so their number could be affordable and meaningful as to research and innovation.
- c) Inclusion of qualitative criteria for decision-making on selected subjects.

### The selected areas, including priorities, will be taken into the 2010-2013 Research and Innovation Plan, which will include measures to make this priority-setting operative.

The results of the process until summer 2009 were the following:

- **Document A:** based on international reference documents following electronic advice from researchers and professionals in Catalonia, it includes over 200 challenges for the future.
- **Document B:** interim working paper including 32 items to which research and innovation need to be oriented.

► **Document C:** the present paper.

► **Intangibles:** interdisciplinary approaches with high added value as they include people from very different backgrounds, positive interaction between governmental departments and their resulting involvement in the sectorial analysis.

Based on these results, the present paper (C) will be analysed by the signatory parties to the NPRI: government (CIRIT and departments), political parties, universities and the most representative social and economic stakeholders. Then a summary paper will be made based on improvements following the previous dialogue, and a more complete document will be elaborated.

The areas covered will be a priority to the government. The selected areas, including priorities, will be taken into the 2009-2013 **Research and Innovation Plan**, which will include measures to make this priority-setting operative. Besides, all selected areas will be the object of deep analysis in order to look for niches and R&D&I lines with the highest possibilities and opportunities considering all stakeholders. Based on this, a necessary dialogue will be started to reach a consensus according to the NPRI commitment in order to «ensure sufficient political agreement so this priority-setting and focusing on RDI is stable enough».

## Areas to guide research and innovation in Catalonia

### Criteria

The criteria followed to assess the areas that shall guide research and innovation in Catalonia are four:

- a) They shall represent local and global future challenges able to become threats or opportunities. Within these areas, R&D&I is crucial to tackle them.

b) They shall be relevant for at least one of the following:

- 1) economic prosperity;
- 2) welfare of people;
- 3) advanced society;
- 4) environmental sustainability.

c) They shall comply with at least one of the following:

- 1) contribution to solving relevant problems in Catalonia;
- 2) once notable success is achieved in this area, profitability should be high;
- 3) opportunity cost in case of research and innovation not turning to a specific area.

d) There shall be some minimum capacities to tackle the area globally or in niches, either through scientific and technological capacities or by business and public stakeholders and fields related with each area.

## List of areas

### Energy

Economically and socially sustainable energy solutions based on improved technologies using renewable sources and increasing energy efficiency, within a consumption setting aware of energy limitations and the need of reducing greenhouse gas emissions.

Catalonia has a significant knowledge in technology and management to tackle the complex development of a sustainable and responsible energy system encompassing economic prosperity, energy supply, environmental conservation and lifestyle changes (flow of persons and

goods, design, occupation and use of space and the medium...) while aspiring to the highest welfare standards. It also features a capacitated business and public sector as well as a civil society quite aware of the energy issue.

**Research and innovation efforts to reach useful technological solutions together with other structural change placing energy at the front of the country's strategic agenda can have a very significant economic impact.**

Research and innovation efforts to reach useful technological solutions, change in electrification systems and usage patterns, together with other structural change placing energy at the front of the country's strategic agenda can have a very significant economic impact dragging along a wide range of innovative industries and business activities.

### Climate

Climate change prediction and mitigation as well as preventive and proactive adaptation of affected social, economic and human activity, in a local context with global implications.

Catalonia needs to implement effective solutions to tackle climate change and its effects on the medium, people and productive activities based on its own existing scientific and technological knowledge. There needs to be awareness that the shift this involves is a driver of change associated with the energy model as well as that of goods and service production and social organisation. No matter the duration, size and even rate of manmade climate change, the prediction of its variations and effects needs to capacitate and guide transformation, which will be radical in some areas and will forcibly require expertise and innovation in many social and economic domains affecting or affected by climate change: water, agriculture, urban systems and mobility, energy, prevention techniques and

technologies, health, etc. Catalonia has enough scientific and technological knowledge regarding climate and climate change to make a significant contribution in this area, especially if it is able to develop strategies and innovations as a part of different production, social and environmental aspects affected by climate change.

## Water

Full management of the water cycle and available resources to safeguard the required amount and quality, while increasing efficiency in responsible consumption and adapting social and economic activity to water availability.

### **Solutions to water challenges have a global dimension, so the market is also global.**

In Catalonia as well as anywhere, water is a critical resource for human needs and productive activities, yet scarce according to required access conditions, amount and quality. Catalonia has significant scientific, technological and management capacities in this respect, which combined offer great opportunities in a field of global social and economic relations acting as a dragging factor of other public and private activity and knowledge areas. At the same time, solutions to water challenges have a global dimension, so the market is also global, although the humanitarian component of developing innovative water management systems for worse-off settings and areas must not be neglected.

## Flows

New solutions in infrastructure and means of transport for mobility of persons and goods, aiming at shifting the flow management model towards fostering accessibility, embracing regional and urban planning and space distribution of social and economic activities, while considering energy, territorial and environmental factors.

Flows of persons and goods need to be thought over within territorial, environmental and energy restrictions that are to lead to a substantial shift in transport and infrastructure models, facilities and tools making it possible, moving from the concept of mobility to that of accessibility. Besides, appropriate flow management has to improve the people's life quality and the competitiveness framework. Catalonia has some relevant needs in this field as well as some distinctive restrictions due to concentration of many activities and flows of all kinds on a reduced territory. This challenge becomes an opportunity to completely rethink flow systems regarding persons and goods with imaginative solutions, which in their turn generate innovation in smart and sustainable infrastructure and means of transport, adapted to each setting.

### **Appropriate flow management has to improve the people's life quality and the competitiveness framework.**

Related expertise and experience of Catalan research and innovation stakeholders allows to think of a successful perspective in order to make Catalonia an innovative flow management model along all its value chain. This area, covered by R&D&I based on the social and economic complexity and existing restrictions, creates a field with a large impact in many productive branches.

## Space

Territories, cities and spaces including necessary tangible and intangible items to live, live together and create value. Technological, economic and environmental solutions for «rurban» planning and functionally advanced construction adapted to new social needs.

The tangible and intangible value of space as territory, countryside, city or the place where we live our daily lives (school, housing, work, library, etc.) is strategic for social and economic progress. Increasingly complex flows, facilities

and services are integrated in these spaces to create value. Catalonia has a significant knowledge and innovation record in managing this complexity, partly due to the fact of having a wide range of activities on a reduced area and also because creativity to design spaces has been and still is relevant.

**Spaces, with their different functionalities and contents, are not only a challenge to take on but also a highly valuable social and economic opportunity for Catalonia.**

Hence spaces, with their different functionalities and contents, are not only a challenge to take on but also a highly valuable social and economic opportunity for Catalonia, in which very diverse disciplines and business areas come together.

### Cultural and audiovisual products

Cultural and audiovisual products and services conferring value to creativity and cultural capacity to create contents by means of multichannel distribution and technologically advanced, global and multifunctional business models.

The consumption of cultural and audiovisual products and services increases very significantly all over and diversifies functionalities (communication, learning, leisure, health, etc.), while becoming increasingly multipolar regarding creation, channels and end users. Seen from outside, Catalonia is first and foremost a creative and dynamic society and culture, so contents created here are highly attractive. The opportunity of converting these items into social and economic value requires to take advantage of new technologies and channels built into business models focusing on the diverse and dispersed user who is now proactive and creates contents. If creatives, research and technology stakeholders, companies and Catalan public authorities work in synergy, they

will be able to develop an already relevant industry to become a future pole creating wealth and welfare.

### Emotion and experience consumption

Products and services for tourism and leisure, personal wellness and development, providing value for different audiences based on the emotions and experiences they generate.

Emotions and experiences determine a big part of consumption patterns and habits of people when basic needs are covered. Including emotions and experiences into leisure products and services –as well as in other segments such as retail and personal development– as their core element requires new strategies and business models integrating the views and abilities of humanistic, social and technological disciplines. Based on its tourism record and provided it is able to take advantage of the capacities of researchers and professionals, including new technological standards, Catalonia is able to generate activities of economic as well as social value regarding the use of emotions and experiences widening the concept of tourism and leisure and allowing intangibles, in which Catalonia is strong, to be part of the design and delivery of all kinds of products and services.

### New services

Complex needs covered with new services for people, organisations and communities in a service society that needs to be understood and developed by using emerging technologies, social networks and partnerships between suppliers of different sorts.

In a service society, it is first necessary to better understand what new dynamics are created and which are the needs of people, organisations and communities to develop innovative services for the future. These services will include existing ones (e.g. infrastructure and communications), complex services (for knowledge

communities distributed globally), product-service integration (e.g. car/ICT) and highly segmented complex electronic services affecting all social and economic areas.

**In a service society, it is first necessary to better understand what new dynamics are created and which are the needs of people, organisations and communities.**

Catalonia has relevant capacities in the service branch, but it needs to develop new ones to turn future innovative services into a social and economic opportunity. These new services will require a wide interdisciplinary knowledge and technology base as well as new business and organisational models.

## Food

A high-quality, value-added agrofood chain considering environmental protection and the country's specifics together with state-of-the-art technologies in order to serve the nutritional, consumption, leisure and cultural needs associated to food.

Food production, processing, distribution and consumption is experiencing a deep change due to new habits in a complex society. Besides, food has a cultural and gastronomic relevance in our country that also relates with leisure and intangible items. Catalonia has very relevant capacities in the food industry regarding science and technology as well as the primary sector (which needs to be revitalised with added value), the agricultural industry and the gastronomic branch. This almost unique potential of Catalonia can still generate great economic as well as social opportunities in the future if an overall strategic focus on food is developed serving the needs and new consumption trends related with quality, respect for the medium, health, responsible use, etc., while new, innovative business models are created.

## Materials and ecoprocesses

New materials with new functionalities and applications and new manufacturing eco-processes reducing waste, energy consumption and the use of non-renewable raw materials and reaching product life cycles with a low environmental footprint.

Manufacturing new materials with functionalities and applications facing the existing challenges is a strategic area for the future that needs to be combined with progress in production processes allowing a reduced environmental footprint, less energy consumption and waste creation as well as less dependence on non-renewable raw materials. Catalonia has a high scientific and technological capacity in materials engineering, chemistry and other related key sciences and technologies in an area also counting on a strong business fabric able to absorb progress generated here and elsewhere. Investment and innovation has an impact in many other areas if there are enough synergies and cross-fertilisation of new materials and eco-processes.

## Advanced production systems

Development of smart manufacturing systems able to adapt to necessary change in production means and organisation in order to react to a complex setting full of interactions between own and external resources.

Production systems become more complex to serve new production and business models as well as the need of increasing efficiency. The shift in interaction between man and machine; developing new design tools; production planning and execution; simulation and modelling of products and processes; smart information systems for decision-making; management of and interaction with suppliers, distributors and consumers – all these are key elements for the manufacturing industries of the future. For Catalan industries, this area is of strategic relevance for their future competitiveness, and the

existence of a sufficient scientific and technological knowledge base allows to think of an area of great opportunity to develop research and innovation.

## Breaking technologies

Technologies producing very substantial progress as compared to existing ones and, based on their implementation, develop new industries or change the existing.

The exponential increase of scientific progress allows to develop breaking technologies that, often combined with others (technological convergence), bring about substantial change modifying significantly whole industries or specific niches.

**Although Catalonia has not historically been a leading country in developing breaking technologies, the good scientific capacity that is being developed in many areas allows to act on them to a degree that had never been possible so far.**

Although Catalonia has not historically been a leading country in developing such technologies, the good scientific capacity that is being developed in many areas allows to act on them to a degree that had never been possible so far. The opportunity is especially relevant if Catalonia is able to act on new converging technologies based on systematic interdisciplinary interaction as the existing possibilities are so large that the range of global competition is minimised.

Another thing is the capacity of transforming progress these technologies bring about in value, as this implies to create multiple scientific and technological, public and private effective synergies.

## Health and welfare system

New efficient health and welfare models based on people and adapting to social and economic needs in shared individual and collective responsibility.

**Catalonia needs to set up an adaptable and sustainable health and welfare system serving social needs in an effective way.**

The organisation and functioning of the health and welfare system is increasingly complex regarding demand, offer, technologies and organisation in a setting of economic and care pressure creating distress in professional action and the system as a whole. Catalonia needs to set up an adaptable and sustainable health and welfare system serving social needs in an effective way. This challenge creates big opportunities to rethink systems and service models, to involve users (and non-users) as active stakeholders, to include new technologies into the system organisation, etc.

Catalonia has demonstrated knowledge and innovation skills in health and welfare system design and development. This system is a social as well as economic driver, and it becomes indispensable to think it over from an interdisciplinary perspective, considering that at the heart of action are people as care-seekers and professionals.

## Prevention and cure

Effective prevention and cure strategies placing people as proactive and responsible stakeholders in their mental and physical health throughout their life, while including scientific and technological progress by means of high-quality translational research at all care levels.

The people's state of health depends on a whole range of psychosocial, environmental, genetic,



lifestyle, etc. factors affecting a changing state of health in an increasingly long life cycle. The challenge of keeping the maximum people in the best possible state of physical and mental health is doubtless one of the biggest society is facing, and its degree of success has a significant impact on the welfare state and the economy. Also, the challenge of healthy and productive ageing places prevention and cure strategies and action at a level never reached before by humankind. Keeping the highest physical and mental abilities of people is thus a strategic challenge at country level. And Catalonia has done an extraordinary effort globally acknowledged for its quality.

### **Catalonia has great potentialities in biomedical and care research and innovation as well as an incipient medical technology industry, all of which creates a strategic future opportunity.**

It is necessary to continue these efforts with a future vision and improve effectiveness of translational research to move to action for patients and those who are not at all care levels, acting on prevention and placing people's autonomy and responsibility as to their state of health as a key action line. Catalonia has great potentialities in biomedical and care research and innovation as well as an incipient medical technology industry, all of which creates a strategic future opportunity.

### **Social complexity**

Systems, services and activities acting as a driver for social and cultural development, fostering social cohesion and being part of the community, taking complexity and diversity as an added value.

Social complexity needs to be tackled as a whole and from a two-fold perspective of threat and opportunity/added value. Societies with the

biggest complexity trying to manage it reach a higher degree of development and have a stronger capacity of facing change in the long term.

### **Understanding phenomena and innovation in social and cultural systems, activities and services to manage this complexity is paramount for Catalonia's future.**

Values, culture, role models, education, language, social lifts, conflict management, social networks, etc. are some of the necessary items to find the way through complexity. Understanding phenomena and innovation in social and cultural systems, activities and services to manage this complexity is paramount for Catalonia's future.

Potentialities are big, and the experience of recent years, made under significant stress, has had noteworthy results that are often more apparent when looked at from outside. Also, complexity creates value creation possibilities that need to be used socially but also economically, like the language industries, fostering interculturality in audiovisual products and contents and improving social and economic relations between cultures based on understanding the other.

### **Risk and safety**

Individual and collective phenomena associated with risk perception and analysis as well as development of active and passive safety systems and devices for people, goods and information.

Risk and safety are key in the present society, in which people, goods of any kind as well as information and data make a complex and sensitive whole exposed to different natural and manmade actions that may pose a threat. Perception and communication of as well as



adaptation to risk are of paramount importance for social and economic development. In times of uncertainty, safety is, perhaps more than any-time before, a cherished value that is not free from controversy. Like most advanced societies, Catalonia is exposed to a vast amount of individual and collective risks that need to be addressed through appropriate safety measures. Besides, safety is a driver for prime technological progress and innovation that has often been later implemented in many fields. Risk awareness and public and private innovating action on safety in Catalonia can become a relevant business area in niches where the public and private market will play a relevant role, such as e-safety.

### Learning and society

Effective lifelong learning systems and mechanisms allowing people to acquire competencies and experiences needed to develop their maximum potential in different aspects of life.

**Schools without walls are needed, as is a society learning in a pluralistic way and in networks, disseminating knowledge and ideas and fostering appropriate competencies and experiences for the people's individual and collective progress.**

Learning is more than ever before a social process in which the individual and the community need to play an active role with both-way transactions (learning vs. capitalisation and socialisation of what has been learned, including late life stages). Educational and training systems need to be thought over to adapt to new complex realities and the role of stakeholders, processes and instruments for lifelong learning needs to be redefined. Schools without walls are needed, as is a society learning in a pluralistic way and in networks, disseminating knowledge

and ideas and fostering appropriate competencies and experiences for the people's individual and collective progress.

The challenge is big and Catalonia has an urgent need to tackle it based on knowledge and innovation in all domains related with the educational and training system from a holistic view (including formal and informal processes). Beyond its social relevance, learning generates an enormous economic impact as a whole and in many specific productive activities, making it an economic driver in the most advanced societies, but also a technological one through the implementation of new technologies.

### Innovation and competitiveness

Systems and ways of innovating with an effective impact on competitiveness of public and private organisations and a territory as a whole.

**The implementation of knowledge will require public and private action by both public authorities and business, with leadership and involvement by all people in the organisations.**

Catalonia needs to improve significantly its innovating and transforming capacity as well as to settle a strong and sustainable competitiveness model in the future. To do so, it is necessary to understand the foundations of innovation and competitiveness of organisations and territories as well as to set out according tools, policies and public and private action. The convergence of different social disciplines in which Catalonia has a proven capacity shall allow to develop top research in such a key area for the country's prosperity. Also, the implementation of knowledge will require public and private action by both public authorities and business, with leadership and involvement by all people in the organisations. Regarding territories, specific foundations for competitiveness with a global

view need to be set through mechanisms specifically adapted to the different social and economic realities, developing effective territorial innovation systems.

## Labour and organisations

Forms of labour and organisation allowing maximum development of individual and collective capacities, well integrated into the social and economic fabric where they intend to create value.

Thinking over forms of labour and ways of organising it becomes a key issue in a context of deep social and economic change, which affects labour relations, incentive mechanisms, the dynamics of organisations, people's competencies, job design, etc.

Catalonia has a need and an opportunity if it is able to effectively understand and innovate within this area. To do so, a synergy effort by multiple stakeholders is needed, but also to visualise actions already existing at some companies and in the public sector to move to new forms of labour and organisation allowing to develop the people's full potential in a collective project.

## Governance and globalisation

Interaction of the public and private sector and civil society allowing to accommodate mutual interests in political, social, economic and environmental matters.

### **It is at the global level where companies, civil society, territories and countries need to be present.**

Governance, understood as the many different ways in which individuals and public and private institutions deal with matters of common interest, is a strategic process from a social, economic and political viewpoint by which different

interests and needs shall be accommodated with formal and informal action. This involves the creation of public, private and civic interaction networks at local and now also at global level, with an increasingly intensive use of the net. Catalonia has a notable record in governance processes, by which social and political agreement has been used in many different sorts of activities.

This is a great opportunity if knowledge is improved, there is innovation in this area and at the same time an effort is done to bring it to the global level. It is there where companies, civil society, territories and countries need to be present, and it is there where setting multiple agreed interactions becomes increasingly important, leading to a radical change in the ways of interacting through talent, knowledge and innovation networks creating in their turn a new governance strongly based on intangibles, yet without doing away with classical forms of institutional and governmental interaction.

## Some general considerations

- ▶ Many areas require public-private interaction to be implemented, which will need to come with the creation of new types of clusters: knowledge and innovation communities.
- ▶ Most areas need to be tackled from a multidisciplinary perspective.
- ▶ Social sciences and humanities play a relevant role in many areas.
- ▶ R&D&I strategies and policies in many areas affect several departments of the Government, which will need to work in coordination.
- ▶ New areas of necessary expertise come up, such as service sciences, time usage, etc.
- ▶ Not all that is necessary in research and innovation resulting from the areas to focus on and give

priority can be done in Catalonia (either publicly or privately), but if the needs are known, strategies to seize, share, acquire, adapt, etc. can be set out.

► Branches are blurring. A textile company can be associated with health materials, metal textiles for sustainable buildings or many more things. It is the area a productive or public activity has an

impact in what defines its hyperindustry, as it is started being called.

► The different areas are not isolated from each other, there are many possible and necessary cross-connections and hybrids to be explored. Some hybrids like audiovisual products and health can create big niches of strategic value.