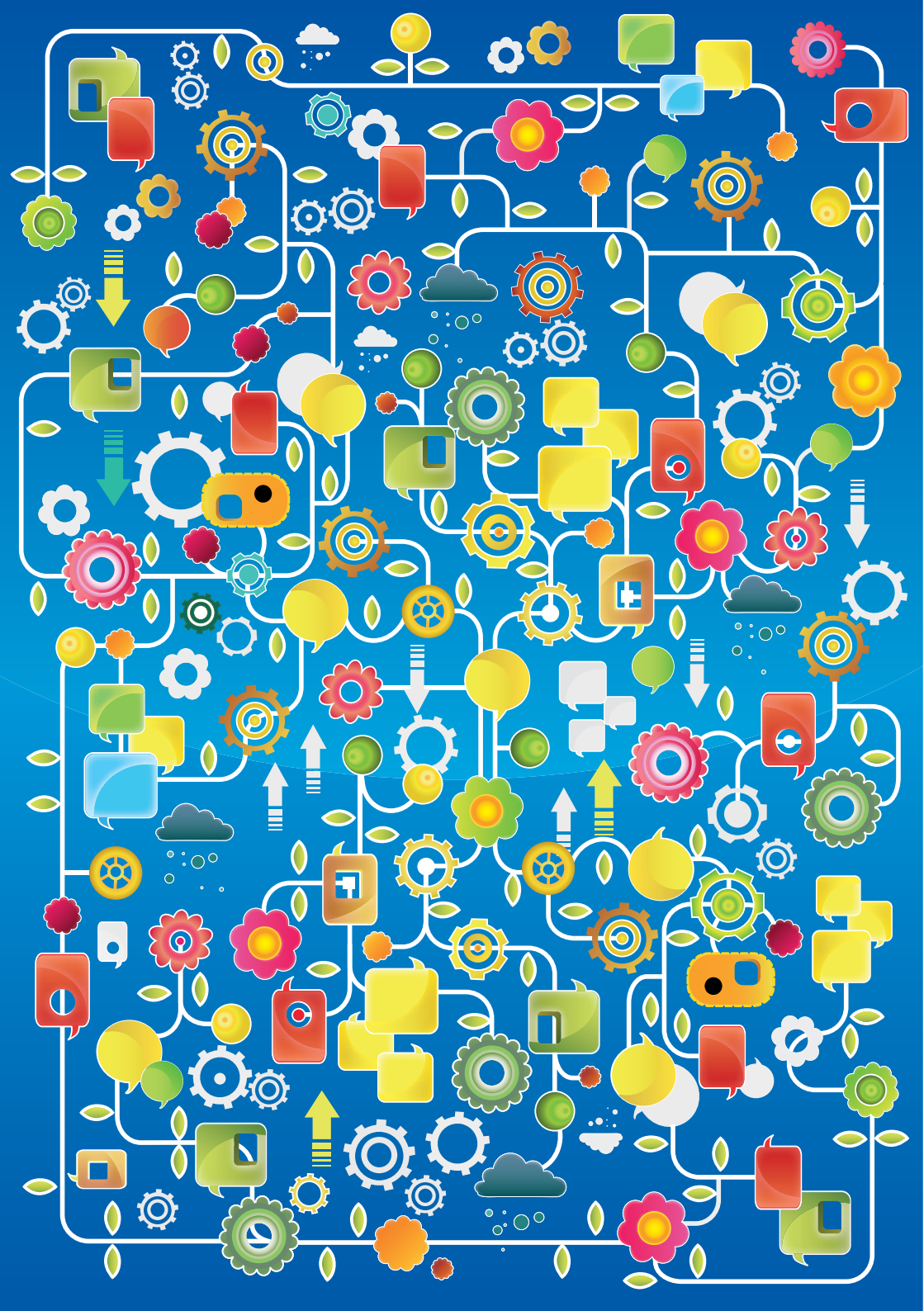
BORDWIIS+

Boosting Regional Development
with ICT-Innovation-Strategies

ICT Innovation Strategy for European Regions: Recommendations for Regional Specialization

INTERREG IVC
INNOVATION & ENVIRONMENT
REGIONS OF EUROPE SHARING SOLUTIONS

European Union
European Regional Development Fund



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1. Introduction

Information and Communication Technology (ICT) is crucial to European competitiveness, innovation strength and industrial development, especially as innovation is made possible in most cases by important developments in advanced ICT and their application. Europe 2020, the current growth strategy of the European Union, has recognized this potential of ***ICT as key enabling technology*** and integrated it as important criteria for national and ***regional growth strategies.*** The overall objective of Europe 2020 is to deliver smart growth that is more effective concerning investments in education, research and innovation, and fits with the regional assets and potentials.

Based on this assumption, the development of so called "***Smart Specialization Strategies"*** is a main task within the context of the next structural funds period. Following this approach, ***innovation strategies*** have to be aligned with policy support and investments that focus on key national/regional ***priorities*** and competitive advantages. Only then will the innovation policy deliver maximum economic and societal added value without putting other regions at a disadvantage. Thus, Smart Specialization is an important part of the European Cohesion Policy and its contribution to growth and jobs.

The European Commission has launched a Smart Specialization Platform to provide regional and national authorities with detailed information material of which the "Guide to Research and Innovation Strategies for Smart Specializations (RIS3)" is the most important and comprehensive one. It gives a clear overview of the policy context and concrete proposals for how to manage a complex strategy process in a step-by-step approach. Though ICT is included as an important innovation factor of a region/nation, the guideline does not cope adequately with its ***complexity*** and overall ***economic relevance***. New policies and strategies are required to fully maximize the possible opportunities and meet the challenges that the rapid development of ICT creates.

In the framework of the INTERREG IVC Project BORDWIIS+ (Boosting Regional Development with ICT-Innovation-Strategies), eight European regions have tackled this challenge in the field of ICT with Smart Specialization strategies. Through close exchange of ***regional experiences*** and ***know-how*** they have identified the most targeted instruments and measures for the development of a ***región-specific*** ICT innovation strategy. The knowledge gained on regional levels and through interregional exchanges has been abstracted in order to build a ***strategy model*** that can be adopted

by other European regions irrespective of whether they can be considered "advanced" ICT regions or not.

The present report, "ICT Innovation Strategy for European Regions: Recommendations for Regional Specialization" summarizes the results of the project. It gives an overview of the partners involved and, more importantly, shows how the regions tackled the challenge of the development of an ***ICT Smart Specialization strategy.***

It's important to underline the main topics of the strategy. The present report has a structure to explain these topics, responding to following questions:

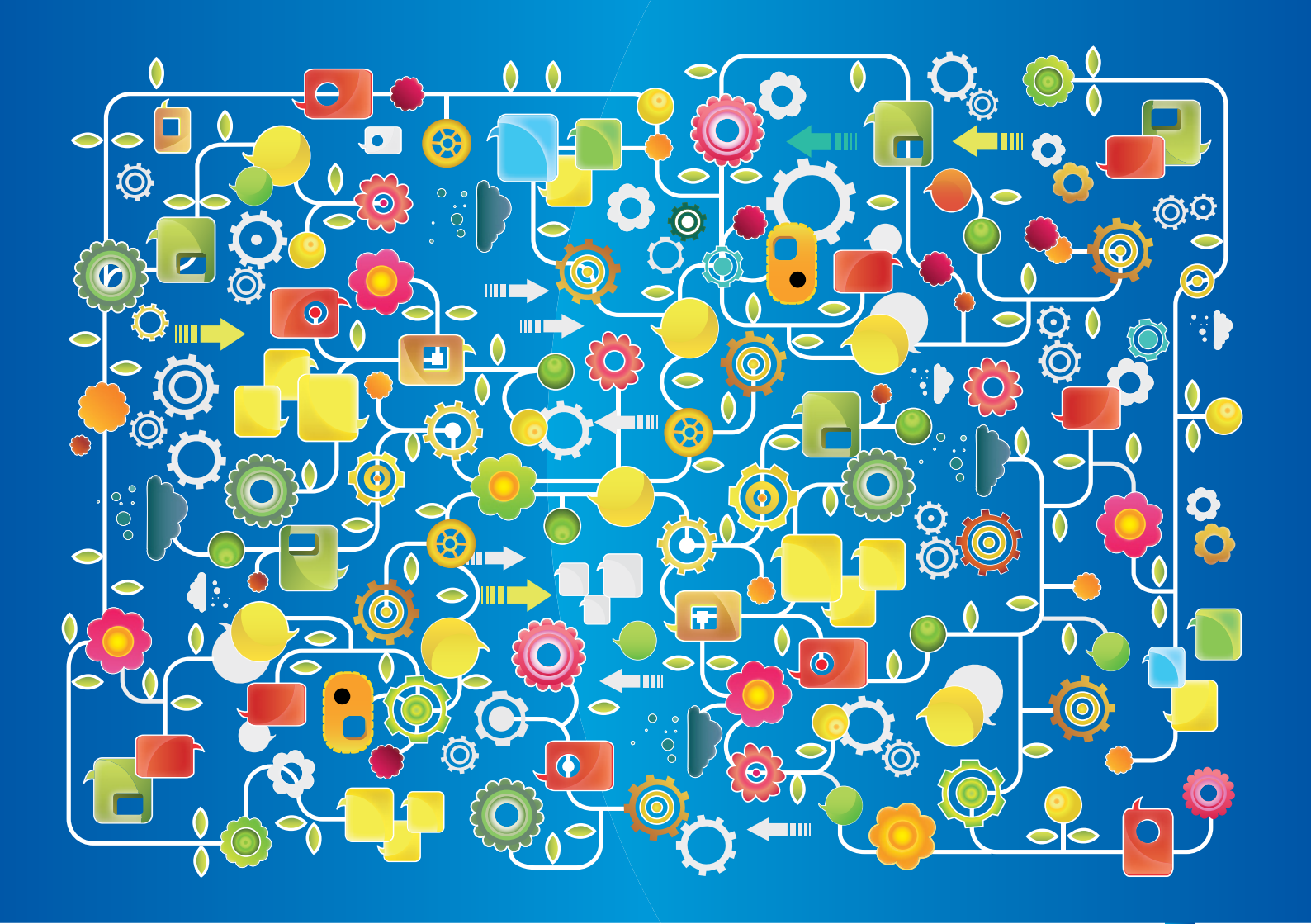
- Why is ICT relevant **(Chapter 3**)?
- Why should each region have an ICT strategy (**Chapter 4**)?
- What are the framework conditions of smart ICT strategy development (**Chapter 5**)?
- How should a strategy be developed (**Chapter 6**)?

Furthermore, the report gives a sharp look at some special needs or regional circumstances that a lot of European regions are facing:

- Cross-Innovations: In the case that a region has strong branches except in ICT, how can the potential of ICT be made useful for them (**Chapter 7**)?
- Innovation systems: Which features do innovation systems need to be successful? And what can regions do to make their innovation system resilient (**Chapter 8**)?
- Special preconditions: Europe has a lot of small regions and economically weaker regions. Those regions often have other needs or demands – what kind of interregional cooperations are fruitful for them (**Chapter 9**)?

2. The BORDWIIS+ regions

The following map shows all the regions involved in the INTERREG IVC Project BORDWIIS+, while the next table compares the demography and their ICT sector data.



2.1 Asturias, Spain

Asturias has a population of about 1.1 million people in an area of 10,604 km^2. It is bordered by Cantabria to the east, by Castile and León to the south, by Galicia to the west, and by the Bay of Biscay to the north. As of 2012, the GDP of Asturias stood at 21.8 billion €.

The research capacities in Asturias are distributed among University of Oviedo, the European Centre for Softcomputing, and CTIC Technology Centre. Among the outstanding fields of research are those related to artificial intelligence, computational statistics, semantic technologies and others that might be collected under the data analysis umbrella. The ICT sector in the region is growing employment, and turnover doubled between 2000 and 2010; the arrival of companies from outside Asturias generated more than 1,650 new jobs. In Asturias about 67.1% of all homes are connected to the internet via broadband connection. The support of the administration stands out in physical and knowledge infrastructures, as well as the promotion of the use of new technologies by society in both business and private sectors .

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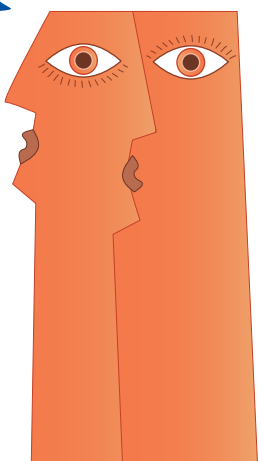

2.2 Central Hungary

Central Hungary occupies a total of 6,919 km^2 with a total population of 2.8 million people. The number of skilled personnel in ICT is far beyond other regions in the UE region and exceeds most European countries in this regard. In ICT employment Hungary ranks number 3 in the EU.

ICT represents around 10% of the total Hungarian economy. Telecommunications accounts for 4.2% of the domestic product. Similarly, 21% of persons are employed with ICT specialist skills. Companies employ 140,000 people in the ICT sector, accounting for 3.37% of total employment. Central Hungary's ICT expertise is closely linked to its well-developed infrastructure and legislative framework that made the region attractive to ICT corporations in recent decades. Global industrial players such as Microsoft, IBM, Oracle, SAP and telecommunication companies have been active in Central Hungary over the decades.

In fact, Central Hungary has nurtured a number of ICT firms that are well-known and well- regarded beyond its national boundaries, such as Balabit, Evoline, Graphisoft, IND, LogMeIn, NNG, Prezi, SaveAs Ltd. and XAPT.

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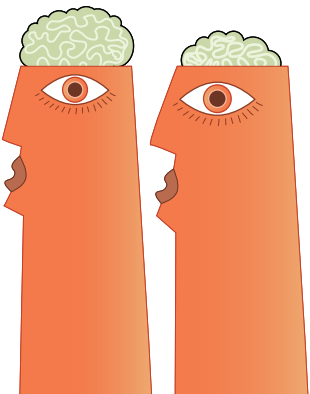


2.3 Estonia

Estonia has 1.3 million inhabitants, a GDP per capita of € 9,600 and an area of 45,227 km^2.

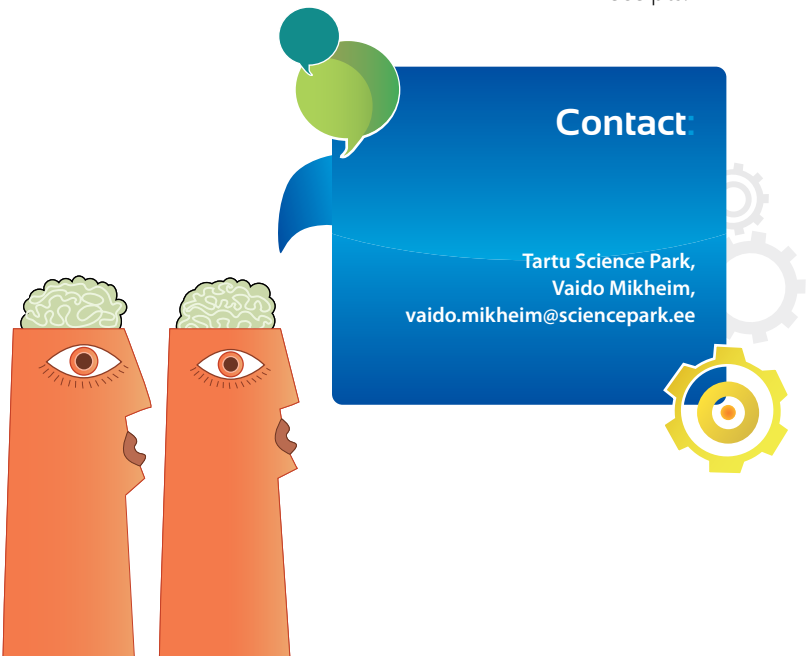
In 2013 there were about 2,600 active companies in the ICT sector, close to 20,000 employees working in the ICT sector and a total turnover of ca 3.7 billion € in this sector.

In Estonia, 100% of schools and government organizations are ICT equipped, 97% of businesses use computers and 76% of families have one or more computers at home. There is a countrywide broadband connection. 99.8% of bank transfers are performed electronically and 95% of income tax declarations are made via the e-Tax Board.

In the field of high-level research institutes and departments, the following list gives an overview of the most important actors in ICT R&D field:

- Tartu University
- Tallinn University of Technology
- EXCS – Estonian, eXcellence in Computer Science
- CEBE – Centre for Integrated Electronic Systems in Biomedical Engineering.
- ELIKO – Competence Centre in Electronics, Information and Communication Technologies
- STACC – Software Technologies and Applications Competence Centre

The future goals of Estonia's ICT policy are a 100 Mbps Internet to every home by 2017, cross border e-Services and E-Receipts.



2.4 Lorraine, France

The region of Lorraine has 2.36 million people, a nominal GDP of 55.14 billion €, and an area of 23,547 km^2. Lorraine borders with Germany, Belgium and Luxembourg.

The French top 5 in ICT sciences and mathematics companies (7.5% of national capacity) are located in the region:

- Inria: National Institute for Research in Computer Science and Control
- IAEM Scientific centre (information technology, automation, electronics and mathematics) - University of Lorraine / CNRS / Inria
- IMS: Information, Multimodality and Signal
- OPTEL: Optics and Electronics for Telecommunication (Centrale-Supélec)
- UMI GeorgiaTech – CNRS (secured telecommunication and nanotechnology solutions)

The main local challenge is to better connect these scientific stakeholders with ICT international markets. The Regional Council of Lorraine aims to identify the missing steps of the innovation value chain, facilitate the processes and fill the gap.

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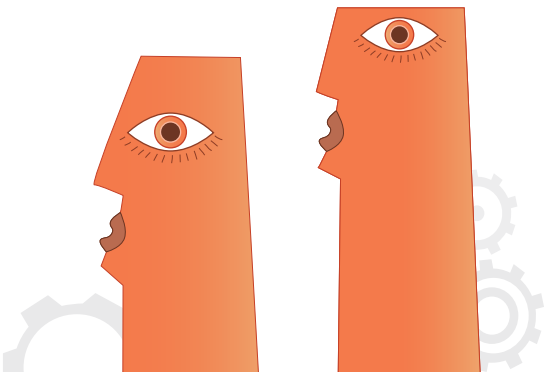
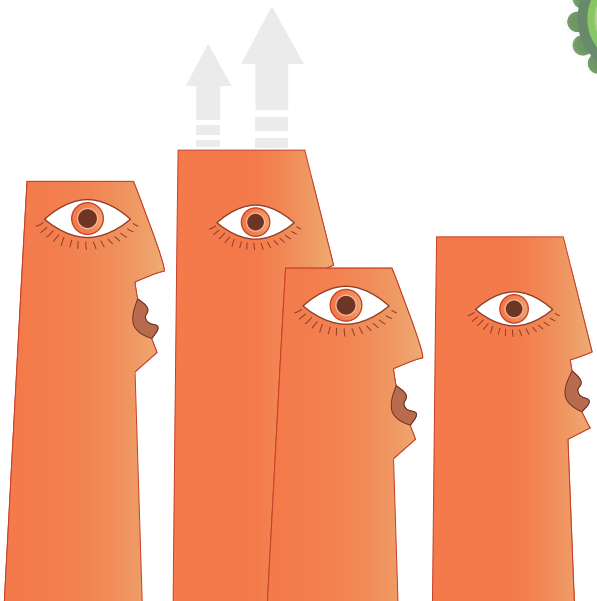


2.5 North Rhine-Westphalia, Germany

With 17,569 million inhabitants, North Rhine-Westphalia (NRW) is Germany's most populous federal state. The GDP in 2012 was 582.05 billion €. ICT is a powerful and promising pillar of the economy in NRW. In 2011, the over 23,600 ICT companies in the state employed approximately 196,000 people and generated sales of around 92 billion €. The NRW companies alone account for about 47% of the nationwide total turnover in the ICT sector. As well as numerous hidden champions, research institutions and universities, some of the industry's big players are also located in NRW.

NRW is a location where industry and ICT work together in many challenging areas. Of these, energy, manufacturing, automotive, medical technology and logistics are – due to their economic weight and social impact – the most interesting sectors for innovative ICT applications and cross-innovations.

Furthermore, NRW is a pioneer in the field of cyber-physical systems (CPS), the complex systems that open the way to the future for a state reliant on its industrial base. NRW possesses all the competencies needed to launch traditional industries into the innovative world of the digital economy, and to realize visions like the Internet of Things, the Industrial Internet and smart grids.



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2.6 Öresund, Sweden

As of 1 January 2010, the population of the Øresund region has been calculated at 3.7 million. The annual turnover of the region amounts to 97.4 billion €. There are 7 science parks and 165,000 students in the region.

The Øresund region is highly knowledge intensive with the ICT sector playing a predominant role. There are about 80,000 people employed in the ICT sector (70% in the Greater Copenhagen Area (CPH), 30% located in Skåne) working in close to 8,500 companies (75% located in CPH, 25% located in Skåne). Altogether they have a turnover of about 22 billion €. This means that 7% of the entire workforce works in ICT, generating 23% of the region's total turnover. Big players in the region are: Ericsson, IBM, Microsoft, Axis Communications, Cisco Systems, and Telia Sonera.

A characteristic for the Øresund ICT region is that most of the R&D is conducted within firms rather than in public institutions. The total number of R&D staff is around 43,000. The ICT sector accounts for more than 13,000 of these. This means that more than 30% of the R&D staff in the region is employed in the ICT sector. In comparison, there are about 700 public ICT researchers in the region.

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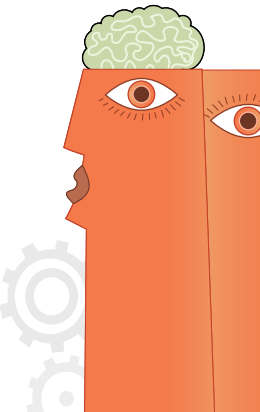

2.7 South-East Region of Romania

The South-East Region of Romania has 2,8 million inhabitants living on an area of 35,762 km^2. The regional GDP in 2010 was 13.1 billion €. There are 1,054 innovative firms, 2 industrial parks and 4 clusters.

The ICT profile of the South-East Region is mainly characterized by:

- decreasing number of firms, employment and turnover
- low level of collaborative R&D, mainly driven by scientific collaborations and not by firms;
- the ICT sector achieves a high relative export quota (41%);
- the region is not among the top regions regarding the ICT sector, despite this fact some international companies are located in the region;
- technological competencies in the field of ICT: s***oftware development, IT services, consultancy and web portal services.***

The South-East Regional Development Agency (SE RDA) aims to support the technological transfer, business infrastructure able to compete in the national and international market and also innovation infrastructure.

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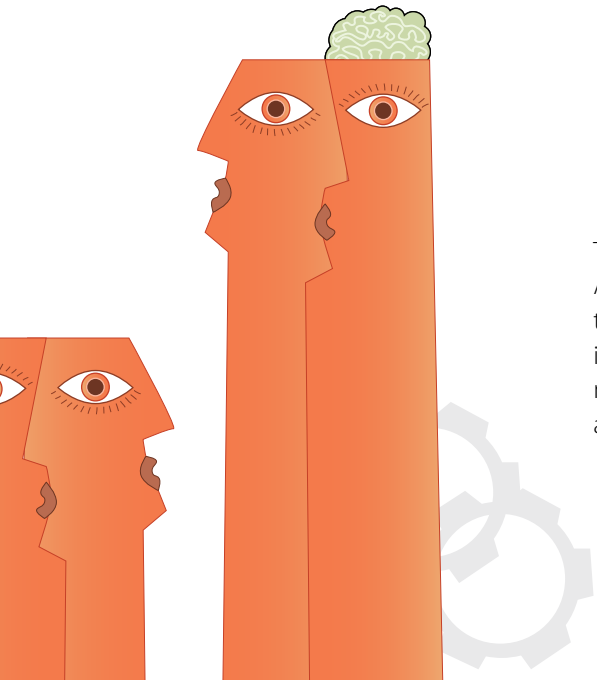

2.8 Tuscany, Italy

The Region of Tuscany has 3.75 million inhabitants, a GDP per capita of 28,700 € and an area of 23,000 km^2.

There are approximately 420,000 registered companies of which around 85% have less than 10 employees. Manufacturing represents over 27% of the regional workforce. The total employment rate is 62.5% (EU27 average 64.1% - EU15 average 65.13%).

Tuscany represents 35% of the national public research workforce in ICT. Main institutes are:

- TeCIP Institute (Institute of Communication, Information and Perception Technologies), partner of Scuola Superiore Sant'Anna and Ericsson spa, specialising in p***hotonic networks, perceptual robotics, and real-time systems;***
- CNR ISTI (Pisa), specialising in networking science and technologies, ***software science and technologies, knowledge science and technologies, visual and high performance, computing science and technologies, and flight and structural mechanics***;
- CNR IIT (Pisa) – ***Informatics and telematics, internet of things and internet of services;***
- CNR Florence Institute for applied physics N.Carrara – ***Bio-photonics,***
- National Institute of Optics (INO) - ***Quantum optics, nonlinear optics and high intensity, systems and optical sensors, interferometry and microscopy, gas and quantum ultracold atoms, micro-and nano-optics, spectroscopy*** and ***metrology;***
- LENS (European Non-Linear Spectroscopy Lab);
- NanoFast – Nanostructures Ultrafast Spectroscopy Laboratory - University of Florence.

The main local challenges are to develop hi-tech clusters operating in ICT-Photonics and smart manufacturing, to better connect scientific competences and infrastructures to traditional manufacturing and to enhance, with demand policies and public procurement initiatives, the diffusion of information society aiming to fill the gap between research companies, industry and people.

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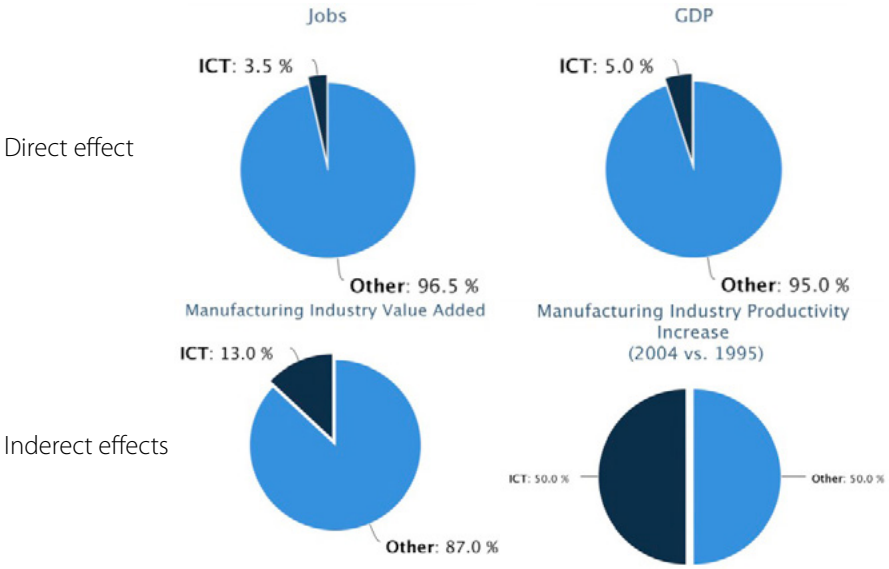
3. The relevance of ICT for innovation and competitiveness

In the space of barely two decades, our society had been deeply transformed by the emergence and the explosion of information and communications technology (ICT). This "digital transformation" revolutionized tools and the organization of our economic activities and now induces radical changes in our lifestyles, which speed up from year to year and sometimes, it seems, even from day to day.

3.1 ICT as key enabler

In Europe, the digital sector represents currently around 600 billion Euros in added value[1], and 6 million jobs[2].

As shown in the images, in rela tive value[1], the direct contribution of the ICT sector may seem low (approximately 5% of gross domestic product and around 3 to 4% of jobs in Europe), considering the extent of the ***digital transformation*** we are experiencing right now. But it is through its indirect effects - how companies and

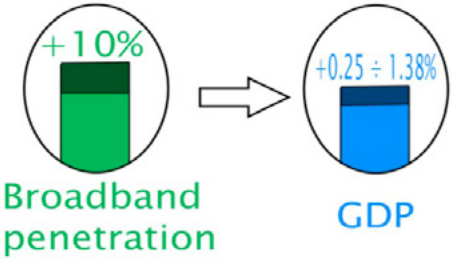


[1] OECD 2012

[2] Eurostat 2011

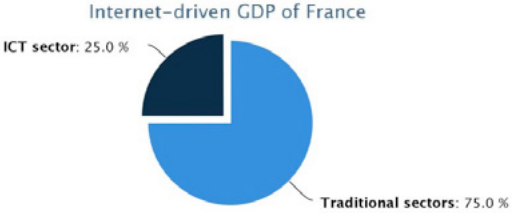
citizens use it - that digital technology acts as a lever on the European economy as a whole. According to ***Europe's Digital Competitiveness Report 2010***, 13% of the value added by total manufacturing results from the European ICT industry. From 1995 to 2004, half of all productivity gains in the EU were driven by ICT[3].

As displayed in the chart, the comprehensive impact of ICT is also reflected by the enormous contribution of broadband to economic growth: an analysis of different studies shows that a 10% increase of broadband penetration is estimated to raise GDP growth by 0.25 and 1.38 percent[4].



The production of goods is an example of the deep influence of digital technologies in entire industrial branches. In traditional industry, the use of digital tools has become widespread in the design of products, their manufacturing (automation), customer relationship and supply chain management, and the optimization of processes, etc.

Thanks to digital means of communication, companies – including SMEs – now may have direct access to the worldwide market, at a low entry cost. In France, according to a study of the McKinsey consulting firm, "75% of the added value of the French GDP by Internet originates from the use of the Web by companies of the traditional sector, against one quarter for the ***Web's pure players***".



The same study establishes that companies with strong investments in ITC tools present annual growth rates and exportation figures two times more significant than others.

Digital technology acts as an innovation catalyst inside companies, illustrated by a strong correlation between ***digital intensity*** of companies (good digital skills, investments in ICT solutions) and their innovation capacity. Many factors explain this result: ICT makes easier collaboration in R&D departments (***Open Innovation***), digital tools allow for virtual

[3] EU 2010

[4] ITU 2012

experimentation for new solutions (***simulation and virtual prototyping***), and access to information on technological progress is almost immediate.

Another indirect contribution from digital technology to the economy is the benefit for citizens: time gain in daily life, 24/7 access to the ***global marketplace*** (access to best prices), free access to services financed by advertisements, expansion of the range of leisure options (example: video games), enhancement of care, and intensification and expansion of personal networks (social networks), etc.

After personal computers, internet connection, smartphones, and media convergence, digital technology is now more embedded in the objects we manipulate every day, reinforcing even more the leverage effect (and the stake) of ICT in international economic competition.

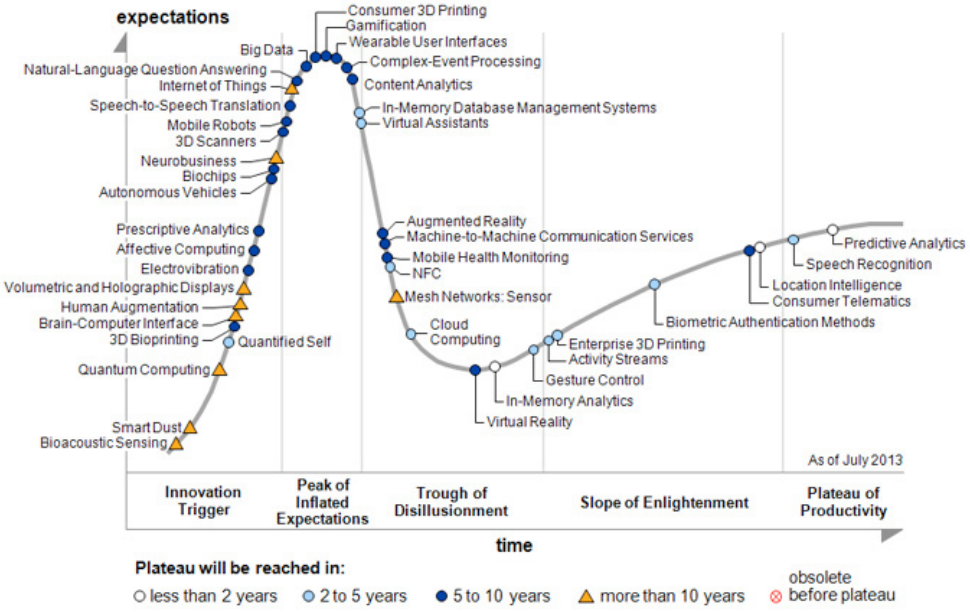
3.2 Some prospective: The disruptive potential of digital technologies

In the recent history of digital technology, some ***technologies*** (qualified as ***disruptive***) led to new markets very quickly (once they were adopted) and on a large scale, new uses and services, making entire frames of economic activity obsolete. The internet, tactile screens and wireless communication technologies are some examples. What are the next disruptive technologies? It is very hard to answer that question, yet political actors and company managers must anticipate themin order to be able to decide their investments priorities.

Literature is rich in diverse prospective visions, however some invariants emerging can be observed. To begin with, even if it seems already common, ***mobile internet*** holds still an enormous potential for development. According to McKinsey, in its 2013 report on disruptive technologies, the number of people using mobile internet regularly (smartphones, tablet computers…) may move from 1.1 billion currently to 2 to 3 billion in 2025, taking into account the potential for developing countries, which are still under-equipped. The use of mobile internet also progresses in intensity: more time spent online every day, more powerful apps requiring increasing needs in storage and computing capabilities, and more apps dedicated to professional users (surveillance, reporting, etc.).

In parallel, it becomes much easier to deploy ***internet services***. Indeed, technologies of "cloud computing" now allow access to transparently and directly distributed computing and storage resources and are able to withstand peaks of almost unlimited activity. Companies do not need to own and maintain

their own computers and network infrastructure anymore: the "***cloud***" replaces that, offering reduced costs and enhanced scalability. Miniaturization, mass production and energy efficiency allowed the emergence of low-cost components, integrating identification functions, data collection, connection to networks, and even capacities of physical action. These new generation "***systems on chips***" equip our phones, our cars, and our production machines, and will soon be integrated in our clothes and in our daily items (example: the first connected fork measuring if the user is eating too fast appeared last year!). "***The internet of things***", now evaluated to have reached 10 billion entities, could move to 50 billion in 2025, according to the McKinsey study, even 1,000 billion, opening new fields of application still unsuspected, notably in the field of health and robotics. More applications, more equipment: data flows will become colossal; it will be necessary to manage them, but most of all it will be possible, by analyzing them, to extract value out of them (knowledge) probably marketable in the future. Named "***big data***", this field is rather limited in its scope at the moment but could represent up to 8% of the European GDP in 2020 (according to a recent French government publication). Bioinformatics and computational biology already exceeded their hype and are now



well-established as pillars of biological research. Nevertheless, recent progress in sensors, cloud computing, semantic engines and big data are preconditions to widespread application and the creation of new fields (biochips, brain-computer interfaces, neurobusinesses).

A quick outlook of emerging technologies and their degree of maturity, reflected in the positioning and associated symbol/color, is represented in the Gartner Hype Curves. Below is the curve relative to the 2013 annual report.

The potential of the above technologies (to which we could add ***robotics*** and ***3D printing***) usable in synergy is estimated to several tens of trillions € at a 2025 horizon[5].

3.3 Global challenges

In parallel to the digital transformation mentioned above, our world is faced with new societal challenges on a worldwide scale. The increasingly scarce raw materials and fossil energy, global warming, the demand for mobility and communication, urbanization, the ageing of populations, the improvement of care and its ever-increasing cost: so many new challenges that ICT could help tackle.

Supercomputers, connected to surveillance satellites and to real-time terrestrial flows of data (from sensor networks), are now able to make more precise and reliable ***weather forecasts***. The automated analysis of climate data accumulated for years allows a better understanding of global warming, with eventually the hope to find solutions to reduce it. Moreover, thanks to digital simulations, it will be possible to find more energy-efficient technologies, as well as to make better use of and speed up renewable energy usage. The "***smart-grids***" and power distribution networks, optimized by the real-time collection of consumption and production data, begins to be generalized, allowing the management of a diversity of energy sources to be maximized, of some of which are intermittent and hardly predictable.

In upcoming years, requirements ***concerning mobility*** will further increase. By 2050 two-thirds of world's population will live in cities (UN-HABITAT 2008) and traffic and pollution are expected to increase drastically, challenging local and regional authorities in affected areas. Together with growing online commerce, the individualization of production and the accelerating interconnection of value-chain processes, these developments trigger the demand for smart solutions in

[5] McKinsey

the area of ***logistics***. The first approaches are already visible: traditional industrial companies become "***smart factories***", where all of the production logistics are represented in the virtual world and production components equipped with a digital memory know what to do next. In everyday life cars do not only become communication devices but also an embedded part of a whole ***intelligent traffic system***, in which traffic jams can be predicted and alerts transmitted to the drivers or – in the long term – to ***autonomously drive vehicles***.

Healthcare is another great challenge: In 2060, the European population will be composed of 30% of individuals aged 65 years or older; currently this number is 17%. It will not be possible to develop the infrastructures dedicated to elderly people for such a rapid rhythm of demographic evolution. ICT begins to realize solutions for ***home-based care:*** remote surveillance for the detection and prevention of home accidents, mechanized assistance, and remote medical assistance, etc. In parallel, the digital technology reveals significant hope in the ***healthcare domain:*** improvement of medical imaging for the early diagnosis of diseases, physicochemical simulations of the human body for the discovery of new medicines, physiological measurements and sensors and intelligent surgical tools. Other ICT-based advances for healthcare are to come, especially in the field of personal medicine and access to remote care.

The last years saw stronger interactions between digital sciences and ***human sciences***. Computer tools penetrated the field of neuroscience, psychology and sociology. It is now possible to make some realistic simulations of individualistic and collective behaviors, and these simulations will be more efficient and accurate. Thus, we can imagine that ICT can, in the future, integrate "the human" into the calculations and help human experts and governments to solve some of our fundamental economic and social problems (education, jobs, inclusion, …).

Nevertheless, one challenge is yet to be taken up in order to make possible all the foreseen evolutions above. Indeed, to maintain the necessary trust of the users, it will be necessary to ensure the ***security and reliability*** of these new technologies, be able to fight against cyber-crime and guaranty respect for the private life of citizens. New needs, innovating solutions to imagine, and once again, strong potential of economic activity are yet to come.

4. Boosting regional development with ICT Innovation Strategies

The starting point of the project BORDWIIS+ was the empirically based assumption that a sound ***ICT strategy*** can help regions to increase their ***competitiveness and innovation performance***. As shown in chapter two, ICT has ubiquitous influence on the way people live and work, enterprises organize their business and innovation processes, collaboration with other firms as well as on innovation itself. The merging of the physical and the digital world has just begun and it challenges the relevant regional actors to cope with the efficient deployment of resources. This leads to the strategic importance of an ICT strategy, which will be specified below.

4.1 The superordinate goal

The good economic performance of regions, positively impacting society, is the main reference for the definition of measures in an innovation policy. As ICT is gaining great relevance for both **economic** and **social development**, improving the framework of information and communication technologies preludes enhanced competitiveness, productivity, social cohesion and the well-being of people.

The main obstacles to an **improved framework** are:

- Given the dynamic evolution of the ICT sector, public policy-makers are facing increasing problems in **identifying** appropriate **targets** and choosing the right means for implementing development strategies.
- At the regional level, where resources can be scarce, the **efficiency** of their use is crucial and a lack of responsiveness may invalidate previous efforts in a given direction.

The European Commission's "Regional Policy contributing to Smart Growth in Europe 2020" clearly shows that these problems still exist. It states: "Many regions are still struggling to invest ERDF funding allocated to ICT (around 4.4% of the total) due partly to a ***lack of planning capacity***".

The framework lays the foundation for a detailed guideline that effectively contributes to fulfilling this urgent, far-reaching and complex need for regional authorities to understand the most recent ICT innovation developments, draw the right conclusions, initiate Smart Specialization processes and support the development and refinement of regional smart ICT innovation strategies. Such a guideline does not exist yet; it is thus the superordinate goal of the BORDWIIS+ project to provide regions with such a

guideline to boost regional development with ICT innovation strategies.

4.2 What makes a region successful?

The focus on regions as entities of innovation systems results from the observation that "***innovative milieus***" with stable cooperation structures and value creation systems develop within a particular ***regional framework***. Shaped by Cooke the concept of regional innovation systems enables the analysis of strengths and weaknesses of such systems. The main evaluation criteria are ***region, innovation, network, learning and interaction*** (Cooke 2009). The more positive characteristics a region has in these categories, the better its ***capacity for innovation*** is – this correlation has gained much attention in the literature and now significantly determines innovation and cluster policy. In a world where ***global networking*** evokes a higher complexity of business and cooperation structures, ***regional infrastructures*** are considered to be of high importance for economic success. In this context, ***regional innovation*** systems are defined as „institutional infrastructure supporting innovation within the productive structure of a region" (Asheim 2007, S. 223). Since the adoption of the Lisbon Strategy in 2000, this concept is manifested in the political area of action of the European Union.

A wealth of publications in the area of innovation, innovation policy and cluster research witness the current interest in questions of ***regional economic development, competitiveness*** and the political parameters most suited to encourage it, yet no clear and generally applicable concept can be drawn from this body of work. Nevertheless, some fundamental principles essential to the development of ICT strategies become evident, for example:

- ***knowledge*** and ***innovation*** are key pillars of economic growth in industrial countries[6]
- the state functions as a ***regulating force,*** influencing types of economic output
- in a globalized age, concentration on regional infrastructures and networks represents a promising approach to international developments[7].
- successful innovative regions reveal certain common features manifestly encouraging for the development of innovations.

What are these features? Important factors are:

- geographical ***concentration of companies*** sharing a single production structure

[6] Hall & Soskice 2001
[7] Cooke, 20091

- predominance of small and medium-sized enterprises (***SMEs***)
- a ***culture of cooperation*** and interactive learning
- sociocultural identity that creates mutual trust
- availability of ***hard infrastructures***
- availability of r***egional public funding***
- availability of ***private finance*** opportunities
- strategic ***cooperation*** between ***industries*** and ***universities*** at a regional level
- intensive ***knowledge transfer***
- entrepreneurial culture that generates ***start-ups***
- taking account of ***social impacts***
- creation of ***incentives for research and innovation***
- ***creative, innovative*** management and employees.

These findings and factors are fundamental for the development of regional innovation strategies. They are not only orientation points in the ***strategy process*** but also elementary starting points for the ***status quo analysis*** of regional innovation systems, which should mark the beginning of all strategy planning, as will be shown in the following remarks.

4.3 The approach: Smart Specialization

The above-mentioned concepts and factors give an idea about what regions need to be innovative and successful. The evidence that there sometimes exist large gaps between different regions concerning innovation capacity and economic performance has led to the rise of a new concept which has its roots in the EU cohesion policy: Smart Specialization. The idea behind this concept is the positive effect of ***"task sharing"*** between different regions: "Regional diversity is seen as an asset since it advocates different routes to growth through innovation and Smart Specialization"[8]. According to Foray, David and Hall, the idea of ***regional diversity*** requires the mobilisation of the attraction forces of a region in order to avoid inter-regional ***imbalances***[9]. Regions need to focus on certain domains by developing distinctive areas of specialization in a cooperative way and without imitating each other. While ***technological leader regions*** can invest in so-called "General Purpose Technologies" (***Key Enabling Technologies*** (KET)), ***less advanced regions*** should concentrate their resources on the co-invention of application domains. Smart Specialization strategies can

[8] European Commission, 2011, S.5
[9] Foray, David & Hall, 2009

help regions to concentrate resources on a ***limited number of key priorities*** rather than spreading investment thinly across areas and business sectors, thus maximizing ***impact*** on investments. It "challenges policy-makers to develop the right policy mix adjusted to regional potentials and needs"[10]. Since information and communication technologies play an important role because of their critical influence on economic growth differentials, they have become an integral aspect of the Smart Specialization approach on the EU level[11] [12].

By the adoption of the ***Digital Agenda*** for Europe (DAE) the development of research and innovation strategies for Smart Specialization (RIS3) has been closely linked to priority setting in ICT. Regarding the disruptive potential of ICT throughout industries (s. chapter 2), there is evidence that regions can enormously ***profit from Smart Specialization strategies*** in the field of ICT as key enabling technologies (KET).

But European regions need ***know-how*** that enables them to initiate and carry out such strategies. Furthermore, ***networking*** and the ***cooperation*** of citizens, public institutions and enterprises is considered a fundamental prerequisite to achieving successful innovation. The ***integration of entrepreneurs*** is an especially critical point in the strategy-development process: they are regarded as the agents "who will search out the right types of knowledge-related specialization". Finally, new collaborative models involving not only public entities, research, and business, but citizens also become part of the value-creation process. The European Commission "Guide to Research and Innovation Strategies for Smart Specializations (RIS 3)" already provides recommendations and a step-by-step approach for the design of RIS3 containing the following six steps (Foray, et al., 2012, S. 17):

- Analysis of the ***regional context*** and ***potential*** for innovation

[10] European Commission, 2011, S.5

[11] McCann & Ortega-Argilés, 2013, S.7

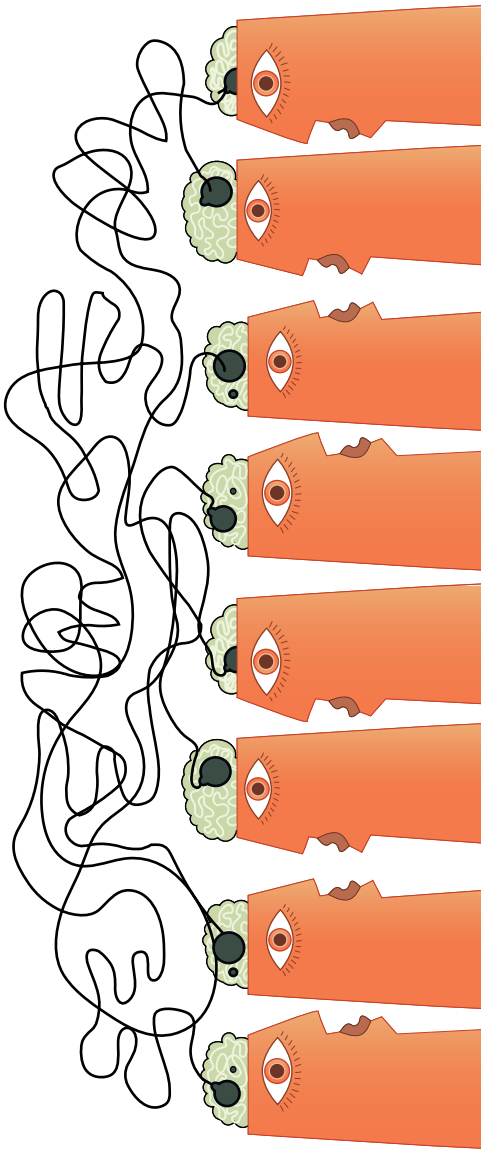
[12] According to the Guide to Research and Innovations Strategies for Smart Specialistion (RIS 3) "[t]he deployment of Key Enabling Technologies (KETs) can be an important component of a Smart Specialization strategy because of their horizontal nature and transformative potential. Many future goods and services will be driven by KETs […]. Moreover, these goods and services will be crucial in addressing the 'grand societal challenges' facing the EU, including energy supply, public health, ageing and climate change" (Foray, et al., 2012).

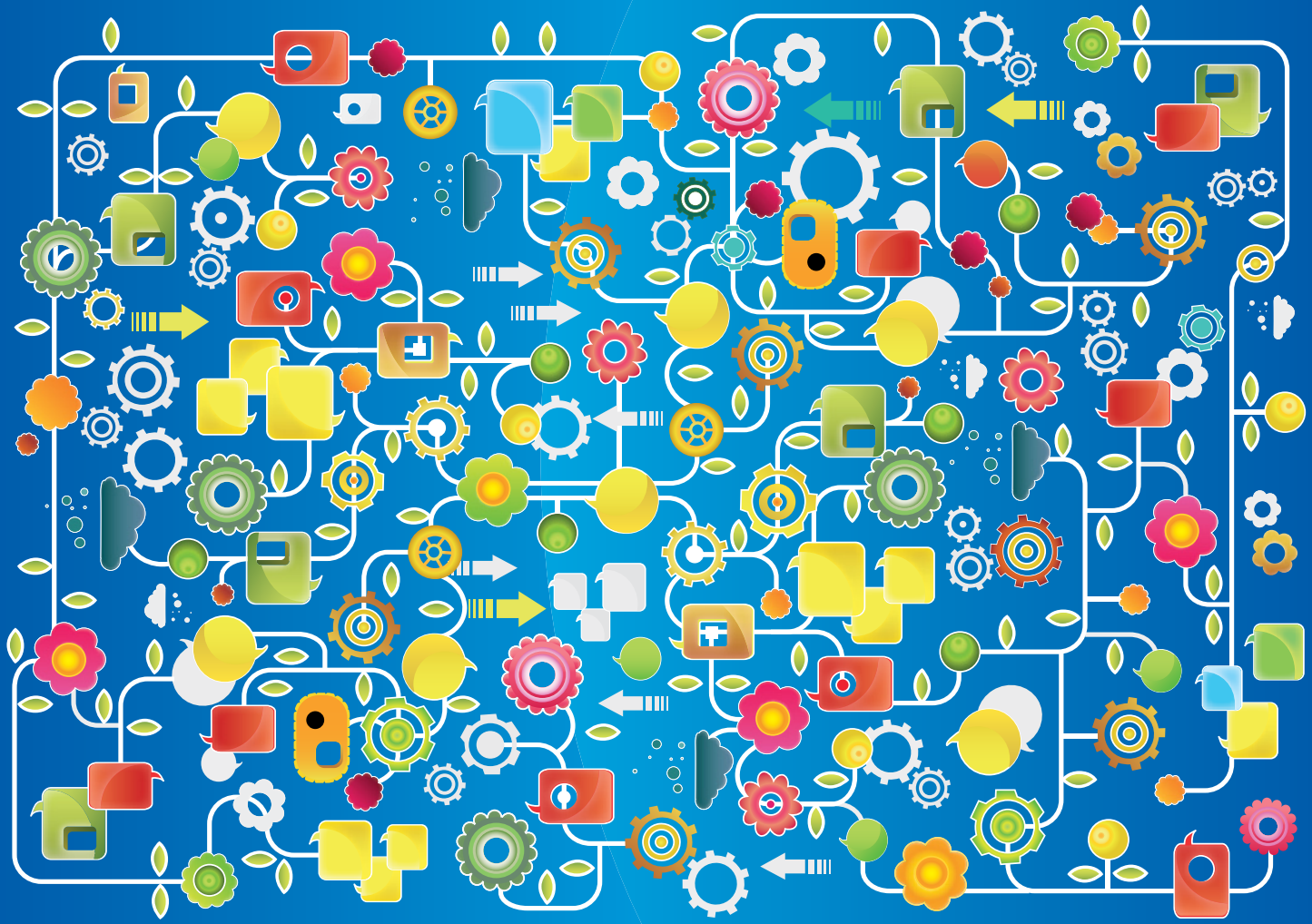
[13] The EC Guide RIS3 has been elaborated to support regions to develop their Strategy as a precondition to access to the cohesion funds (Ex Ante Conditionality). This task should be accomplished by the end of 2013. Even though many regions started one year ago, this period of time is not enough to implement this ambitious task, especially for those regions that did not have a specialization policy before, which introduces some disrupted elements regarding innovation policy. Some years it will be necessary to put in practice this new approach, in particular to have data available, to put in place new governance, and to develop those topics / initiatives initially selected for specialization.

- Set up of a sound and inclusive ***governance structure***
- Production of a ***shared vision*** about the future of the region
- Selection of a limited number of ***priorities*** for regional development
- Establishment of suitable ***policy*** mixes
- Integration of ***monitoring*** and ***evaluation*** mechanisms[13]

The steps represent a structured way to RIS3. Nevertheless they do not bring into consideration the complex facets of ICT.

The ***Common Framework*** of the BORWDIIS+ partners wants to fill this lack and provide a ***tailored method*** with adequate instruments for the development of ICT innovation strategies based on the Smart Specialization approach. It is based on ***intensive work*** in the partner regions and close ***interregional exchange*** on experiences as well as on sound desktop research on ***strategy development*** and ***priority setting***.





5. Guidelines for the ICT strategy process

Before starting the detailed strategy process, the regional stakeholders in charge should realize what will await them and what aspects should not be missed. According to the experiences of European leader regions, there are some ***basic principles*** an ICT strategy process leaning on Smart Specialization should follow. They can be understood as **guidelines** for a successful ***strategy process***:

- **Open-mindedness and heterogeneity in team building**. The various parties involved must be selected with a view of their specific expertise, personal and institutional influence, and heterogeneity, to cover all aspects and interests of the four-stage strategy model. This is especially important with respect to the interdisciplinary structure of the technological focuses. HR selection should consider the following groups:
  - ICT technicians from universities and non-university research institutes
  - decision makers and creative thinkers from major regional industries and SMEs active in the ICT sector or in applications directly connected with ICT
  - stakeholders from national and regional industrial ICT organizations
  - creative and culturally committed individuals known for thinking 'outside the box'.

Open-mindedness and creativity are key factors in the strategic process.

- **Political decision makers' involvement.** Political decision makers are essential: a sustained ICT strategy can only be successfully developed if it is rooted in overarching political and economic structures.

The involvement of political decision makers is indispensable.

- **Strong social stakeholders involvement.** ICT is not only a major driver of growth, and thus of key political, economic and scientific importance; it also plays an immense role in the everyday life of the population. To launch a successful system of innovation, all relevant parties must be committed to the strategic process, including regional social, political and cultural interests.

An ICT strategy can only succeed if it takes account of social factors and requirements.

- **High-quality broadband network.** Access to the broadband network is essential for both business (as important location factor) and private life today.

Full broadband coverage will be urgently needed to enable participation in digital life in the next decades. Thus broadband policies are now a vital part of broader ICT policy strategies.

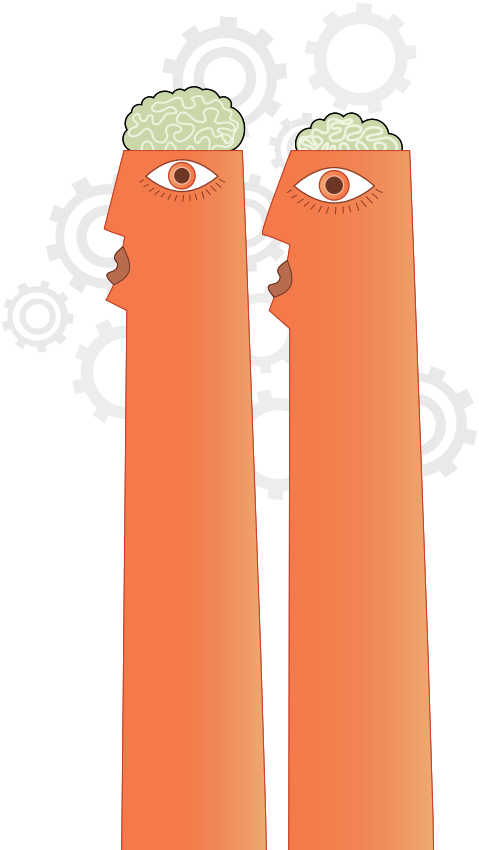
A high-quality broadband network should be focused as a main target and prerequisite of successful ICT strategy implementation.

• **Focus on specific regional issues.** One of the main challenges in the development of a successful strategy is the identification of specific regional focus areas. These must be future-oriented, and wherever possible reveal unique features or special development potential. If (as can be assumed for NRW) such strengths are already present, they must be evaluated in terms of their future potential as anchor points for technological specialties.

Technological specialties must be related to existing regional strengths with high development potential.

• **Sustainable model in organization and financing.** Sustainable forms of organization and financing are crucial to the effective strengthening of an industry for future tasks. Here it is helpful to look at other regions and learn from their strategies and achievements. Success elsewhere can be a good basis for the development of one's own organizational and financing models.

Benchmarks should be used as a back-up and factor in the search for organizational and financial models of one's own – and especially for avoiding blind alleys.



6. The method: "Common Roadmap Framework"

The **priority setting** in the ICT sector is challenging to regional authorities in two ways:

- with a highly **complex** topic, characterized by **dynamic** and **fast** development of digital technologies, difficult to capture in a strategic framework, but also
- with the problem of **bringing into practice** an adequate strategy for this ***long-term process,*** while considering all aspects mentioned in the guidelines above.

Against the background of the EU cohesion policy it is necessary to provide a helpful structure for all regions in Europe that are about to take up an ICT innovation strategy. This structure must be ***detailed but flexible*** in order to meet the needs of "pioneer regions", but also of less advanced regions, where stakeholders are less experienced in the development of high-tech innovation strategies.

The "Common Roadmap Framework" set-up in the framework of BORDWIIS+ provides such a strategic "overlay". On the basis of the experience and know-how gained in strategic processes and reflection of interregional cooperation between European Regions, the framework foresees **eight fields of actions** to be completed during the strategy process. Moreover, it gives a broad **set of recommendations** for their implementation into praxis. The framework is meant as a method to achieve the "superordinate goal": ***boosting regional development with ICT innovation strategies.***

6.1 Who: Integrating all stakeholders of the "quadruple-helix"

Driven by the conviction that **intensive cooperation** at the interface between ***politics, business, science, technology*** and ***society*** is essential for a future-oriented regional ICT strategy, the responsible ***management team*** must aim to **involve** all relevant sectors in the strategic development process: only in this way can smart and effective specializations be achieved.

To take account of changes brought about by ICT in everyday life at both public and individual levels, which are massive and frequently disruptive, the classic triple helix of parties involved in innovation (politics, business, and science) has to be complemented with an ***emphasis*** on the **social dimension**, with the firm intention of integrating this perspective in all ICT strategy discussions and decisions.

Whereas the latest iteration of the triple helix depicts the stakeholder involvement towards *wealth generation* (**business**),

novelty production (**science**) and *government* (**politics**)[14], the quadruple helix includes the *public* (**society**) as a fourth pillar to account for a user-oriented innovation approach that is largely driven by ongoing technological advancements[15] in a socialized context.

User-driven innovation, including innovations carried out by consumers in private, as well as companies involving and utilizing users in innovation processes, can be seen as an universal connector between the three existing pillars. The *quadruple helix* and its stakeholders therefore represent the holistic approach to pursue research- and technology-driven innovations as well as demand- and user-oriented innovations as it is practiced in this project.

6.2 What: Fields of action & instruments

With the above considerations in mind, the following fields of action have proven to be suitable for the development of ICT innovation strategies based on the *Smart Specialization* approach. Together, they build the **Common Framework** – the strategic model that can be adapted by different European regions on their way to Smart Specialization in the ICT sector. Their order is *only a suggestion* for the course the strategic process can take. It is *not binding* and should be *continuously negotiated*, within the strategy management team as well as between the involved actors. Furthermore, the **actions** have different **relevance**, depending on the *regional preconditions.*

Outstanding actions and instruments are: the **Policy Analysis**, the ICT **Inventory**, the ICT Smart Specialization **Scenario** and the **Roadmap**.

6.2.1 Policy analysis

The *identification* of the regional policies at the very beginning of the strategy process is important considering that regional preconditions are crucial to pave the way for **tailor-made strategies**. The identification of the policies addressed gives a general picture of each region's specific *context* and *insight* into ICT policy strategies, as well as main innovation *stakeholders* and *relationships* among them. This detailed knowledge is necessary to guarantee that all relevant stakeholders in the region get involved with the next phases of the strategy. Finally, it sets the framework for the successful implementation of the ICT strategy.

Already implemented ICT innovation policies and future strategies must be

[14] Torkelli, et al., 2007
[15] yawson, 2009

taken into account as well as general innovation policies, which also influence the framework in which ICT innovations develop.

Instruments:

- **Desktop Research:** The main instrument for the analysis of existing policies in the field and at the interface of ICT is detailed desktop research. The following key questions should be answered with regard to the region:
  - Are there already strategic outlines for ICT in the region?
  - Which institutions carry out a constitutive function for research, technology and innovation policies (ministries, associations, public-private partnerships, and private companies)? Which competencies do they have?
  - What kinds of participation mechanisms exist for the involvement of stakeholders (informal and institutionalized)? Please also mention practical experiences you have already made.
  - Please specify the scope of research and development programs in your region (referring to financial resources, availability of contests, etc.). Do the thematic focuses comply with the needs and the potential of the ICT sector?
  - Please try to assess the transparency and integration of regional and national R&D programs (if possible).
  - Is there an adequate framework for the development of public private partnerships? (This questions aims at identifying the sustainability of innovation policy/ cluster initiatives)
  - Do R&D institutions consider the bureaucratic obstacles related to public project funding in the area of ICT as high?
- **Best practices benchmark** (international): in parallel to the development of the structure and content of the strategy itself, ***comparisons*** with other regions and proven ***success models*** in order to learn from the experience of other clusters and regions. Good practices can help to identify possible forms of organization for cluster initiatives in order to ensure the sustainability of the ICT strategy – and with it the effective application of resources once the strategy will be implemented.

6.2.2 Status quo: Industry structure and position

Apart from the policy analysis, the assessment of the status quo concerning ***ICT performance*** in the region is a basic step to be taken before the strategic dialogue begins. For each region, the **status quo assessment** needs to analyze the following:

- the structure of the ICT industry
- the national and international position of ICT industry,
- technological competences and the main actors in business and science,
- strong application sectors
- special societal challenges in the region need to be analyzed.

In addition, it is relevant to know about the factors which influence – positively or negatively – the development of ICT innovation. In this context the success factors mentioned in chapter 2 are important points of reference, such as:

- predominance of SMEs (small and medium-sized enterprises),
- availability of hard infrastructures,
- intensive knowledge transfer,
- entrepreneurship culture.

The assessment "soft" factors aiming at the analysis of a special mentality or cooperation culture is an especially difficult task that can only be met by qualitative analysis and long-term observation of the situation on the spot. Thus, responsible actors in strategy management are advised to work on this task in connection with the other fields of action where stakeholders are directly addressed.

Instruments:

- **ICT Inventory:** Detailed research, ideally with the help of a research institute or regional/national statistic agencies, is necessary in order to specify the most important data about the ICT region and the national framework conditions. The output of such research should be an ICT inventory comprising information about the ***ICT market***, the position of the region as an ***innovative location*** for ICT, technological ***competences*** and ***cross-innovations***. These categories are important with regard to Smart Specialization but also basic for all other fields of actions.

The following indicators can help to collect data about the innovation potential of the region:

- **ICT Market**[16]
  - Growth of national/ regional IT market by percent
  - Data concerning employment

[16] Since there is no generally applicable definition of the ICT sector, the responsible authorities are advised to specify how the region is statistically constituted (which branches belong to the ICT sector? Is it necessary to make a special selection?).

within the ICT sector (growth/ average related to the production of ICT/ growth forecasts)

- "hard facts" about your region: number of ICT enterprises, employees, turnover

- Information about the strongest ICT sectors in the region, "big players" (most relevant enterprises), important research institutes and excellent clusters or networks

• **ICT innovation benchmarks** (innovation competences):

- Data about the innovation framework (e.g. ICT patent figures and private investment in R&D compared with other regions and its ratio in percent of GDP, innovation index (if available)/ nationwide position innovation)

- Start-up statistics concerning ICT and/or related areas (e.g. technologically based services and software), start-ups straight from university, information about external funding and the availability of venture capital

- High school and research landscape, nationwide standing in the area of ICT research

- Broadband infrastructure/ penetration

- Knowledge transfer

- Internationalization (in-going and out-going of enterprises, especially of SME's)

- Transparency of funding support landscape/ support facilities for business start-ups

- Intensity of cooperation between business, science and public partners

- National benchmark for possible interregional cooperation

• **Technological competences** (In which areas is ICT research particularly high? What are the technological priorities and focuses in the region?):

- High-level research institutes and departments

- Relevance of different technological trends in the region (e.g. machine-to-machine communication, sensor networks, embedded systems, RFID, cloud computing, etc.)

- Relevance of other ICT technologies

• **Cross-innovations**[17]**:**

- What are the strong application sectors in your region? Please specify by quantitative and qualitative data (e.g. importance

[16] Cross-innovations have a high potential for the development of ICT and the success of the ICT market. Referring to the Smart Specialization strategy, which is focused by the European Union's innovation policy, each region needs targeted support for research and innovation and thus a competitive advantage. Concentrating on strong application sectors in a region can be one way to improve innovation processes and economic outputs.

for the regional economy, GDP-ratio, employees, importance for the whole country, pilot projects, etc.).

- What are the "big players"? Are there any "hidden champions"?

- What are the societal challenges and promising solutions in the mentioned area/s?

• **SWOT-Analysis:** based on ICT inventory and policy analysis

6.2.3 Fundamental considerations, statements of problems, definition of goals

When the status quo assessment determined the ***strengths*** and ***weaknesses*** of regional ICT performance, the next step is to introduce a clear dialogue on this insight. The assessment is the starting point of the strategy process, involving the relevant stakeholders in the region and formulating the leading questions:

• What ***goals*** can be defined for an ICT strategy, taking into account the current status?

• What ***overall framework*** is available in terms of state and regional politics?

• Which ***players*** should be involved in the strategic development process?

In this stage of the strategic process, regions are advised to address a critical mass of **representatives** from ***enterprises, science, politics*** and ***public organizations*** in order to present the results achieved so far in the previous fields of action. It is important to get a ***common understanding*** of the ICT industry position and the competences of the region as well as to identify problems and to define overall goals of the ICT strategy. **Consensus** should be achieved on three points:

a. an ICT strategy for the region is necessary for the region's economic and societal development,

b. who must be involved and

c. what procedure will be set up in order to achieve the goals.

• **Trend monitoring:** The identification of future technological trends and application areas (Where is ICT going?) completes the analysis carried out so far. It provides regional authorities with an overview of relevant trends and innovation potential in accordance with regional competences.

• **Kick-off Workshop:** *Key ICT players from the region should be involved*, including high level representatives of the State government as well as stakeholders from the region's ICT sector (executives from big industry and key

regional SMEs with major innovative potential), together with scientists, engineers and researchers from institutes and departments with major interdisciplinary interests. With a kick-off workshop the ***strategy process becomes official*** and drives the working progress. Leading questions should be prepared for discussion during the workshop, such as the following:

- What does a meaningful framework for the ICT strategy of the special region involve?
- What political decisions must be taken?
- What should the strategy itself include? What are its main concerns and instruments?
- How can development and implementation phases be soundly supported?
- What is the significance of ICT for business / society / politics?
- What special challenges does the region face due to its socioeconomic structure and history?
- Who are the key ICT players in the region?
- If the competences do not exist in the Region: Who are the key ICT players in other regions allowing us to develop our strategy

Ideally, the output of a kick-off workshop should be a (more or less) structured list of requirements and recommendations for action.

- **Definition of a governance structure:** On the basis of existing cooperation relationships and deliberations with different stakeholders (e.g. during the kick-off workshop) a governance structure should be defined which gives a ***clear overview of the stakeholders*** along the quadruple helix that are/will be invited to participate further in the strategy process. The strategy management team (cluster management, innovation agency) has to ensure broad participation of enterprise executives especially.

6.2.4 Shared vision about the future of the region

The listed ***fields of action*** so far can be understood as preparation measures, providing the direction of the ICT strategy and its process. Based on this, the creation of a "shared vision of the future of the region" builds the heart of the working process. It is meant to lead to **specific conclusions** for the region. In this phase, Smart Specialization comes into play: the ***knowledge*** and ***results*** achieved so far

will help regional stakeholders as well as policy makers to evaluate the ***status quo*** of their region's ICT innovation potential, to gain benefit from the strengths and opportunities of their regional ICT sector and to affect the social and economic evolution of Smart Specialization with regard to ICT. It is an important milestone to transfer this knowledge into a ***common vision*** of the regional ICT performance: where will our region be in 20-30 years' time – economically and socially?

Deriving from the answer to this question, the following required actions realized in this phase are seen to be:

- ***focusing*** on existing strengths and ***expansion*** and exploitation of their potentials
- development of new forms of ***cooperation***
- the bundling and transmission of ***information*** on existing best-practices, pilot projects and interesting applications
- establishment of technological ***priorities***
- set-up of a ***strategy draft*** with goals and adequate measures.

This field of action is considered the most intensive one with regard to time exposure, organizational overhead and outputs. It is important to make use of different instruments that address different ***stakeholder groups*** (see 5.2.4. Definition of governance structure) in order to achieve a broad consensus on the strategy draft.

Based on the experiences made by the BORDWIIS+ project partners, the following topics and certain stakeholder groups can be addressed during this phase[18]

[18] Whereas each region will identify different technological, economic and social priorities, there are some fields with high demand that can develop high economic potential in all regions, e.g. E-administration, E-health and E-education. Authorities participating in the strategy development process should analyze this potential while developing a shared vision about the future of the region.

Strategic focus	Stakeholder groups addressed
Technological focus **A promising platform can be built by exploiting existing ICT competencies and focusing on industrial strengths.**	business, science & technology, public authorities
Focus on software **Software is the foundation-stone of all complex ICT systems and a central aspect of every ICT strategy. Yet here, too, priorities must be set in line with other prioritized technologies and underlying social challenges.**	science & technology, business
Entrepreneurship focus **The dynamism of an economy is reflected in its business start-up culture. High-tech start-ups are in particular demand. The quantity and quality of knowledge-based ICT innovations cannot be enhanced without clearly focused support for start-ups in the ICT sector.**	business, science & technology, society, public authorities
Focus on society – Digital Life **A democratic society must take measures to integrate people at all levels into digital life and promote the creativity that will thereby be released. Only in this way can the inherent dynamism of ICT be strengthened.**	society, public authorities

Instruments:

- **Foresight/ Normative Scenario Analysis:** Defining different scenarios concerning the future of ICT in the region draws the attention of stakeholders on casual links in future processes and on decisive points/milestones. On the basis of the normative scenario methodology, stakeholders can find out which instruments have to be applied to achieve certain objectives and thus define strategic measures. Since quantitative methods are very complex and require professional support, it is more likely that qualitative analysis based on subjective assessments with regard to selected forecasts and on experiences of different stakeholders can help to drive the development of a shared vision about the future of the region.

• **Expert Workshops:** In small groups with focus on specific topics that have been identified as relevant during e.g. the kick-off workshop, experts formulate trends, scenarios and priorities for the region. Depending on the aspect in focus, different stakeholders of the quadruple-helix are involved to discuss in detail which challenges the region has to face in the future, what trends play a decisive role and to derive fields of action and a detailed policy mix. A group of 10-15 persons should participate in each workshop.

• **ICT Smart Specialization scenario:** A specific "Smart Specialization scenario" for the region should be drawn that describes ICT priorities, a vision and aims concerning its future development. Factors that have to be considered in the scenarios are the type of the region, specific current strengths as well as future potential. Particular attention has to be paid to the aspect of "cross-innovation" – fields of application of ICT with a high growth potential. On this basis, a status quo of the region in its specific Smart Specialization process should be determined and finally recommendations defined for the next steps on the way to Smart Specialization.

6.2.5 Defining an integrated policy mix

This field of action is devoted to the refinement of the initial rough concept and detailed **concretization** of its proposals. For this purpose intensive work is necessary on behalf of the strategy management team. The results to date need to be merged integrated in a selected form of strategy presentation, e.g. a roadmap or an action plan. On the basis of existing programs and measures, their reflection and the identification of priorities and new instruments during the strategy process, an **integrated policy mix** must be elaborated that allocates strategic outlines, target groups, actors involved, etc.[19]

Instruments:

• **Action Plan/Roadmap:** An action plan or integrated roadmap transforms the results of the (linternal) strategy process into a formal strategy all stakeholders addressed can refer to. It contains the strategy aspects ***What*** (actions to be realized), ***Who*** (actors responsible for the changes), ***When*** (the time dimension) and ***How*** (measures

[19] In this regard there are important novelties at the EU level concerning RIS3: For the first time policies from different backgrounds placed under different umbrellas can and must mix, not only R&D and promotion policies, but also sectorial policies.

and resources necessary for the implementation).[20]

6.2.6 Adoption

After an intensive work process in the above-mentioned field of action, its output – the draft of the ICT innovation strategy – must be ***made transparent*** to the "broad masses". While the strategy process itself integrated representatives along the quadruple helix it is now necessary to get publicity and **disseminate the strategy.** Business, science and technology and politics should especially be informed about the outcome of the strategic process since it touches their needs, and strategy only can work successfully when a mission statement exists within a critical mass of different stakeholders from the region. It is thus an important step to ***officially announce*** the strategy in order to mark a starting point for the implementation of the ICT innovation strategy.

Instruments:

- **Final Conference/Release of Regional ICT Innovation Strategy:** Presentation of the final ICT strategy to an exclusive circle of persons, among them high-level politician(s), enterprise executives, scientists and intermediaries. The final conference is also the starting point of the implementation phase. It must correlate with public relationship measures in order to "reach the masses" (see below).

- **PR strategy:** Even though a broad participation of stakeholders could have been guaranteed during the strategy process and included enterprises are considered representatives, it is one more important challenge to make the process and its results visible to the outside world. Enterprises, scientists, politicians and intermediaries working in the field of ICT and at its interface must get the chance to inform themselves about the strategy and to be part of the Smart Specialization process. The more stakeholders are involved the more promising the ICT strategy is. Measures such as press releases, a newsletter etc. should be integrated into a sustainable PR strategy.

6.2.7 Evaluation & validation – in the loop and as a continuing process

As already mentioned in the introduction to this chapter, the order of the ***fields of action*** as suggested in this framework must not be taken as fixed. Rather, ***each region must develop its own strategic***

[20] More information and tools can be extracted from the RIS3 Guide and from OECD documents ((Foray et al. 2012), (OECD, 2011)).

order aligned to the specific circumstances on the spot, current possibilities and resources as well as to experiences made during the process.

Sometimes it seems to be more targeted to start the strategy process with a broad dialogue before carrying out in-depth analysis of the regional status quo of the ICT sector.

Thus, ***"evaluation and validation"*** is also a very important field of action. What this means is that the strategic process must continuously be reflected:

- Have the steps made so far brought the right outputs?
- Do we need another field of action to reach our goals?
- Have we involved all relevant stakeholders?

To ***ask and answer*** these questions "i***n the loop"*** (during the strategy process) is one of the most important tasks of the strategy management team. At the same time "***evaluation and validation"*** also has to be understood as the final step and long-term part of the strategy process: It is not sufficient to develop an ICT innovation strategy and to implement it – **strategy development** must be regarded as a **continuous process** during which the outlines of the strategy are challenged all the time and have to be reflected on in order to bring it into line with new trends and regional requirements.

Instruments:

- **Definition of evaluation criteria (in the loop):** Each field of action should be completed by a reflection on the efficiency of the strategy process, the measures used and the objectives of the strategy itself.
- **Monitoring (continuing process):** The management team responsible for the coordination of the strategy process should evaluate the progress after the implementation of the strategy periodically. The following criteria can serve as orientation to find out if the strategy still meets the requirements and the work done by the management team is targeted:
  - A detailed determination of the status quo according to national/ international benchmarks, continuous monitoring and current trends in a global economic context is guaranteed.
  - The strategy represents the competences of economy and science in the region.
  - The division of responsibilities between regional clusters and intermediaries is clear.

- A long-term organizational structure for intensive cooperation of the ICT players is being set up.
- Events are carried out in order to spread new technological trends
- The potential of interregional cooperation is continuously analyzed
- Cross-innovation topics projects are actively driven
- The ICT strategy is accompanied by a PR strategy

• Peer review:

Regional ICT players can get new and important insights into their ICT strategy by looking at it from other regions' perspectives. Over the course of three stages (***preparation, assessment, follow-up***) a region can accomplish an efficient self-evaluation, based on a guided review of their current strategy, which in turn helps to get into a worthwhile dialogue with ***peer regions,*** representatives of the ***European Commission*** and independent ***academic experts*** (Foray, et al., 2012, S. 25). More qualitative studies can be carried out on activity domains where a region shows relative specialization, involving regional and international experts in close cooperation with ***cluster actors*** (Foray, et al., 2012, S. 32).

6.2.8 Interregional cooperation: exploit synergies

Regional development and ***interregional cooperation*** are two main issues of the EU cohesion policy. In light of a major innovation gap between the EU and the USA, European regional authorities are encouraged not only to develop an adequate strategy but also to cooperate with other regions and to profit through an exchange of experiences and common activities. As the experience of BORDWIIS+ shows, interregional cooperation allows for many ***interesting insights*** into new **forms of cooperation** and **successful models** in other regions. An orientation on other regions also supports the reflection of a region's own ICT innovation strategy since there is more than one reference area for the chosen strategic outlines and measures. In cooperation with other regions, new approaches and instruments can improve the ***effectiveness*** of innovation strategies and regional development (European Union, 2007, S. 3). Moreover, interregional cooperation is also crucial with regard to ***Smart Specialization***: The more a region knows about the technological and economic focus of other regions concerning ICT, the better it can specify its own strategic profile and improve its competitiveness through smart cooperation with regions that are specialized in complementary

technologies or applications.

Instruments:

- **Cooperation Framework:** To further advance the international cooperation involved in cross-border ICT strategies it is advised that one of the participating project partners takes on a leading role. The moderation of upcoming events and activities, the continuous monitoring of topics, as well as the invitation to joint activities can be part of that role.

- **Information Platform:** Support for the cooperation framework can be gained by utilizing existing networking solutions (e.g. Linked-In, Basecamp,…) to establish a fast and reliable communication channel that is already part of the day-to-day activities of ICT players. In formal and informal information networks, specific interests and recent developments can be shared, as well as the need for support exchanged.

- **Flexible, need-oriented cooperation:** The potentials for cooperation presented above can only work if regional players participate in an active and flexible way, whereas regions are by no means obliged to participate.

7. Cross-Innovations: How can the potential of ICT be made useful for other strong branches?

Information and Communication Technologies have – without doubt - a great influence on all kinds of enterprises and on all branches. The smart use of ICT is a main condition for boosting the ***competitiveness*** of regional ***companies of all sectors.*** The following chapter describes the special needs of regions with no distinguished ICT branch, but where other important sectors are strong and would benefit from the right ICT Smart Specialization strategy.

7.1 Lorraine

Lorraine is not a high ICT place, but some assets deserve to be highlighted. It is necessary to continue to support ICTs and to go on the ICT sector structuring in order to give concrete, coherent and comprehensive solutions as regards future challenges. This structuring of the ICT sector requires connections/links between different SMEs and wider spread of ICT solutions in the enterprise. Upstream awareness-raising and learning increase is necessary to realize the potential of ICT development; then, afterwards, an activity structuring downstream work. ***Network*** and ***infrastructures*** figure prominently in the ICT sector in Lorraine.

However, there are many other companies, mostly SME, having real ***innovation capacities.***

The ICT sector is obviously a real challenge for competitive companies and therefore for the territory. Thus, Lorraine addresses this ICT issue in coherence with the Smart Specialization strategy (S3) with the aim to increasingly disseminate and use ICTs.

ICTs are a fundamental transversal tool for competitive companies in the specific activity areas in Lorraine. The growing use and diffusion of ICT will benefit all sectors and companies in the region. Four specific activity areas were identified, which are strongly dependent and impacted by ICT:

- **New materials for mass industry:**

  Today, Lorraine has to rely on the materials of the future. This specialization needs more research and innovation. One way is the networking between technological, research and academic centers and companies in order to facilitate their collaboration. Networks like the LOTHAIRE network are set up to be dedicated to learning and research fields. These networks are a strong basis to enhance research and collaborations.

  This specialization includes also the ***modeling, simulation*** and ***experimentation*** of the materials of the future. ICTs are an indispensable tool for high-performance computing, digital chains, processes and

materials simulation, control systems (captors' integration in production processes and equipment, on place control…). One of the most important challenge of this specialization is the ability of Lorraine to provide control and measurement methods (***integrated captors***) and hence an ICT high level skill.

• Improve production capability performance – smart factory/ advanced manufacturing: E-administration could be a solution to facilitate relationships and collaboration between enterprises from the same territory. Moreover, this specialization has to allow Lorraine to be an experimental territory for smart factories. ***Robotics, captors,*** and ***automation*** are indispensable elements for a smart factory that require ICTs' growing use to achieve a more connected, smart and productive factory. Lorraine will continue its effort for better connected enterprises and to further encourage them to integrate ICTs in their processes.

• Promote detection, extraction, exploitation, valorization and recycling of natural resources to develop clean energies and green chemistry:

ICTs' application to this specialization should be double. On one hand, ***new molecules*** development generates large volumes of data to analyze and hence simulate calculation use. To the other hand, life cycle optimization of natural resources requires ***smart processes*** (optical captors…). Target and growing ICTs should be functional to this development.

• Develop an activity chain in Heath sector:

The aim is to ***improve patients' treatment*** and reduce costs at the same time. For this purpose, Lorraine has to reduce infrastructure costs by pooling resources. ICT technologies, enabling a better interconnection between all actors and by facilitating patients' remote follow-up, are a solution for the future. The E-health regional platform set-up (SOLTIS) is a first step. E-health in Lorraine is in a structuring process. Lorraine has also opted for specific areas in health, answering to prevention and diagnostic needs induced and fostered by new technologies development. This areas involve targeted ***biomarkers*** development and clinical validation, but also new processes and products development related to therapeutic ***active principles repositioning.*** These developments generate a large data mass requiring biostatisticians, bioinformaticians and computer specialists. Lorraine has some advantages in ***robotics*** and ***high-tech***

medical imagery. Both areas require specific ICT uses including simulation, modeling calculation, etc., In order to take the lead in these areas, Lorraine has to promote a large diffusion and use of ICT.

7.2 Tuscany

ICT in Tuscany features more than 8,500 businesses[21] with over 38,000 employees. The entrepreneurial ICT consists mainly of small and micro-enterprises, with high ***dynamism*** and ***innovation capacity***, but with ***insufficient resources,*** both human and financial, to enable a growth strategy in a market where the share is gaining more weight internationally.

Another feature of the Tuscan ICT system is the fact that the few ***companies of medium to large size are mostly system integrators,*** with expertise ranging over many areas. The consequence of these two features is the absence of structured compartments that can express leadership in specific areas of the ICT landscape.

- **ICT and photonics:**

One of the main fields of cross innovation in Tuscany is ICT and photonics. The applications in this field have multiple benefits in various sectorial areas, related to the sensors (safety and security), defense, aerospace, biomedical, transportation, energy, environment, food, cultural heritage, and quality control in industrial processes. In Tuscany the main ICT and photonics applications are related to ***life sciences*** and ***healthcare***, with companies operating in the field of laser and surgical and therapeutic tools for minimally invasive diagnostics and ophthalmology and other companies that produce optical components, optoelectronic devices and sensors, for both diagnostics for medical treatment. Other important applications relate to the ***aerospace industry,*** a sector involving approximately 1,000 employees in the region, with the presence of some prime contractors at national and international levels, specialized in electro-optical instruments for earth observation and planetary exploration, and also companies active in the design, development and supply of parts and subsystems as well as for downstream services. Other fields of application are ***environment*** and ***cultural heritage.*** In Tuscany industries in these fields are represented by medium-sized businesses and some large companies. In this context, ICT and photonics applications are extremely interesting and range from the development of sensors for control, safety and environmental monitoring,

[21] businesses and ISTAT data register ASIA 2010 relating to undertakings producing goods and services in the ICT sector, in accordance with the current OECD definition

to diagnostics, and conservation and restoration of artistic, architectural and cultural goods.

• ICT and smart manufacturing:

In this case this field of cross innovation refers to the interconnections between ICT and ***automation, mechatronics*** and ***robotics.*** It is important to highlight that these three technological areas must be ***combined*** and ***integrated*** to develop technical solutions, in terms of speed, safety, and cost control and the sustainability of productive processes. Interesting fields of application are represented by all so-called ***traditional sectors***, such as fashion, furniture, marble, jewelry and paper production, those with high energy cost and that need efficiency in terms of automation and process control. ICT and smart manufacturing finds several fields of application not only in ***productive processes*** but also in the broader field of ***organizational processes.*** According to this view an important field of application is related to ***smart cities***, and with regards to that, in Tuscany the main cross innovation applications are related to water consumption reduction solutions, waste-water management solutions, culls in energy consumption, energy efficiency devices and artifacts, info-mobility and intermodal logistics, smart grids and storage.

8. What makes regional innovation systems resilient?

Over the past three decades, studies regarding regional innovation systems (RIS) have gained increasing attention on behalf of academics, practitioners and policy makers.

Lundvall, one of the first authors to promote thinking about systems of innovation, mentioned regionalization in relation to globalization and referred to regional networks but did not believe a regional perspective on innovation could be as useful as national systems, even in respect of such geographically contingent processes as tacit knowledge exchange [Lundwall, (1992)][22].

The popularity of the concept of a regional innovation system is closely related to the emergence of regionally identifiable nodes or clusters of industrial activity as well as the surge in regional innovation policies where the region is deemed as the most appropriate scale at which to sustain innovation-based learning economies [Asheim and Isaksen, (1997)].

[22] Lundvall, B., ed., National Systems of Innovation; Towards a Theory of Innovation and Interactive Learning (London, Pinter, 1992).

Definition of regional innovation system (RIS)[23]: A regional innovation system is "a set of institutions that (jointly and individually) contribute to the development and diffusion of new technologies. These institutions provide the framework within which governments form and implement policies to influence the innovation process. As such, it is a system of interconnected institutions to create, store and transfer the knowledge, skills, and artifacts which define new technologies." (Metcalfe 1995).

Currently, there is a substantial number of empirical and theoretical studies that try to highlight the key features of how to set up regional innovation systems. However, until today hardly any attention has been made on how to strengthen existing RISs or how to make them resilient. Experiences gained in the BORDWIIS+ project supported under the INTERREG IV C Programme show that BORDWIIS+ well-functioning regional innovation systems play an important role in unlocking the European research paradox[24] and the phenomenon known as the Swedish paradox[25] as well. The resilience of regional innovation systems depends on carefully selected evidence-based policies and instruments, industry-academia co-operations, adequate and well-targeted financial sources together with a culture of trust among triple- and quadruple-helix actors.

Considering innovation and the flow of knowledge an economic input according to the innovation system theory is contrary to the neoclassical approach: the success and resilience of the regional innovation systems depend on economic, social, cultural and environmental features embedded into the regional actors' behaviour and business relations. **Policies** play a major role in addressing regional inequalities and divergence. Evidence from BORDWIIS+ partner

[23] Please note that the concept of regional innovation systems have no commonly accepted definitions, but usually are understood to be a set of interacting private and public interests, formal institutions and other organizations that function according to organizational and institutional arrangements and relationships conducive to the generation, use and dissemination of knowledge [Doloreux, (2003)]

[24] The European research paradox refers to the perceived failure of European countries to translate scientific advances into marketable innovations. The term was re-introduced by the European Commission in 1995.

[25] The Swedish paradox refers to the fact that in Sweden high scientific investments and high scientific productivity of universities are not translated into innovative products and processes at the desired levels. The phenomenon has been discovered in scientific works by Edquist & McKelvey 1997; Henrekson & Rosenberg 2000; Goldfarb & Henrekson 2002; Jacobson & Rickne, 2003; Vinnova 2003.

regions show that regional innovation systems greatly rely on a horizontal set of supporting policies (e.g. North Rhein Westphalia, Asturias or Lorraine), especially those of evidence-based ones. There is also a strong focus on developing regional strategies that de facto combine sectoral policies in a regional context." (OECD, 2003, p. 6)[26]. BORDWIIS+ regions have performed regional analyses and comparative analyses and developed their Smart Specialization regional innovation strategies in a complementary manner. BORDWIIS regions, such as the Central Hungary Region and the South-East Region of Romania have started developing alternative Smart Specialization strategies through harmonizing national level priorities with EU priorities when launching calls. Moreover, BORDWIIS+ regions have found that many regions face over-complicated and over-strict national procedures and frequent changes therein; insufficient involvement at the regional and local level in the establishment of the operational programmes; insufficient resources to co-finance projects; politically motivated changes in investment priorities; and last but not least disproportion between the degree of control and the scale of the projects.

The **quality and quantity of cooperations** among regional actors, mainly structured in a triple-helix or quadruple-helix manner, enables participants to share and create local explicit and tacit knowledge. The suboptimal research collaboration and knowledge / technology-transfer between public research organisations (PROs), particularly universities, and industry [European Commission, (2005, 2007)][27] is one of the main bottlenecks of the European regional innovation systems. University-industry co-operations should be strengthened by technology transfer offices (e.g. the Tartu University operates a technology transfer office that has helped numerous spin-off and start-up companies to succeed).

"Changes can happen only if research institutions, notably universities, are given autonomy to position themselves, cooperate and compete at European and international levels, and better link their research activities to the needs of industry and society" [European Commission, (2007)][28].

[26] OECD (2003) „Regional Competitiveness Policie." Paris, France: OECD Publications, pp. 6.

[27] Commission Communication 'More Research and Innovation – A Common Approach', COM(2005) 488; Commission Green Paper 'The European Research Area: New Perspectives', COM(2007) 161 final.

[28] European Commission - Joint Research Centre, Institute for Prospective Technological Studies study by Joaquín M. Azagra-Caro, Gérard Carat, Dimitrios Pontikakis: University-industry cooperation in the Research Framework Programme, 2009

Financial capacity, especially in the form of competitive funds and regional funds, help enterprises to innovate and grow. Absorption capacity of regional actors in the EU is relative low compared to the US. Innovation funding is a controversial and often-cited approach in all countries around the world. The debate is mainly centred around Williamson's article (1988)[29], which concludes, inter alia, that innovation is principally funded by firms' own financing. Authors and experts agree that innovation has a clear economic impact on the whole community. BORDWIIS+ partner regions agree that the efficient use of regional financial sources can help boost innovation-based partnerships (e.g. a similar long-lasting partnership has been launched between the University of Lund (SE) and Tartu Science Park (EE) aiming at fostering the exchange of knowledge and resources in a cross-border manner between the named countries).

Some research is both very expensive and needs to be done on a very large scale to provide meaningful results [European Commission,(2010)][30]. The role of collaborative innovation funding is valorized. According to recent statistics 1 € of public funding leads to an increase in industry added value between 7 € and 14 €. Regarding HORIZON 2020, greater added value is foreseen. Adding profit margins set up by private companies investing in marketable research makes collaborative projects more profitable and viable. Motivated by the above, BORDWIIS+ partner regions are now working on a memorandum of understanding that paves the way for more comprehensive inter-regional cooperation for the coming 7 years.

In the context of social network theory, clustering can be understood as increasing the number and/or size of nodes in a certain space or sector, whereas networking means linking the nodes.

The new understanding of innovation (marketing innovation, service innovation, process innovation, organizational innovation).

[29] Williamson, O.,E. (1988): Corporate Finance and Corporate Governance, Journal of Finance, Vol. 43. pp. 567-91.

[30] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Europe 2020 Flagship Initiative Innovation Union, COM(2010) 546 final, Brussels

European Commission - Europe 2020 flagship initiative – Innovation Union, 2010, Brussels

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In sum, RIS has two key features: firms in the regional core cluster, institutional infrastructure clusters and RIS are indeed closely related; clustered firms enjoy advantages in terms of innovation performance through processes of localized learning clusters and RIS may co-exist in the same territory and the regional innovation system may in fact contain several clusters. The presence of the industrial cluster is seem as a key attribute in RIS cluster-based policies and can be beneficial to economic development.

Key preconditions for developing resilient RIS:

The presence of a leader who has a clear vision for RIS: the foremost thing in building a successful RIS lies in the leadership of an innovative agent who will become the leader of RIS

- Continuous support for the expansion of the network in the long term to build successful RIS, the networks of which have been initiated at an early stage, have to be self-reproductive only when the infrastructure for the expansion of these networks was fully supported, the networks will be active, as a result the RIS could succeed
- A proactive commitment based on trust: if the innovative agent who participates in the RIS does not act on the basis of reciprocal principle and trust, it is rarely possible for him to induce proactive commitment
- Interactive learning through the sharing of relational knowledge: in order to facilitate interactive learning, the relational knowledge in the RIS has to be shared among the participants from complementary perspectives of each other
- The circulation of success and social approval of failure to build up the RIS successfully: it is necessary to build a virtuous circle of a successful social climate that right and fair failure would be approved by abusiness society, which could foster entrepreneurship [Joung Hae Seo, (2006)][31]

[31] Joung Hae Seo: Regional Innovation System and Industrial Cluster: Its Concept, Policy Issues and Implementation Strategies, National Workshop on "Sub-national Innovation Systems and Technology Building Policies to Enhance Competitive of SMEs" 27-30 October, 2006, Beijing, China, slideshow

9. Special preconditions: Experiences from a small and economically weaker region

9.1 Asturias: Benefits of Regional Cooperation for a small region

Asturias has a long and successful experience collaborating with other regions in the framework of European associations or consortiums and the regions wants to continue with it. They have learnt a lot about innovation policy thanks to projects financed by Interreg Programmes, and ERA-NETs have been very useful, offering companies the platform to participate in international research and technology projects.

Thanks to the Smart Specialization process, for the first time Asturias has a map of competencies and capacities linked to priorities now. It consists of a single picture for technology and industry with the interaction of different sectorial policies.

As a result, from now on the region will focus on European cooperation in their portfolio of excellent knowledge or in internationally oriented technological markets. This approach offers new opportunities for regional cooperation. Being a small and peripheral region, some bilateral European regional cooperation was, until now, very difficult to achieve. During this new period the region thinks not only about the topics for cooperation but also about the best instruments. Bilateral cooperation suits very well with some specific tools - for example those oriented to mobility of human resources or public-private initiatives. In any case peer reviews might be a good starting point.

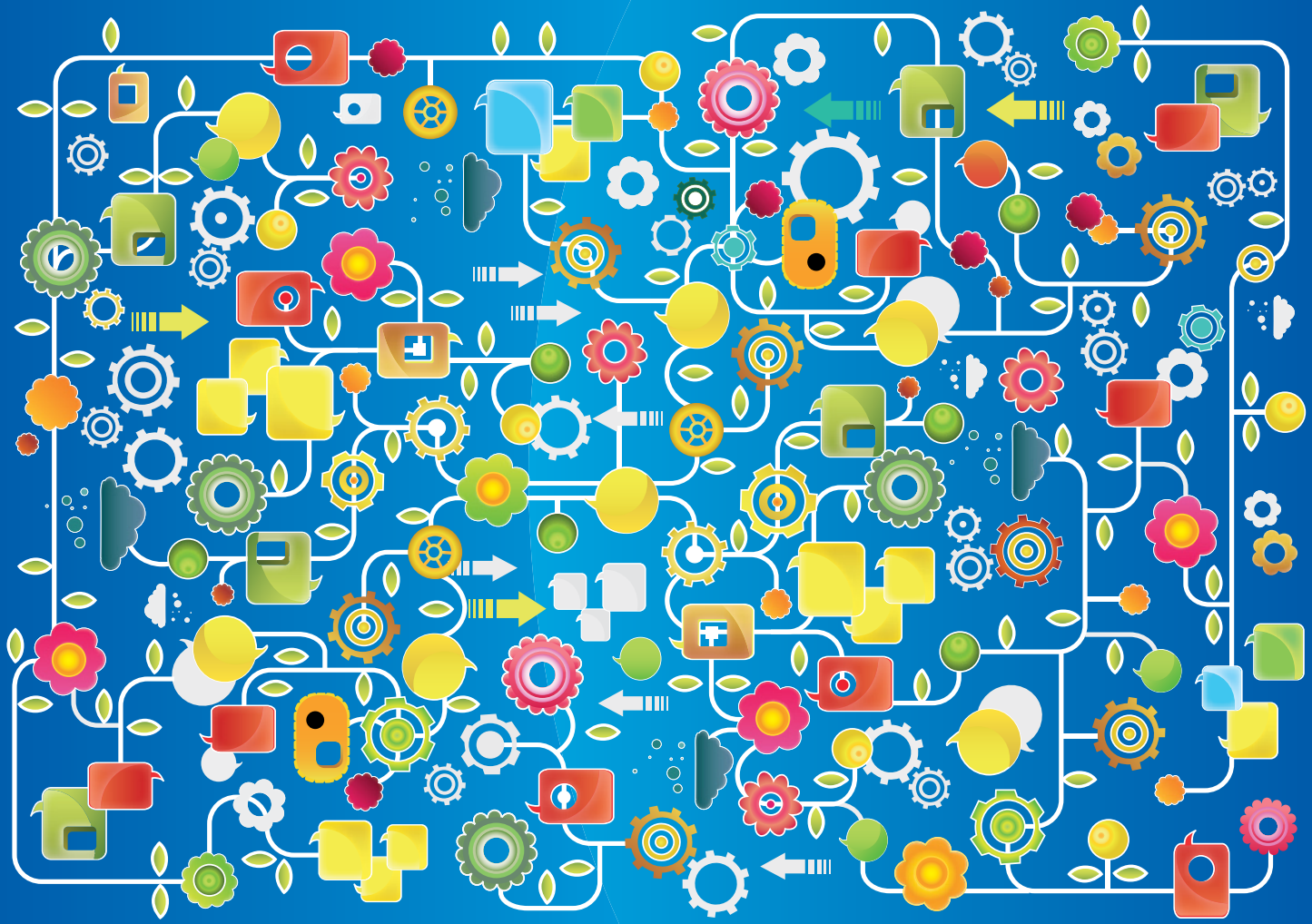
More recently Asturias has joined the "Vanguard Initiative 'New growth by Smart Specialization' Engagement for the renaissance of industry in Europe" that will help to find common points with regions who also have a long industrial tradition.

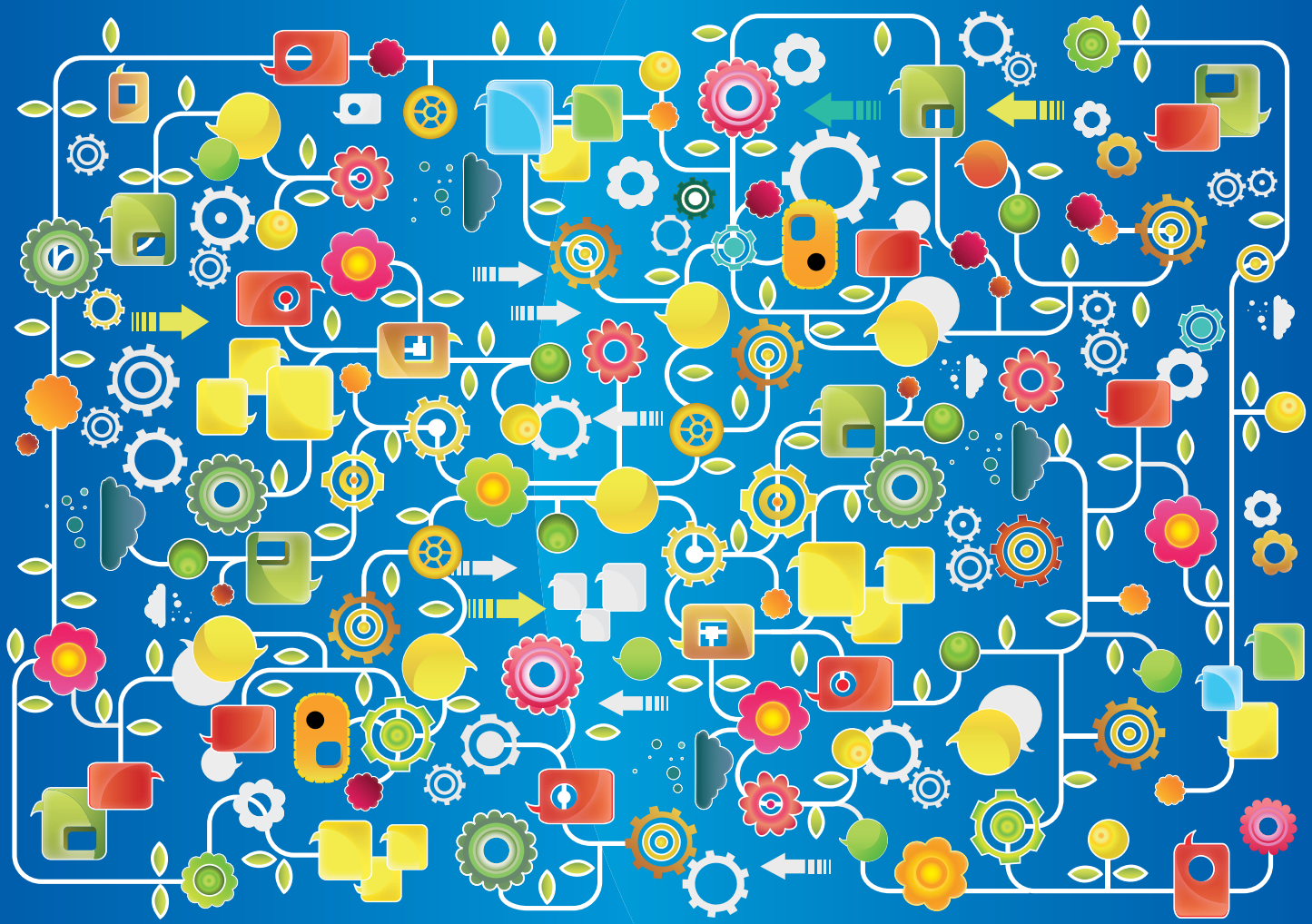
9.2 South-East Region of Romania – example for the benefits of interregional cooperation for an economically weaker region

For the South-East Region of Romania, a Smart Specialization strategy is the best way to exploit territorial potential through innovation for growth based on key opportunities and challenges and a strong public-private and academia partnership. The current specialization profile of the region is based on the competencies in software development and ICT service. In cooperation with potential cross-innovation areas like agriculture, tourism, ship-building and

logistics, future specialized solutions are possible, for example in ICT for advanced mobility solutions with a specialization on tourism, ship building and services for agriculture. The South-East Region of Romania can be characterized as a medium-tech manufacturing and service provider region. Some of the potential areas for Smart Specialization in the region are ICT (software), agro-food (wine production, bio-food), tourism, textile manufacturing (clothing design), energy efficiency and renewables, and sustainable construction / urban regeneration. Existing ICT capabilities can be used to advance the service sector and established industries. Opportunities can be found in connecting services providers, in tourism or agricultural sectors, in particular. As regards the potential for interregional cooperation, the South-East Region of Romania can benefit from collaboration in projects linking "old" and "new" member states' regions and deepening the exchange of experience between the regions with respect to current challenges and future instruments. The most interesting fields for cooperation are the development of smart mobility solutions, e-government and innovative public procurement and e-learning. In terms of interregional cooperation, the INTERREG EUROPE programme (successor of the INTERREG IV C programme) develops tools and services to support regional/national players in the design and implementation of structural funds programs. Some tools and services could be useful such as organization of thematic peer reviews and thematic events to meet and exchange with European counterparts.

The future interregional cooperation can contribute to the improvement of the implementation of the structural funds programme(s) in the South-East Region. Cooperation projects involving and stimulating a partnership of European regions exchanging the experience on a defined field of regional development and mainstreaming projects allowing interested partners to work together on a shared regional policy issue in the field of innovation are an important tool for the further development of the region.





10. Conclusion

The present report "ICT Innovations Strategy for European Regions: Recommendations for Regional Specialization" is a systematic comprehension of the know-how representative of eight European regions have gained in their own way to Smart Specialization in the field of ICT in the project BORDWIIS+ over the last 2.5 years.

The goal was to develop a document which can be used by regions which differ with respect to size, economic strength, competencies and capabilities. Regional authorities are not bound to a certain order and certain activities; they can use the recommended instruments and measures as components for their tailor-made ICT strategy. Moreover, the "Recommendations" not only take into account the regional dimension, but also give advice for the interregional collaboration in the field of ICT and strategy development. It is the first guideline in the context of Horizon 2020 and the Digital Agenda for Europe that brings systematically together ICT strategy development and Smart Specialization.

The results of the BORDWIIS+ project in the form of the Common Roadmap Framework fit seamlessly with the current strategy activities that take place on the EU level: In April 2013, a workshop on priority setting and collaboration in information and communication technologies has been organized by the Smart Specialization Platform in Seville. During the workshop representatives from different regions have addressed many aspects of ICT strategy development reflected by the results of the BORDWIIS+ project. The workshop is the beginning of an intensive peer review dialogue between European regions on ICT.

Meanwhile these activities have been expanded: currently, the Smart Specialization Platform of the Joint Research Centre, DG CNECT and DG REGIO are developing a Digital Agenda Toolbox. It shall help political authorities to understand the potential of digital growth and encourage them to make it a key element in their RIS3. While the report "ICT Innovation Strategy for European Regions: Recommendations for Regional Specialization" can serve regions to develop an ICT strategy following the Smart Specialization approach, the toolbox will – in a next step – enable policy-makers to integrate this strategy into the overall national or regional research and innovation strategy for Smart Specialization (RIS3).

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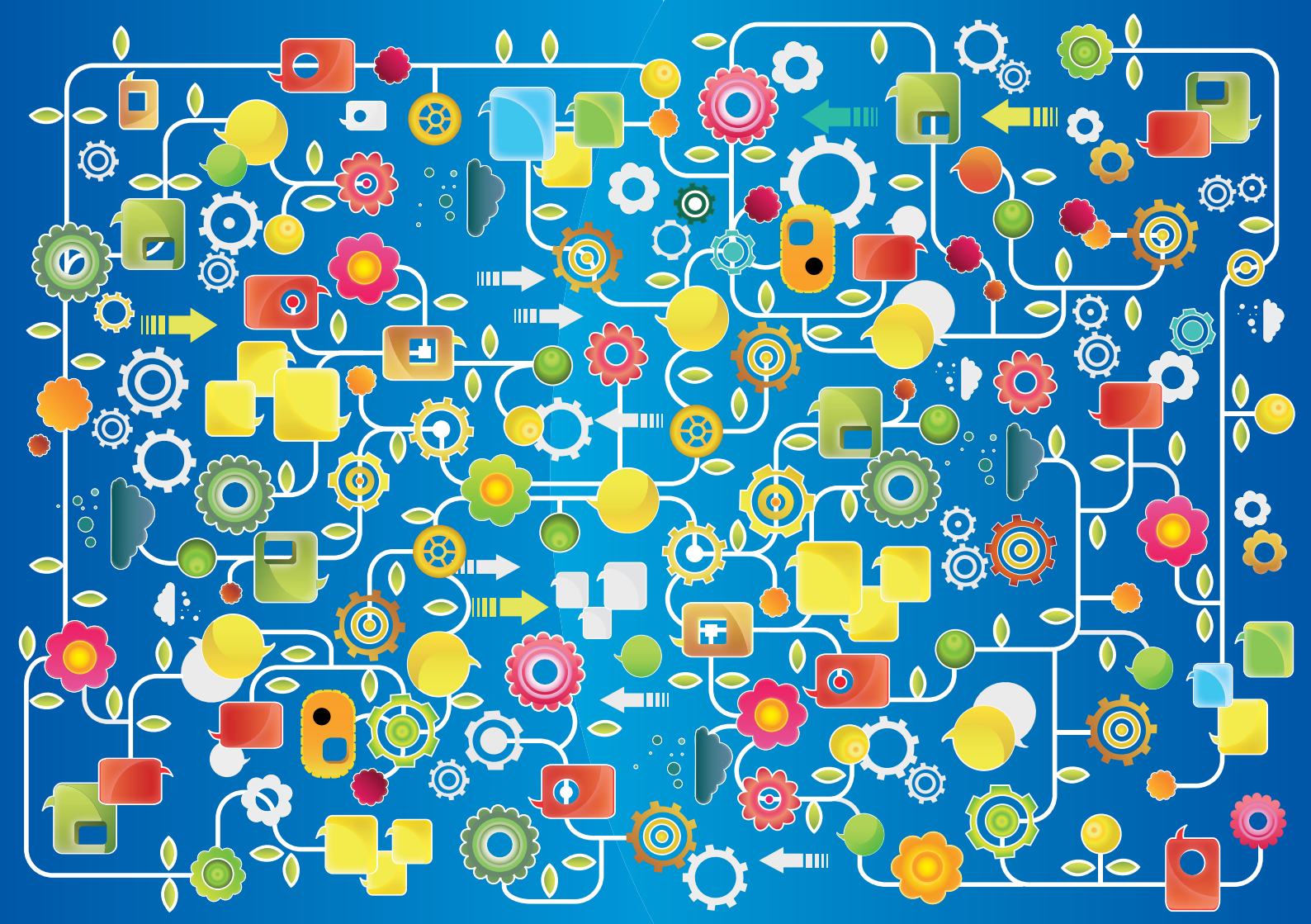


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