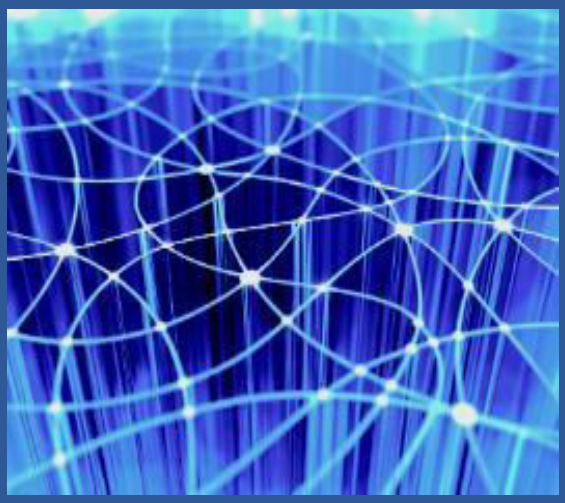
WORKING PAPER



Health Innovation Enablers

Foundations for sustainable investment in modest and moderate innovator regions

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DANUBALT

Novel Approaches in Tackling the Health Innovation and Research Divide in the Danube and Baltic Sea Region

Foreword

Scientific, technological and innovation performance, notably in health, is influenced by diverse factors, as is well known and documented in the literature. The latter emerge at varied intensity, degrees and dimensions in the different regions of the EU. Whilst extensive studies explore these factors or a combination thereof, the literature reviewed remains somewhat patchy and failed to provide a holistic scrutiny of pertinent indicators that impact on health innovation and research potential in the different EU regions. This state of affairs can unduly influence policy design, which in turn might lead to suboptimal measures to attenuate the innovation divide and thwart transnational collaboration.

The objective of this study is to review what has been done so far and to define a set of proven factors that both support carrying out sound analysis while also backing informed policy design.

This Working Paper is partly but not exclusively dedicated to policy makers, program managers as well as public authorities and institutions interested in understanding the innovation divide and collaborative research gap. A special focus has been put upon the two macro regions, namely the Danube and Baltic Sea.

This review has been realised thanks to the financial support of DG Research and Innovation, Health Directorate. Without the engagement of the consortium team, it would have been not possible to have a large outreach beyond the partners regions.

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Executive summary

DanuBalt has been funded to analyse the mechanisms hindering the efficient exploitation of EU and regional instruments in the Baltic Sea and Danube macro regions as well as provide remedies that can help improve investment in regional health systems by efficiently using Structural Funds in combination with Horizon 2020. Currently, the divide in research and innovation potential has regressed to 2009 performance levels with specific differences in scientific excellence, internationalisation and business innovation cooperation.

The mechanisms that are central to unlocking better use of EU and regional instruments are health innovation 'enablers'. However a weakness with current performance indexes (including the Innovation Union Scoreboard and Regional Innovation Scoreboard is that regional data on enablers is limited as is the scope of enablers that facilitate performance in modest and moderate innovator regions.

The systematic literature review that informs this Working Paper is a first step in building a consensus framework for health innovation enablers that regions in the Baltic Sea and Danube macro-regions believe are essential to improving their performance in a way that balances regional needs with national and EU funding priorities.

Key messages

- Challenges - The potential of health innovation in modest and moderate innovator regions needs attention to several issues that are compared to systematic, fragmentation and integration problems (as identified by the recent High-Level Group Blueprint 2014 and other sources) including: imbalance between research and innovation; size, fragmentation and direction of EU funds; the academic waltz; decisions without thinking of consequences, human capital, the 3% GDP R&D target; broken innovation value chains; the "one-size-fits-all" approach; SME engagement and industry logic to take part or not; continued silo planning instead of integrated strategic planning
- Innovation enablers - 17 individual health innovation enablers were identified from 39 papers/reports that met selection criteria specific to innovation enablers. These enablers operating at the three levels: ecosystem (recruiting and retaining a skilled workforce, education and training, competitive income policies, favourable regulations, social infrastructure and services); intermediary (efficient and effective value chain, start-up and incubation services, technical business support, support in accessing EU Funds, IP protection services, innovative public procurement, living labs, open innovation networks); and organisational (social capital, absorptive capacity, organisational capabilities, technology development)
- Enablers and macro-region solutions - The T-Spectrum developed by the Harvard Catalyst initiative a tested pathway that can help stakeholders in modest and moderate innovator regions locate and develop realistic and sustainable health innovation activity if used in a way that avoids the unrealistic "catch-up" logic that drives several performance indexes. It also provides a framework for understanding where enablers can best be located to contribute to driving cost effective, locally relevant innovation systems with comparable evaluation of core enablers while also accounting for optional local enablers. Finally, it provides a way of mapping how capacity and capability in modest and moderate regions can be a basis for collaboration with follower and leader regions to provide additional innovation capacity to the latter regions while providing opportunities to strengthen capacity and capability in the former regions
- Next steps - As part of the process for developing a consensus framework of enablers with partners and stakeholders: descriptions of each enabler will need to be refined; enablers need to be categorised as core or optional by representatives from participating modest and moderate innovator regions; specific questions/variables need to be added under each enabler that help measure performance. These should focus on inputs, processes, outputs as well as outcomes.

1 Starting points…

Innovation is a priority embedded in Europe 2020 and Cohesion Policy 2014-2020 with two major instruments providing a means to address the divide in research and innovation potential between member states: European Structural and Investment Funds (ESIF) and Horizon 2020. Smart Specialisation Strategies (S3) and EISIF Partnership Agreements (implemented through thematic national Operational Programmes and place-based intersectoral Regional Operational Programmes) provide national and sub-national investment priorities.

Both Structural Funds and the Research Framework are intended to help member states and regions achieve the EU2020 goals of smart, sustainable and inclusive growth. In this context, health research and innovation are not silo priorities. Investing in and benefiting from health research and innovation has economic, social and environmental dimensions.

As important, there is no "one-size-fits-all" approach for addressing the divide in current research and innovation potential. Each region has its own capacity, capability and resources that influence how EU funds can be accessed and used. However, a common challenge for generating, adopting and diffusion of health innovation across the care cycle is the need to provide healthcare systems that are accessible, affordable and more sustainable[1, 2, 3]. A related challenge is how to achieve synergies between H2020 and Structural Funds thereby maximising the cost effectiveness of both instruments.

Currently, the divide in research and innovation potential has regressed to 2009 performance levels with specific differences in scientific excellence, internationalisation and business innovation cooperation[4].

In this context, DanuBalt has been funded to analyse the mechanisms hindering the efficient exploitation of EU and regional instruments in the Baltic Sea and Danube macro regions as well as provide remedies that can help improve investment in regional health systems by efficiently using Structural Funds in combination with Horizon 2020.

1.1 The focus on health innovation enablers

The mechanisms that are central to unlocking better use of EU and regional instruments are health innovation 'enablers'. For the Innovation Union Scoreboard (IUS) and Regional Innovation Scoreboard (RIS), enablers

[1] EU Council Conclusions (2011) *Towards modern, responsive and sustainable health systems*. 6 June. Access at:
[2] EU Council Conclusions (2013) *Reflection process on modern, responsive and sustainable health systems*, 10 December. Access at: https://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/lsa/122395.pdf
http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/lsa/140004.pdf
[3] Christensen C M (2011) A disruptive solution for health care. Harvard Business Review. Access at: https://hbr.org/2011/03/a-disruptive-solution-for-health
[4] DG Enterprise and Industry (2014) *Innovation Union Scoreboard 2014,* October, Brussels: Belgium (page 6)

capture the main drivers of innovation performance external to companies[5]. However, the IUS/RIS is limited in reflecting the actual scope of enablers that facilitate performance at different levels within and external to regional innovation systems. Relatedly, current evidence about health innovation enablers is patchy and sometimes contradictory. So, the review drew on health specific and relevant evidence from other sectors. In sum, this paper and subsequent tasks focus on enablers because:

- The Innovation Union ScoreBoard (IUS 2014[6]; RIS 2014[7]) and other initiatives/projects do not use a common set of enablers.
- The indicators used by IUS rely on available national level data but do not have comparable regional level data.
- Whilst some indicators are broad and can include a wide variety of innovations, most are narrower and targeted towards measuring analytical knowledge, the STI mode of innovation and narrowly defined RIS[8].
- An additional issue is that the data available at national level might limit the relevance of enablers used by IUS and the Regional Innovation ScoreBoard.

1.2 How the paper is organised

The paper seeks to get straight to the point about what enablers exist, how and where they operate, what variables are used to measure them and practical mapping of how they can applied in modest and moderate innovator regions:

2. Challenges in reducing the innovation divide
3. Identifying enablers
4. Enablers contributing to Macro-Region solutions.
5. Measuring enablers

The evidence for this paper comes from a systematic literature review (see Annex A for search strategy and selection criteria) and is a first step in building a consensus framework for health innovation enablers that regions in the Baltic Sea and Danube macro-regions believe are essential to improving their performance in a way that balances regional needs with national and EU funding priorities. Subsequent steps will include: an online survey, follow-up interviews and an expert panel review of the draft consensus framework.

The specific audiences that this paper seeks to engage are stakeholders working in or influencing regional innovation systems in the Baltic Sea and Danube macro-regions currently rated as modest (n=28) or moderate

[5] Ibid: page 8
[6] Ibid.
[7] DG Enterprise and Industry (2014) Regional Innovation Scoreboard 2014. October, Brussels: Belgium
[8] Trippl M, Asheim B and Miörner J (2014), Identification of regions with less developed research and innovation systems, Working Paper for FP7 Project 'Smart specialisation for regional innovation' (p.15), at: https://ideas.repec.org/p/hhs/lucirc/2015_001.html

(n=22) innovator regions. These numbers include Latvia (modest innovator) and Lithuania (moderate innovator) that cannot be categorised as regions using NUTs. Estonia is currently rated as a Follower.

2 Challenges in reducing the health innovation divide

Health innovation does not happen in isolation from its geographical location and the human capital, resources and infrastructure that locations provide. Currently, there are nearly 300 NUTS II regions and 91,000 municipalities in the EU28[9]. They have major powers in key sectors (education, environment, transport, economic growth, housing, social care, urban renewal and sometimes healthcare). But they are largely unable to address the current infrastructure gap. Public investment in the EU declined by 20% - and 60% in some countries - between 2008-2013[10]. The only current alternative for some of the EU13 will be to rely on European Structural and Investment Funds (ESIF) for more than 50% of public infrastructure funding. In Slovakia, Hungary and Bulgaria, ESIF will be responsible for 90% of public infrastructure projects. This is because local government revenues have declined in real terms in many European countries that provided data for 2009-2010, for example, by 19.7% in Bulgaria, 13.1% in Germany and 11.3% in Ireland[11].

In the context of this infrastructure gap and fragile local economies, the potential of health innovation in modest and moderate innovator regions needs attention to several issues that are compared to systematic, fragmentation and integration problems identified in a new High-Level Group report on European Innovation Ecosystems[12]:

Challenges identified by HLG Secretariat (2014) ***Inspiring and completing European innovation systems*** (selected statements)	Challenges identified by **Other sources**
Imbalance between research and innovation - Too much funding goes to traditional sectors instead of research and development in new and emerging sectors. It is too research oriented and does not sufficiently focus on the entire innovation value chain, from research to market, increasing the risk that research funded with public money never reaches the market because of multiple, but mainly regulatory, obstacles, or that it is even commercialised elsewhere	**Direction of EU funds** - Regions with innovation systems categorised as modest or moderate do not have much opportunity to lead H2020 project applications and have limited capacity to absorb and apply ESIF funds. Regarding H2020, the system appears to currently favour the funding of projects with coordinators from EU15 countries able to show internationally recognised expertise and leadership.
Size of EU research budget - Despite its increase, the EU's research budget itself is too small compared to public funding of research in competing economies such as the USA, Japan, China, or compared to the aggregate public	**The academic waltz** - Experience with the TRANS2CARE cross border project (Italy and Slovenia)[13] identified a problem with a majority of funded research projects and initial project ideas… they

[9] ManagEnergy (2015), Mobilising capital for sustainable local energy. Accessed on 10 July 2015 at: http://www.managenergy.net/article/123#.VbXCB3gTHFI

[10] DG Regional Policy (2014). From subsidy to strategic investment: what can the EU's new, reformed Regional Policy do for growth and jobs in 2014-2020? Speaking notes for Commissioner Johannes Hahn, 28 May

[11] Davey K (Ed.) (2012) *Local government in critical times: Policies for Crisis, Recovery and a Sustainable Future*, Council of Europe texts 2011, Strasbourg, February 2012.

[12] HLG Secretariat (2014) *Inspiring and Completing European Innovation Systems: Blueprint,* EPPA SA: Brussels, August (pages 18-19)

[13] http://www.trans2care.eu

funding of research in the Member States. Countries and companies all too rarely reach the 3 percent target	focus on work that reflects Technology Readiness Levels 1-3. This is the comfort zone for universities and reflects academic priorities. The TRANS2CARE Coordinator labels this as The Academic Waltz (1-2-3, 1-2-3…).
Decisions without considering consequences - National governments still operate too much in isolation from each other and from the EU research programming, sometimes ignoring global industry value chains, though Horizon 2020 goes in the right direction. Occasionally they also seem to decide on policies without taking into account the effects on neighbouring economies, with a risk of weakening the Single Market or the Monetary Union.	**Human capital** - Investing in and retaining human capital in modest regions has a higher impact on regional production than infrastructure investment. Human capital is a necessary pre-condition for growth in these regions (as confirmed by the TRANS2CARE project and the ESPON KIT report) [14]. A widening gap is found in the challenge of the brain drain from east to west as clearly demonstrated recently in the Baltic Sea and Danube macro-regions[15].
Fragmented EU budget - The EU budget is fragmented over many sectors, projects and countries, which seem more politically driven than opting for a careful selection of two or three priorities based on truly common interests.	**The 3% GDP R&D target** - The 3% of GDP in R&D target applied in previous SF periods under the Lisbon Agenda had a high impact in very few EU regions. The ESPON KIT report (2013) argues that for R&D to have a substantial impact on GDP a critical mass of R&D and human capital must be present in a region and this is not the case for most modest and moderate innovator regions[16]
A broken innovation value chain - Due to a lack of systemic approach, there continues to be fragmentation between the regulatory work and research investments, leading to potentially damaging obstacles to access in markets. In particular for new technologies, the parallel design of new regulatory concepts and trajectories seems to be missing. This breaks up the innovation value chain, reducing the efficacy of the research investments.	**Limitation of a 'one-size-fits-all' approach** - Formal knowledge (R&D and patents) generates innovation only in those areas that register a critical mass of this type of knowledge. This shows that a "one-size fits all" strategy is not an efficient policy or performance assessment choice[17]
Industry logic for/against participation - Despite improvements in the Horizon 2020 approach, red tape and blocking IPR protection have maintained doubts from leading innovative companies about participating, while for some SMEs participation in EU funded programmes may have become their *raison d'être*. On-going simplification of the programmes needs to be pushed further, in order to avoid waste of resources or obstacles for start-up entrepreneurs, precisely the group, which should be supported.	**SME engagement** - Many SMEs still do not profit from the FP as a source of funding because it is far from market; as a consequence, the expected positive effects of their involvement on growth and innovation did not fully materialise, even if efforts have been made to increase their participation to 15% as a target[18]. There needs to be better engagement between universities, industry and the public health care sector to stimulate TRL4-5 and then TRL6-9 projects[19].
Silo planning instead of strategic planning - Fragmentation is increased within the Commission, between DGs and their individual research planning, sometimes top down and with little relevance to innovation in markets and the weakness of overall steering and coordination, leading to insufficient cross-fertilisation and overarching priorities. Too much planning instead of	

[14] De la Fuente A, Doménech R and Jimeno JF (2003). Human capital as a factor of growth and employment at the regional level: the case of Spain. Final Report. ec.europa.eu/social/BlobServlet?docId=1945&langId=en

[15] See: http://scanbalt.org/press/news+archive/view?id=3099 The European regions most affected by the brain drain phenomenon are: the South (Greece, Spain - especially Catalonia, and Portugal), and Eastern Europe (Romania and Bulgaria – where low wages in education, research and medicine caused a professional staff exodus to Western countries). For example, in Romania and Hungary the healthcare system is visibly affected by the migration of doctors and nurses, which has led to a shortage of specialized medical staff- source: http://one-europe.info/brain-drain-eu

[16] Ibid (p.41)

[17] Capello R and Lenzi C (2013) Territorial patterns of innovation and economic growth in European regions, Growth and Change, *Growth and Change 44(2): 195-227*

[18] Steinbeis Europa Zentrum (2014) DanuBalt: Novel Approaches in Tackling the Health Innovation and Research Divide in the Danube and Baltic Sea Region. Final proposal HCO-14-2014, Submitted 15 April: p3

[19] Ibid (p.3)

experimentation and trials in the real world lead to unaffordable delays.	
Weak bottom-up approach - The involvement of companies seems weak in many programmes which means that there is an insufficient bottom-up, market driven approach and occasionally even waste on politically fancy projects driven by lobbies without accountability for economic growth and employment	**Obstacles to smaller groups** - Several bureaucratic obstacles hamper the effectiveness and efficiency of the initiatives (e.g. different funding schemes, overheads, time to grant, inflexibility in budget allowing new concepts, public procurement rules, and allocation of larger budgets for larger groups does not allow smaller groups to achieve targeted solutions etc.)[20].

Table 1: Challenges to health innovation in the Baltic Sea and Danube macro-regions

Whereas the first 4 issues in Table 1 (Column 2) generally have an equal effect on all the regions, this divide heavily hits Central and Eastern Europe. Notably it affects the use of Structural Funds (SF) for research and innovation. Some countries, including Romania and Bulgaria spent less than 35% of the Structural Fund (SF) allocation for RDI during the 2007-2013 period, while other regions had difficulties in committing to spend SF at all. The causes of difficulties in taking up EU funding include shortage of resources to co-finance projects, lack of long-term strategic vision from central and local authorities, low administrative capacity to manage funds, weak inter institutional cooperation and underdeveloped public-private partnerships. For regions in Bulgaria, Hungary, Poland and Romania this is a lingering problem.

2.1 Seeking synergies between ESIF, H2020 and S3

A problem for regions in some EU member states is that regional authorities who previously acted as Managing Authorities for ESIF Regional Operational Programmes have been re-designated as intermediary bodies while responsibility for research and innovation remains at national level. For example, in Spain the Ministry of Finance will be the only ERDF ESIF managing authority in Spain for 2014-2020. This raises questions about how regions ensure that ESIF priorities are aligned with Horizon 2020 and their smart specialisation strategies (S3). The need for synergy between ESIF and S3 faces particular challenges:

- S3 strategies need to focus on a limited number of technology sectors. This has the effect of locking what can and cannot be funded using ESIF. As Member States and regions have discovered this they are trying to extend the scope of their S3
- Although S3 action plans are required by 2016, in some MS with RI Operational Programmes, it is argued that the Operational Programme is the Action Plan although S3 Action Plans are more detailed
- However, H2020 started sooner than ESIF and some ESIF Operational Programmes were not signed off until mid 2015.

Regarding the allocation of ERDF ESIF funds:

- 80% is allocated to Cohesion Policy Thematic Objectives 1-4, 16% to low carbon economy

[20] Ibid (p.3)

- For more developed regions, ESIF investment in RI will focus on business investment in RI
- In less developed regions (modest and moderate innovator regions) the focus should be on RI infrastructure and capacity building.

It is accepted that current knowledge about how to deliver practical synergies is limited although the Stairway to Excellence project (S2E) has recently launched. It has been specifically set up to (i) support EU13 countries (that entered the EU after 2004) and regions in developing and exploiting synergies between ESIF, Horizon 2020 and other EU instruments as a means of closing the innovation gap[21] (ii) support implementation of S3s in the EU13[22]. DanuBalt should consider connecting with S2E to share its own learning as the project progresses and to raise awareness about S2E and the material it is gathering that can guide EU13 regions in the Baltic sea and Danube Macro-Regions.

S2E Launch Conference: Participant consensus on key synergies enhancing elements[23]

- *An initial strong political commitment is needed at national and regional levels, as well as a strategic orientation, when using ESIF in projects and programmes of significant scale and scope.* The S3 is considered a good framework to guide this process and to select a number of limited priorities, which would help the process to be more strategic.
- *Bringing together academia, research institutes, business and regional authorities.* This is a key element towards a common strategic approach to invest in areas where combining Horizon 2020 and ESIF could lead to a greater impact on competitiveness, growth and jobs.
- *Improving the communication between all SF beneficiaries but especially between the research communities and managing authorities of Structural Funds.* The research community needs to better understand how to apply the European Structural and Investment Funds (ESIF) and better understand the regional priorities, while regional authorities should be able to comprehend and identify excellence and potential projects to be combined.
- *In many cases, inefficient coordination between regions and national governments is impeding the ability to reach effectively all the potential participants.* Different areas of government and different sectors can have different organisational cultures. Coordination of funding agencies and end-beneficiaries are natural ways to overcome the cultural differences among stakeholders. ESIF could be used to reinforce cooperation, communication and coordination between these groups of actors.
- *ESIF should aim at building strategic infrastructures as well as attracting the top researchers.* Leveraging structural funds to build infrastructures will in turn leverage the participation in large-scale European funded projects[24]
- *ESIF could help to improve the regional/national innovation system* by building the capacity of SMEs to innovate successfully, incentives to connect academia and industry to create growth and to facilitate networking between innovation actors.
- *Coordination of public support and the provision of tailored information are essential.* Streamlined information on

[21] http://s3platform.jrc.ec.europa.eu/stairway-to-excellence

[22] http://s3platform.jrc.ec.europa.eu/stairway-to-excellence

[23] Perez SE, Conte A and Harrap N (2014), Synergies between EU R&I Funding Programmes. Policy Suggestions from the Launching Event of the Stairway to Excellence Project, JRC Technical Report, S3 Policy Brief Series No. 12/2014: pages 17-18

[24] Note, this is already underway e.g. the CORBEL (INFRADEV-4-2014) and ELIXIR-EXCELERATE (INFRADEV-3-2015) projects

different funding schemes should be provided to potential beneficiaries

- *As part of the building capacity strategy, a combination of measures should be taken with a short, medium and long term perspective*: (a) specialised training to have qualified professionals in project offices in universities, evaluating agencies and managing authorities. (b) Direct support to stakeholders (business, universities, research groups, innovation agencies, etc.) to provide a way to improve participation, and (c) creation of structures with a long-term view, such as creating international projects offices).
- Ultimately, creating synergies through parallel or consecutive projects requires a long-term consistent vision/approach and support to all projects along the whole value chain.

3 Identifying health innovation enablers

3.1 Where and how enablers operate

Ecosystem - *The concept of the innovation ecosystem perceives innovation as the result of the 'right' interaction among actors in order to turn an idea into a solution or bring a product or service onto the market…Building on...[enablers and enhancers], the ecosystems will promote creative and bold thinking, free from bureaucratic constraints and a one-sided focus on regulation, able to achieve innovative solutions and capable of addressing new challenges as well as developing alignment with stakeholders* (HLG 2014: p20). Enabling actions include: reform the regulatory and legislative environment; align financial rules and incentives with human capital goals; modernise education and training (Dzau et al 2012: 14)

Intermediary - The intermediary level are those processes operating as connectors between innovation policy and implementation including financial portals, specialist legal support and regulatory bodies. Enabling actions include equiping patients and carers as co-designers/co-creators; supporting access to EU, private and public funds; building quadruple helix-based collaboration (universitiies, industry, public healthcare and patients/carers) and innovative public procurement

Organisational - The organisational level occurs within micro entities, SMEs, large companies, universities, public authorities, technical business support and other organisations that operate within regional innovation systems. Enabling actions include active knowledge sharing and ideas networks driven by the open innovation principle; recognising, absorbing and using external information; build organisational mindsets that allow openness, integration, autonomy and experiementation; translating basic research into R&D and commercialisation

Difference between enablers and enhancers - 17 individual health innovation enablers were identified during this literature review operating at the three levels shown above. However, it is important to distinguish between enablers and other factors such as enhancers and/or firm activities that contribute to performance in regional innovation systems. For example, Mammadov distinguishes between enablers and enhancers that contribute to the performance of organisations in the public sector[25]. He suggests that enablers are important foundation elements for organisations while enhancers represent innovative practice adopted by an organisation that boost enablers that then deliver innovative outputs. This means that enhancers help to implement enablers though: greater organisational effectiveness, operational efficiency and resource optimisation. For Mammadov these enhancers are the 'Innovation Epicentre' of an organisation. He argues that in combination these build a long-term culture of sustained innovation.

That said, the review of current evidence from peer reviewed papers and grey literature (including reports, strategies and agendas) that inform this paper are of two types: evidence including current policies and strategies that shape and provide opportunities for health innovation; evidence that is specific to enablers from generic and more patchy health sources (See Annex B for a summary of relevant papers/reports).

The six criteria used to review and select evidence about relevant innovation enablers are:

1. Defines the enabler(s) and describes its variables
2. Identifies the level(s) at which an enabler(s) are activated
3. Shows how enablers support the shift from basic research to R&D and onto commercialisation
4. Explores the interplay of enablers and cultural dynamics
5. Describes how the enabler(s) has been tested or applied in practice
6. Shows how enablers are evaluated.

3.2 Ecosystem enablers

E1 - Recruiting and retaining a skilled workforce	E4 - Favourable regulations
E2 - Education and training	E5 - Social infrastructure and services
E3 - Competitive income policies	

11 of the 39 papers/reports that met the inclusion criteria for enablers concern different aspects of human capital: recruiting and retaining a skilled workforce; education and training and competitive income policies. Each source

[25] Mammadov R (2014), *How to promote innovation in the public sector,* LinkedIn Pulse blog at: https://www.linkedin.com/pulse/20140408162835-3199405-how-to-promote-the-innovation-in-public-sector 8 April 2014

described the enabler, showed why they matter and how they can be or were assessed (see Table 3 that shows possible variables for each enabler and Annex B for more source information). Each of these three aspects can be defined as follows when considering local assets for health innovation:

- E1 Recruiting and retaining a skilled workforce – the available workforce and sub-sets of specialised skilled workforce should be compatible with regional S3 priorities and are essential to attracting and retaining health innovation investment.
- E2 Education and training – continuous attention is needed to right-skilling new and ongoing employees though the quality of available education and training in parallel with education and lifelong learning systems development. This needs to go beyond traditional forms of learning for younger researchers and technicians. For example, innovation boot camps can combine skills and knowledge about IPR, market and business concepts with hands-on experience as participants develop and work on innovation products that relate to their work within individual projects
- E3 Competitive income policies – competitive incomes are crucial to recruiting and retaining sub-sets of specialised skilled workforce. However, stakeholders in modest and moderate innovator regions can't generally compete with those in northern Europe (although Horizon 2020 includes new programmes to help the restructuring, recruitment and retention of leading scientists and researchers in the EU13). Perhaps this enabler needs to be offered together with other incentives (e.g. E2 and E5 good quality 'Social infrastructure and services', E7 one-stop shop services for start-up and incubation support and E13 open innovation networks) to attract and retain skilled workforces.

Figure 1: Strengths and weaknesses within the entrepreneurship components of Miami's innovation ecosystem

Human capital is not just about employees; it is also about business owners and entrepreneurs. Figure 1 above illustrates the types of indicators that might generate regional and local data for assessing RIS performance specific to the entrepreneurship element of human capital. This example from the local innovation ecosystem in Miami illustrates how the ecosystem seeks to attract and utilize a specific type of human capital[26]. Human capital (in its various guises) is a necessary pre-condition for growth in modest and moderate innovator regions and so should be categorised as a development priority.

The ecosystem level contains two other enablers that effect the operating environment for innovation ecosystems and the people who work within them: E4 Favourable regulations and E5 Social infrastructure and services. 4 of the 39 included papers addressed these two enablers:

- E4 Favourable regulations – an essential pre-condition for attracting and retaining business is the operation and regular review of favourable regulations and related legislation. This is not confined to proper use of intellectual property protection, contracts and employment regulations. It extends to transparency of decisions and no corruption.
- E5 Social infrastructure and services – transport and relevant physical infrastructure for health innovation workspace and ICT are essentials for attracting and retaining business. However, the quality and scope of social infrastructure and associated services (kindergartens, schools, healthcare, short-to medium term social housing, social care and urban greenspace) offering full coverage can be critical in influencing investment decisions.

3.3 Intermediary enablers

E6 - Efficient and competitive value chain	E10 - Intellectual property protection services
E7 - Start-up and incubation services	E11 - Innovative public procurement
E8 - Technical business services	E12 - Living Labs
E9 - Support in accessing EU Funds	E13 - Open innovation networks

21 of the 39 selected papers/reports provide material about eight intermediary enablers (see Table 3 that shows possible variables for each enabler and Annex B for more source information).

- E6 Efficient and competitive value chain – The competitiveness of an individual company depends on the competitiveness of the value chain to which it belongs. It is suggested that an innovation value chain has 3 parts: knowledge production from a range of internal and external sources (this includes a collaboration

[26] Endeavour Insight (2014), *What do entrepreneurs in your community really need?* 4 February at: http://www.ecosysteminsights.org/what-do-entrepreneurs-in-your-community-really-need/

element through open innovation networks (E13)); innovation production (product or process); and exploitation via output production (labour productivity, sales growth and employment growth)[27]

- E7 Start-up and incubation services – Providing start-ups and recently formed companies including university spin-offs, with targeted services through a one-stop shop service (seed funds, low rent options, innovation vouchers, fast track procedures for administration and evaluation of projects)
- E8 Technical business services – Providing 3 year plus established companies with outsourced specialist services: strategic financial brokerage, venture capital services, option appraisal of financing options, legal/design and marketing, briefings about government funded support, interregional and overseas market insight visits)
- E9 Support in accessing EU Funds – there is a mix of: European-level support e.g. the European Institute of Public Administration in Maastricht provides expertise on accessing and using Structure funds); in each EU Member State there are a range of support services available for organisations seeking to access a range of EU funds. For example, the Horizon 2020 Research Programme (including SME instruments) National Contact Points (NCPs) are available in each of the EU28 and give personalised support on the spot and in applicants' own languages. Structural Funds are the responsibility of a coordinating national managing authority and intermediary bodies such as relevant national Ministries and information can be accessed online or through interactive support. This support is also available from regional development organisations e.g. Brandenburg Economic Development Board (ZAB) and occasionally a European expert in a local Chamber of Commerce.

IP DISABLES OPEN INNOVATION WHEN:	IP ENABLES OPEN INNOVATION WHEN:
One-size-fits-all approaches, such as "no patents no talk," predominate	IP management is adaptable
IP and OI strategies are disconnected	IP and OI strategies are integrated
Lawyers are a roadblock to OI, dictating the who, when and how	Lawyers help pave the way for cooperation
There is a "patent everything" outlook	Smart patenting — which involves only valuable inventions — prevails
IP is treated as an end in itself	IP is seen as an opportunity for value creation and the building of ecosystems
IP builds fences through the hoarding of patents and excessive secrecy	IP is available to others and, through licensing and cooperation, is likely to be profitable

Figure 2: When IP disables or enables open innovation[28]

[27] Roper, S. Du, J. and Love JH (2008). Modeling the innovation value chain. Research Policy. 37(6-7): 961-977

- E10 Intellectual property protection services – this is usually available locally and is seen as a means to support fair competition while generating a stream of health innovations. But IP management creates obstacles to academia-industry relationships. For example, universities take a stronger position on IP terms before working with industry. This can severely delay collaboration by 18-24 months. Relatedly, companies and universities can be tempted to patent everything created in their labs with major cost implications e.g. Proctor & Gamble only use 10% of their patents but pay annual renewal fees for the unused 90%[29] (see also Figure 2 above).
- E11 Innovative public procurement - Innovation in public procurement is an underdeveloped enabler for regional innovation systems and especially for SMEs. Public procurement is currently re-emerging as the most sought after instrument of demand-side innovation policies in Europe[30]. Although public procurement is said to account for 17% of the EU's GDP (€2000bn) experience of SMEs in modest and moderate innovator regions in Portugal suggest that SMEs are more likely to engage in pre-commercial and other innovative procurement initiatives if they are seen as risk-benefit sharing, non-complex and compatible[31]. Examples of networks and initiatives that help to build mutual benefit relationships between health innovation SMEs and healthcare supply chain managers are medtecnet-BB in Berlin-Brandenburg and a NHS Passport Scheme by Groundwork in Liverpool/Manchester[32]
- E12 Living Labs – A Living Lab is a real-life test and experimentation environment where users and producers co-create innovations. Living Labs have been characterised by the European Commission as Public-Private-People Partnerships (PPPP) for user-driven open innovation. A Living Lab employs four main activities: co-design by users and producers; discovering emerging usages, behaviours and market opportunities; implementing live scenarios within communities of users; assessment of concepts, products and services according to socio-ergonomic, socio-cognitive and socio-economic criteria. There are opportunities for Living Labs to contribute to pre-procurement projects aimed at supporting public authorities to undertake relevant actions that stimulate health innovation[33]. For example, Amsterdam is the Living Lab for the Amsterdam Institute of Advanced Metropolitan Solutions. Research and valorisation are

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[28] Alexy O, Criscuolo P and Salter A (2009) Does IP strategy have to cripple open innovation? MIT Sloan Management Review, Fall 2009, 51(1): 71-77 p.73

[29] Alexy O, Criscuolo P and Salter A (2009) Does IP strategy have to cripple open innovation? MIT Sloan Management Review, Fall 2009, 51(1): 71-77 p.72 http://sloanreview.mit.edu/article/does-ip-strategy-have-to-cripple-open-innovation/

[30] Innova Europe (2011), *Inefficient use of public procurement to foster innovation in SMEs,* November. Chapter 6 of Final Report to tender No 55/PP/ENT/CIP/10/F/S01C016
Accessed at: https://procurement-forum.eu/.../Technopolis_Insufficient+use+of+PP.pdf

[31] Fernandes T and Viera V (2015), Public eProcurement impacts in small and medium enterprises, *Int. J. Procurement Management* 8(5): 587-607

[32] More details about both can be found in: Watson J (2006), *How the Health Sector can contribute to regional development: the role of local procurement.* Health ClusterNET Report 1, Access at:
http://healthclusternet.eu/media/attachment/HCN_Report_1_new_logo.pdf

[33] http://www.openlivinglabs.eu/aboutus

integrated through a network of 'test beds'. The first 3 of these are: rain sense, urban pulse and urban mobility[34].

- E13 Open innovation networks – the principle of open innovation underpins three of the organisational enablers (E14-E16) and three of the intermediary enablers (E6, E11-E12). In the context of networks these can provide a platform for knowledge sharing characterised by high levels of trust, refined information exchange and joint problem solving between academia, industry, public healthcare and patients/carers. This quadruple helix interaction is now more critical due to the focus on personalised medicine and the drive for affordable solutions in healthcare delivery. Case examples of how public healthcare services have contributed to open innovation networks and regional innovation systems were identified and assessed for their policy implications as part of the Health ClusterNET Interreg IIIC network operation[35].

3.4 Organisational enablers

E14 - Social capital	E16 - Organisational capabilities
E15 - Absorptive capacity	E17 - Technology development

17 of the 39 selected papers/reports provide information about organisational-level enablers. A majority of these (11) focus on social capital while 7 of those 11 also address other organisational enablers. (See Table 3 that shows possible variables for each enabler and Annex B for more source information).

- E14 Social capital – social capital is a strong resource that develops from productive social ties. Its use depends entirely upon the values and objectives of the actors involved[36]. It depends on commitment by stakeholders to the principle of open innovation that underpins several other enablers at intermediary (E6, E11-E12) and organisational (E15-E16) levels. Networks provide a primary route for social capital to be spent and accumulated. But to realise their potential for knowledge exploitation the best networks do not remain small with weak inter-firm and intersectoral links. Rather they need to become larger and more cohesive[37]. This is characterised by high levels of commitment, trust, fine-grained information exchange, and joint problem solving[38].

[34] http://www.ams-institute.org/category/research-programs/

[35] http://healthclusternet.eu/pages/practical-knowledge/health-innovations/

[36] Fountain JE. (1998), Social Capital: its relationship to Innovation in science and technology. Science and Public Policy, 25(3): 103-115

[37] Filieri, R, McNally, R, O'Dwyer M, & O'Malley L. (2014), Structural social capital evolution and knowledge transfer: Evidence from an Irish pharmaceutical network. *Industrial Marketing Management*, 43(3), 429440

[38] Yu, S-H. (2013), Social capital, absorptive capability, and firm innovation. *Technological Forecasting and Social Change*, 80(7), 12611270.

- E15 Absorptive capacity – absorptive capability has been defined as "a firm's ability to recognise the value of new external information, assimilate it and apply it to commercialised ends" [39]. This knowledge or intelligence is not just about innovative new ideas. It also includes processes, products and services[40]. A challenge is that organisations operate in a rapidly changing environment and needs to be able to filter and match information obtained from different knowledge sourcing: internal R&D, knowledge commons, external background and foreground knowledge
- E16 Organisational capabilities – Companies need a portfolio of organisational capabilities to search for, plan and generate viable innovation products and processes. For example, it is suggested that established SMEs and larger firms that develop organisational openness capability, integration capability, autonomy capability and experimentation capability will increase their radical innovation performance [41]. More generally (including start-ups and <3 year SMEs) the wider implications for business pans and operations include: selecting local partners carefully across every stage of the value chain (see also E6); ensure that operations are as efficient as possible to bring down cost and maintain margins; take into account the needs of local customers and ensure that pricing and other aspects of the business model are appropriate.
- E17 Technology development – the three catalysts for technology development are located at different stages of the translational research pathway introduced in Section 4 below: T0 and T1 (scientific excellence); T2 and T3 (research & development); T4 and T5 (commercialisation). Stakeholders within a regional innovation system need to put in place a portfolio of activities covering these three catalysts. The critical shift is not the number of patents lodged but commercializing them successfully.

[39] Cohen, W.M., Levinthal, D.A., (1990). Absorptive capacity: a new perspective on learning and innovation. *Administrative Science Quarterly* 35 (1), 128–152.

[40] Chang, J., Chi, HR. Chen, MH. and Deng, LL. (2012) How do established firms improve radical innovation performance? The organisational capabilities view. *Technovation* 32: 441-451, p.443

[41] Ibid p442

4 Enablers contributing to macro-region solutions

In the DanuBalt project, the EU's health innovation divide is tackled through collaboration between the first two Macro-Regions (Baltic Sea and Danube). Macro-regional strategies (MRS) are instruments to make smarter use of the financial resources available and to maximise the effectiveness of European Union (EU) regional policy investment. There are no border restrictions and therefore they tackle the problems at the appropriate level. MRS pulls together different countries or regions, within and beyond the European Union facing common challenges and situations. What this means is MRS driving better collaboration in part, by exploring comparative advantages together. The purpose is to achieve deeper economic, social and territorial cohesion: without the need to create new large-scale institutions[42].

In an ongoing financially insecure operating environment an MRS can be a useful non-cost tool to better coordinate the existing available resources and to increase the effectiveness of investments[43].

Within the EU strategy for the Baltic Sea Region (EUSBSR), health and Innovation are top priorities and the flagship project within the strategy, ScanBalt Health Region, seeks to develop a common framework for innovation in health economy and life science. Within this flagship project other projects are generated. For example, the BSHR HealthPort is specifically concerned with improving the access of SME's to healthcare providers' procurement of innovative products/services[44].

Of particular relevance to DanuBalt, the BSHR HealthPort launched a health innovation agenda (2013)[45] that provides a promising template for the Danube Macro-Region. It promotes an ecosystem approach to a sustainable innovation environment. To aid this, ScanBalt International Business Innovation Support (IBIS) has been developed. IBIS is a multidimensional approach and builds on ideas and models developed in Bridge-BSR and HealthPort. IBIS is an instrument for macro-regional development and is part of the EUS-BSR flagship project ScanBalt Health Region (SBHR). It implements the EU innovation strategies and may be considered as an implementation guideline providing a blueprint for concrete realization[46]. To achieve this it gives particular attention to several issues that are highly relevant for modest and moderate innovator regions in taking an innovation along the continuum from idea to commercialisation: scouting and early evaluation, business support and financing, implementation and marketing, education and qualification, regulation and procurement[47] (see also Section 3 above and Section 5 below).

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[42] Vidal, IM (2015), *Macro-regional strategies across Europe.* European Parliamentary Research Service, 28 January. Access at: http://epthinktank.eu/2015/01/28/macro-regional-strategies-across-europe/

[43] Ibid

[44] http://eu.baltic.net/BSHR-HealthPort-The-EU-Baltic-Sea-Region-Flagship-ScanBalt-HealthRegion-and-BSHR-HealthPort-on-Tour.22499.html

[45] ScanBalt (2013), *Driving cross-sectoral in health and life sciences: Innovation Agenda for the Baltic Sea Region Health Economy*. ScanBalt: Copenhagen

[46] Ibid p5

[47] Ibid p6

4.1 Why health innovation needs a common pathway to locate enablers

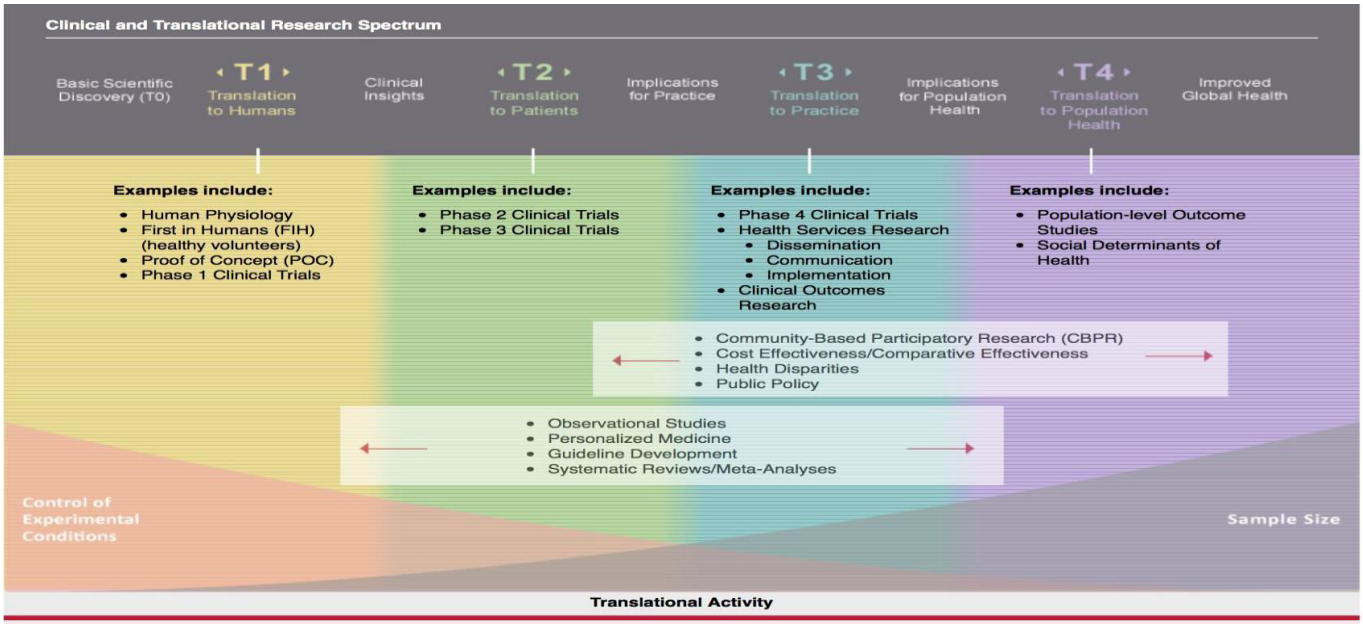

Figure 3: The Harvard Catalyst T-Spectrum[48]

There are a range of innovation models that present phases that a new product needs to go through from the first idea to basic research, to R&D and onto commercialisation and market impact. These are mostly generic and not specific to health innovation. They are used to shape the development of business plans, economic clusters and regional innovation systems and often, in a narrower way, inform how performance is measured. Obviously, for planning, performance assessment and review purposes it is critical to know what is being developed and how. Ideally, health innovation needs a common and comparable development pathway with local flexibility to locate, activate and assess enablers.

Translation research models (T models and Process models) provide a possible basis for modest and moderate innovator regions to pursue health innovation in a way that maps the phases ('T') and processes from research to clinical application, regulation and market access. However, most current 'T' models are inconsistent in how they

[48] https://catalyst.harvard.edu/pathfinder/ Note: The Pathfinder/T Spectrum is based on material from the following 3 journal references:
Sung NS, Crowley WF Jr, Genel M, Salber P, Sandy L, Sherwood LM, et al. Central challenges facing the national clinical research enterprise. JAMA. 2003 Mar 12;289 (10):1278-87. PubMed ID: 12633190
Westfall JM, Mold J, Fagnan L. Practice-based research - "Blue Highways" on the NIH roadmap. JAMA. 2007 Jan 24;297(4):403-6. PubMed ID: 17244837
Szilagyi PG. Translational research and pediatrics. Acad Pediatr. 2009 Mar-Apr; 9(2):71-80. PubMed ID: 19329097

identify specific translation stages[49]. The process models connect the various phases but have not been used practically yet.

The T-Spectrum developed by the Harvard Catalyst initiative (Figure 3 above) is currently the translational research continuum with the widest scope and clarity about the types of basic and applied research needed across this spectrum. This provides a tested framework that can help stakeholders in regional innovation systems locate and develop realistic and sustainable health innovation activity.

4.2 Enablers connecting 'T' blocks on the health innovation pathway

But more important for this paper, it also provides a framework for understanding where enablers can best be located to contribute to driving cost effective, locally relevant innovation systems with comparable evaluation of core enablers while also accounting for optional local enablers (with both providing data for capacity building audits and different types of benchmarking). This is important because connectivety between the 'T' stages is better understood in terms of knowledge transfer but not in terms of the interplay between basic/scientific research, industry, public healthcare and patients/carers e.g. understanding who does what and when, understanding what rightskilling and resources are needed at different connection points (C1-C5) between T1 and T4. Another factor is the need to ensure more attention to innovation rather than basic research in modest and moderate innovator regions who do not have a critical mass of basic research infrastructure and knowledge endowment.

Also, the interface between organisations that enablers should provide at the intermediary level can be problematic for organisations on tight budgets whose thinking is limited by the need to insert 'cut-off' points that ensure in-house resources are not overextended.

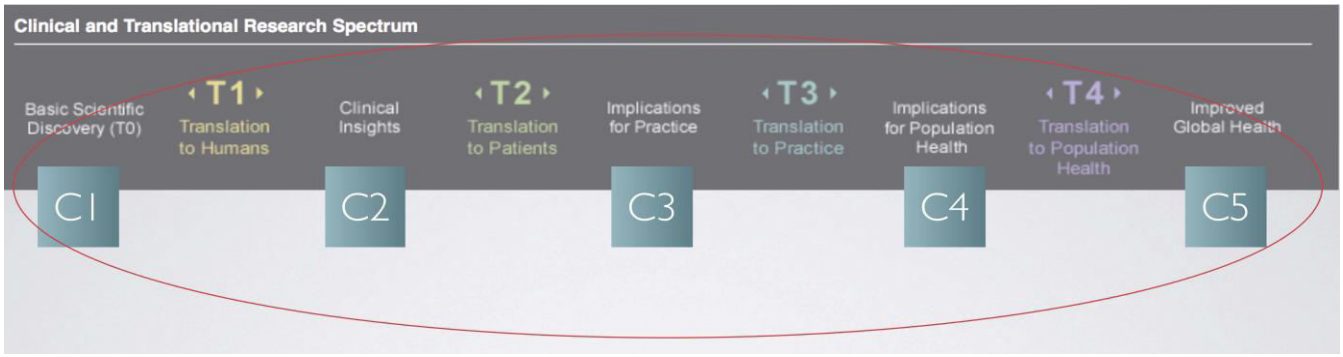

Figure 4: Pathfinder/T-Spectrum enabler connections (Adapted from the Harvard Catalyst T- Spectrum)

[49] Rajan A, Sullivan R, Bakker S and van Harten W (2012), Critical appraisal of translational research models for suitability in performance assessment of cancer centers, *Oncologist* 17(12): e48-57: e51, e53,

Connection point	Ecosystem enablers	Intermediary enablers	Organisational enablers
1			
2	E1-5	E6-10, E13	E14-17
3	E1-5	E6-10, E12-13	E14-17
4	E1-5	E6-13	E14-17
5	E1-5	E6-13	E14-17

Table 2: Enablers connecting 'T' blocks in modest and moderate innovator regions

4.3 Sharing interregional capacity and capability

Applying EU innovation performance (RIS 2014) and territorial innovation patterns (ESPON 2013) to the T-spectrum suggests where and how modest and moderate innovator EU regions can fit with a health innovation pathway (see Figure 5 below). For those modest and moderate innovator regions without universities or significant private/public basic research capacity (those that have the features of imitative, smart and creative diversification and smart technological application areas) can offer additional capacity for Applied Science and European science-based areas. For example, imitative regions can focus on local assessment of innovation products against criteria that maximise adoption and diffusion potential with local health systems while building competencies in adapting products. Smart and creative diversification regions have the potential to adapt innovation productions and guide adoption by sub-national healthcare services. Smart technological application regions have the creativity, capacity and competencies to develop lower cost generic alternatives to new innovations. Overall, these three types of region that are also modest or moderate regions are likely to have relevant innovation development capacity to meet the additional development capacity needs of Applied science and European Science-based regions (see Annex Cfor how RIS 2014 and ESPON 2013 categories match in Baltic Sea and Danube macro-region members). Meaningful R&D partnerships could also be used to strengthen capacity in support regions. This approach can help regions avoid playing an impossible catch-up game with innovation follower and leader regions in the short to medium term.

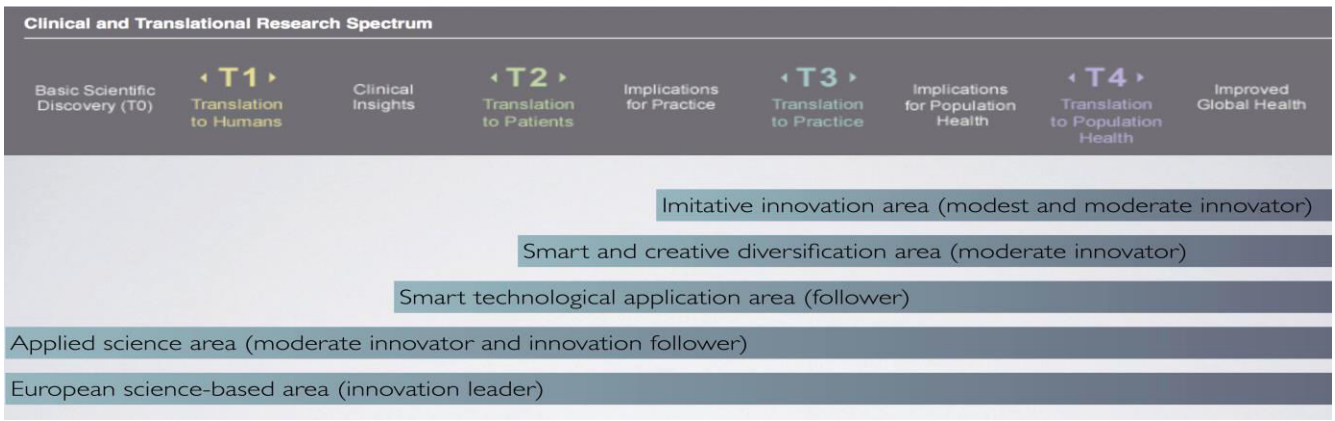

Figure 5: Locating EU innovation performance and territorial innovation patterns against the T-Spectrum (Adapted from the Harvard Catalyst T-Spectrum)

5 Measuring enablers as part of innovation performance

5.1 Local sensitivities when assessing enablers

Assessing innovation performance using the Innovation Union Scoreboard and the Region Innovation Scoreboard is both useful and problematic. It provides a European picture for innovation performance but *it fails to identify what system failures or system deficiencies are prevailing in the region. Moreover, it does not offer insights into problems of organisational and institutional thinness, nor does it capture the capacity of regions to support regional industrial change*[50]. Beyond this it does not adequately capture regional assets and their impacts. In essence, it is not region sensitive.

As shown elsewhere, the IUS and RIS does not account for territorial patterns of innovation and it presents modest and moderate regions as homogeneous entities (Capello and Lenzi 2013, Tippl et al 2014 and Annex C for more detail). In addition to the ESPON (2013) research, recent research identifies three types of less performing (modest) regional innovation systems: organizationally thin (peripheral regions), negative lock-in (old industrial areas) and fragmented (metropolitan) regions:

> ***Organisationally thin RIS*** *are systems in which essential elements are only weakly developed or even missing. Examples include the lack of a critical mass of innovative firms, a weak endowment of other key organisations and institutions and low levels of clustering. Organizationally thin RIS are often present in peripheral areas. These regions are characterised by insufficient levels of R&D and innovation due to the dominance of SMEs in traditional sectors, the lack of assets to nurture new industries, a weak capacity to absorb knowledge from outside the region, and a thin structure of supporting organisations.*
> ***Locked-in RIS*** *are characterized by an over-embeddedness and over-specialization in mature sectors and outdated technologies. Locked-in RIS often prevail in old industrialised areas. The capacity of firms in these areas to generate radical innovation is limited and the supporting organisations tend to be too strongly oriented on traditional industries and technologies. Various forms of negative lock-in (functional, cognitive and political ones) keep these regions in ancestral development paths.*
> ***Fragmented RIS*** *suffer from a lack of connectivity due to a suboptimal level of networking and knowledge exchange between actors in the system, leading to insufficient levels of collective learning and systemic innovation activities. Fragmented RIS can frequently be found in metropolitan areas. In this type of region fragmentation is often the outcome of too much diversity and a lack of related variety, resulting in levels of regional knowledge exchange and innovation below what could be expected given the often rich endowments of knowledge exploration as well as exploitation organisations found in metropolitan regions.*
>
> Trippl et al (2014: 4)

In this context of these regional differences, comes the question of how best to assess innovation performance in general and for enablers specifically? Whilst some Regional Innovation Scoreboard indicators are broad and can include a wide variety of innovations, most are more narrow and targeted towards measuring analytical

[50] Trippl M, Asheim B and Miörner J (2014), Identification of regions with less developed research and innovation systems, Working Paper for FP7 Project 'Smart specialisation for regional innovation' (p.15), at: https://ideas.repec.org/p/hhs/lucirc/2015_001.html

knowledge, the STI mode of innovation and narrowly defined RIS[51]. As previously shown, enabler data is missing at regional level.

The spiral system using an iterative approach was designed for use with disruptive innovation. But, it has benefits for use with health innovation enablers generally. It aligns with the need for flexibility that allows for responsiveness and adaptability for the stakeholders, resources and capacity within a regional innovation system[52]. This could help RIS in modest and moderate innovator regions to avoid needing to align with the "catch-up" logic that underpins the RIS 2014 approach to measuring performance[53]. An equivalent example is provided with E11 'Innovative Public Procurement' (in section 3.3 on intermediary enablers) where medical SMEs in Berlin-Brandenburg were able to benefit from membership of medtecnet – a network that marketed SMEs to public procurement decision-makers in the health sector[54].

What these SMEs offered was an ability to meet niche demands that larger businesses such as Siemens do not have the same flexibility and speed to meet. Arguably, using this approach for RIS in modest and moderate innovator regions would enable its resources to address niche and transitory gaps in the markets for health innovations (see also 4.3 above). It also suggests that assessing performance should consider the interplay between enablers within and across the three levels e.g. in this context the quality and impact of dynamics for E11 might include E4 'Favourable regulations', E8 'Technical Business Support', E14 'Social capital', E16 'Organisational capabilities' and E17 'Technology development'.

An alternative for assessing locally relevant performance would be to provide a list of enablers across the three levels where they should be active (E1-E17 at ecosystem, intermediary and organisational level) as the basis for engaging the main stakeholder groups (academia, industry, public healthcare and patients/carers) in a capacity building audit process. Originally developed in New South Wales[55] and then adapted for use in the UK[56], it is an approach to the development of sustainable skills, organisational structures and resource allocation that can be adapted to audit (baseline and subsequent re-audits) core and optional enablers in an RIS. Capacity building has often been described as the invisible work that is essential in building infrastructure, maintaining and sustaining programmes and creating flexible problem solving capability. This work is often visible as strategies for workforce and organisational development, leadership and partnership development, and resource allocation. In a RIS context capacity building refers to at least two things:

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[51] Tippl et al 2014: p.15

[52] Briones JA (2012) Beyond Stage-Gate – repeating disruptive innovation, http://www.innovationexcellence.com/blog/2012/03/18/beyond-stage-gate-repeating-disruptive-innovation/

[53] Trippl et al (2014) p.14

[54] Watson J (ed.) *How the health sector can contribute to regional development: the role of local procurement.* Health ClusterNET Report 1, http://healthclusternet.eu/pages/practical-knowledge/local-procurement/

[55] NSW Health (2001), *A Framework for Building Capacity to Improve Health*, Health Department, Sydney. Access at: http://www.redaware.org.au/wp-content/uploads/2014/07/A-Framework-for-Building-Capacity-to-Improve-Health.pdf See also: NSW Health (2000) Indicators to help with capacity building in health promotion, Health Department, Sydney. Access at: http://www0.health.nsw.gov.au/pubs/2000/pdf/capbuild.pdf

[56] Watson J and Bowen S (2005), *Analysis of the PAF self-assessment for health improvement: 2004/05,* Report for Scottish Executive Health Department, Health Improvement Strategy Division, 15 July.

- Our capacity to deliver specified, high quality services or responses to particular situations or problems;
- Capacity of a more generalised nature – the capacity of the system we are working in to solve new problems and respond to unfamiliar situations.

So, this tool can be used for different ends. For example, conceptualising and mapping the domains, levels and integrated aspects of a capacity building approach helps with building the evidence for the link between this critical approach and implementation of the S3, H2020 and ESIF applications. At a system level, capacity building aims to create dynamic and innovative approaches to action, and most importantly flexible and responsive systems to tackle new and emerging challenges for an RIS. At a practical level, exposing capacity building effort provides institutions and organisations with insights to effective and sustainable practice. Overall, the tool collects data to identify strengths and weaknesses and inform discussion between stakeholders to reach consensus on what needs to be done different to improve performance.

5.2 Enablers and their variables

Enabler	Assessment variables	Source(s)
Recruiting and retaining a skilled workforce	Right-skilling the workforce, patients and communities as assets, employment types, competencies, resource assets, new jobs, retention rates	Bramwell et al (2012); IDM Working Group (2012); Kearney (2011); OECD (2010); Sappänen (2008); Walshok et al (2013)
Education and Training	Optimise talent through technology, competencies, motivations and competencies of mentors and advisors, partnerships between regional education institutions and regional businesses, government funding to offset training costs, training products that can be customised to sectoral and geographic variations	IDM Working Group (2012); IGHI (2014); INOLINK (2011); NSW (2010); OECD (2010); Trippi et al (2014); Walshok et al (2013);
Competitive income policy	Competitively priced staff, open labour market for researchers, brain drain,	Galsworthy (2013); IDM Working Group (2012); Kearney (2011)
Favourable regulations	Employee regulations favourable to EC citizens, access to local markets, enforced IPP laws,	IDM Working Group (2012); IGHI (2014); Kearney (2011)
Social infrastructure and services	Differentiation from breadth and depth of social infrastructure	Kearney (2011); Sappänen (2008);
Efficient and competitive value chain	Trust-based relationships, online services, focused sector strategies	Kearney (2011); NSW (2010); Roper et al (2008); Schmidt (2005)
Start-up and Incubation support	One-stop shop system; Seed funds	Bruneel et al (2012); INOLINK (2011); NSW (2010);

Enabler	Assessment variables	Source(s)
Technical business services	"Patient" capital, angel investors, SME growth financing, PPP's, one-stop shop system, strategic financial brokerage, venture capital services, Specialised legal services, marketing, advertising, design services, awareness of government funded programmes	Amirall et al (2012); Bramwell et al (2012); IGHI (2014); INOLINK (2011); Kearney (2011); Lehmann et al (2008); NSW (2010); Sappänen (2008)
Support in accessing EU Funds	Fast track procedures for applications; expert advice on co-financing, awareness of and access to NCPs	INOLINK (2011)
Intellectual Property protection	IP strategy (balance open and proprietary strategies, generate licensing revenue while fostering collaboration, avoid one-size fits all approach), Patent applications, Patent approval,	Alexy et al (2009); Bramwell et al (2012); IGHI (2014); INOLINK (2011);
Innovative public procurement	Pre-commercial public procurement for procuring R&D services, prompting SME access to public procurement, eProcurement, passport schemes, profiling SMEs with supply chain managers	Fernandes and Viera (2015); INNOVA Europe (2011)
Open innovation networks	Utilizer network, Enabler network, Provider network, User network, network spillovers, open innovation, specific and general links, promotion platforms	Filieri et al (2014); IGHI (2014); INOLINK (2011); Leminen et al (2012); NSW (2010); Sappänen (2008); Walshok et al (2013)
LivingLabs	Patients and communities as assets, patients as co-producers and designers,	IDM Working Group (2012); IGHI (2014); Leminen et al (2012); Niitamo (2009);
Social capital	Goal alignment, associability, concern for the collective, collective action, communication, information flow, cooperation, enhanced knowledge (generate new knowledge), control mechanism, flexibility, risk taking, creative environment, general trust, formal and informal networks, civic participation, institutional trust, social norms	Camps and Marques (2014); Camisón and Villar-Lopez (2012); Chang et al (2012); Esterhuizen et al (2012); Filieri et al (2014); Kaasa et al (2007); Sappänen (2008); Sisodiya et al (2013); Trippi et al (2014); Walshok et al (2013); Yu (2013)
Absorption capacity	Openness capability, integration capability, autonomy capability, experimentation capability, knowledge creation paths, learning organisation, open access publications	Bramwell et al (2012); Chang et al (2012); Esterhuizen et al (2012); Filieri et al (2014); Roper et al (2008); Walshok et al (2013); Yu (2013)

Enabler	Assessment variables	Source(s)
Organisational capabilities	Organisational innovation, product and process innovation, firm performance and environmental uncertainty, ICT systems delivering productivity benefits	Camisón and Villar-Lopez (2012); NSW (2010)
Technology development	R&D funding (Government and private),	Bramwell et al (2012); IGHI (2014); Kearney (2011); OECD (2010); Sappänen (2008);

Table 3: Summary of enablers and their variables

A considerable number of variables have been practically or conceptually used to test assumptions about or evaluate the 17 enablers identified as part of this exercise. As part of the process for developing a consensus framework of enablers with partners and stakeholders: descriptions of each enabler will need to be refined; enablers need to be categorised as core or optional by representatives from participating modest and moderate innovator regions; specific questions/variables need to be added under each enabler that help measure performance. These should focus on inputs, processes, outputs as well as outcomes.

6 Conclusions

At the start of this review four main challenges for understanding and improving innovation performance were identified:

- The Innovation Union ScoreBoard (IUS 2014[57]; RIS 2014[58]) and other initiatives/projects do not use a common set of enablers.
- The indicators used by IUS rely on available national level data but do not have comparable regional level data.
- Whilst some indicators are broad and can include a wide variety of innovations, most are narrower and targeted towards measuring analytical knowledge, the STI mode of innovation and narrowly defined RIS[59].
- An additional issue is that the data available at national level might limit the relevance of enablers used by IUS and the Regional Innovation ScoreBoard.

To address this issue realistically, attention is now given to developing a consensus-based framework for core and optional enablers as a basis for comparable performance improvement and sustainability in modest and moderate innovator regions.

This review provides a first step by identifying a total of 17 innovation enablers that appear to be most relevant for contributing to improving the performance of modest and moderate innovator regions in the Baltic Sea and Danube macro-regions (plus the Moldavian regions). It will be interesting to assess the relevance of these indicators for Estonia whose performance has it now ranked as a Follower region by RIS 2014.

At the same time, territorial innovation patterns identified by the KIT project (ESPON 2013) only partially match with the four RIS 2014 performance categories (see also Annex C). The implication here is twofold: (i) that attention to performance improvement needs to accommodate to different territorial patterns and so a 'one size fits all' approach to change and improvement will not work (ii) the indicators currently used for the IUS/RIS might not be sensitive enough to inform local solutions.

That said, the best way forward should not be to increase the size of the bag of indicators and metrics. If this happens, then modest and moderate regional innovation systems risk being distracted by a demand for performance assessment that oversteps what is needed to improve performance. In this context and to maintain flexibility combined with quality within a regional innovation ecosystem, consideration should be given to focusing on the use of qualitative criteria for tracking the impact of enablers.

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[57] Ibid.

[58] DG Enterprise and Industry (2014) Regional Innovation Scoreboard 2014. October, Brussels: Belgium

[59] Trippl M, Asheim B and Miörner J (2014), Identification of regions with less developed research and innovation systems, Working Paper for FP7 Project 'Smart specialisation for regional innovation' (p.15), at: https://ideas.repec.org/p/hhs/lucirc/2015_001.html

7 References

7.1 Enablers

Alexy O, Criscuolo P and Salter A (2009) Does IP strategy have to cripple open innovation? MIT Sloan Management Review, Fall 2009, 51(1): 71-77 http://sloanreview.mit.edu/article/does-ip-strategy-have-to-cripple-open-innovation/

Almirall E, Lee M, and Wareham J (2012), Mapping Living Labs in the Landscape of Innovation Methodologies, *Technology Innovation Management Review,* September: 12-18, www.timereview.ca

Bramwell A, Hepburn N and Wolfe DA (2012), Growing innovation ecosystems: university-industry knowledge transfer and regional economic development in Canada. Knowledge Synthesis Paper on Leveraging Investments in HERD, Final Report to the Social Sciences and Humanities Research Council of Canada, May 15

Bruneel J, Ratinho T, Clarysse B and Groen A (2012), The evolution of business incubators: comparing demand and supply of business incubation services across different incubation generators, *Technovation* 32(2): 110-121

Camisón C and Villa-López A (2014), Organizational innovation as an enabler of technological innovation capabilities and firm performance, Journal of Business Research, 67: 2891-2902

Camps, S., & Marques, P. (2014). Exploring how social capital facilitates innovation: The role of innovation enablers. Technological Forecasting and Social Change, 88, 325348. P.327

Cankaya A, Heidamann Lassen A, Wandahl S and Bolvig Poulsen S (2010), User-driven innovation in a supply and value network: a systematic literature review, Conference Paper, January

Capello R and Lenzi C (2013) Territorial patterns of innovation and economic growth in European regions, Growth and Change, *Growth and Change 44(2):195-227*

Caragliu A and Lenzi C (2013), Structural elements and dynamics in territorial patterns of innovation: a perspective through European case studies, *Regional Science Policy & Practice 5(4): 393-383, November.*

Chang, J., Chi, HR. Chen, MH. and Deng, LL. (2012) How do established firms improve radical innovation performance? The organisational capabilities view. *Technovation* 32: 441-451 p442

Cohen, W.M., Levinthal, D.A., (1990). Absorptive capacity: a new perspective on learning and innovation. *Administrative Science Quarterly* 35 (1), 128–152.

Czajkowski et al 'Human Capital and Innovation—Basic Concepts, Measures, and Interdependencies' in M. A. Weresa (ed.), Innovation, Human Capital and Trade Competitiveness, Innovation, Springer International Publishing Switzerland 2014

DG Enterprise and Industry (2014), *Public procurement as a driver of innovation in SMEs and Public Services,* Guidebook series – How to support SME Policy from Structural Funds

Dzau VJ, Grazin N, Bartlett R, Udayakumar K, Kibasi T, Henke N and Pettigrew M (2012), *A neglected resource: transforming healthcare through human capital,* Report of the Innovative Delivery Models Working Group. Access at: https://www.imperial.ac.uk/media/imperial-college/institute-of-global-health-innovation/public/human-capital.pdf

Esterhuizen, D. Schutte, CSL. And Toit ASA. (2012), Knowledge creation processes as critical enablers for innovation. *International Journal of Information Management*, 32(4): 354-364

Fernandes T and Viera V (2015), Public eProcurement impacts in small and medium enterprises, *Int. J. Procurement Management* 8(5): 587-607

Filieri, R., McNally, R., O'Dwyer, M., & O'Malley, L. (2014). Structural social capital evolution and knowledge transfer: Evidence from an Irish pharmaceutical network. *Industrial Marketing Management*, 43(3), 429440

de la Fuente A, Doménech R and Jimeno JF (2003). Human capital as a factor of growth and employment at the regional level: the case of Spain. Final Report. ec.europa.eu/social/BlobServlet?docId=1945&langId=en

Galsworthy, M. (2013) Bring in fair pay policies to stop Western Europe brain drain. theconversation.com 28 October

HLG Secretariat (2014) *Inspiring and Completing European Innovation Systems: Blueprint,* EPPA SA: Brussels, August.

INNOLINK (2011) *A study on regional innovation systems in the EU,* NanoBioNet, Saarbrüken

INNOVA Europe (2011), *Inefficient use of public procurement to foster innovation in SMEs,* November. Chapter 6 of Final Report to tender No 55/PP/ENT/CIP/10/F/S01C016 Accessed at: https://procurement-forum.eu/.../Technopolis_Insufficient+use+of+PP.pdf

Institute of Global Health Innovation (2014) *From Innovation to Transformation: a framework for diffusion of healthcare innovation*, Imperial College London

Kaasa A, Kaldaru H and Parts E (2007) Social capital and institutional quality as factors of innovation: evidence from Europe, Tartu University Press: Tartu

Kearney AT (2011), *Next Generation Economic Clusters: incubating and driving economic development.* http://www.atkearney.nl/documents/10192/e8d102e2-8b82-469a-aa5b-8d15c5893a5d

Lane JP, Flagg JL. (2010) Translating three states of knowledge: Discovery, invention, and innovation. Implement Science, 5:1–14.

Leminen S, Westerlund M and Nyström A-G (2012), Living Labs as Open-Innovation Networks, Technology Innovation Management Review, September: 6-11, www.timereview.ca

McGuirk H, Lenihan H and Hart M (2015), Measuring the impact of innovative human capital on small firms' propensity to innovate, *Research Policy* 44: 965-975

Niitamo V (2009) *Transforming the last mile to become the first mile of citizen centric innovation.* Presentation, Nokia, Tallinn, 18 December. http://www.arengufond.ee/upload/Editor/events/Kohvihommik/Niitamo-091218-Arengufond-Living-Labs.pdf

NSW Ministry of Industry and Investment (2011), *Regional Innovation Strategy: resilient Businesses, Sustainable Jobs.* http://www.trade.nsw.gov.au/__data/assets/pdf_file/0011/55388/NSWRegionalInnovationStrategy_201112.pdf

Öberg, C and Shih, T (2014), Divergent and convergent logic of firms: Barriers and enablers for development and commercialization of innovations. *Industrial Marketing Management*, 43(3), 419428 p425

Owen-Smith J. and Powell WW. (2004) Knowledge networks as channels and conduits: The effects of spillovers in the Boston biotechnology community. Organization Science. 15(1): 5-21

Roper, S. Du, J. and Love JH (2008). Modeling the innovation value chain. Research Policy. 37(6-7): 961-977

ScanBalt (2013), *Driving cross-sectoral innovation in the health and life sciences: an Innovation Agenda for the Health Economy in the Baltic Sea Region.* Baltic Sea Health Port, Copenhagen

Seppänen S (2008), Regional innovation systems and regional competitiveness: an analysis of competitiveness indexes, Paper presented at DRUID-DIME Academy Winter 2008 PhD Conference on Geography, Innovation and Industrial Dynamics, January. http://www2.druid.dk/conferences/viewpaper.php?id=2033&cf=28

Schmidt, H. (2005) Value chain analysis for policy-makers and practitioners. International Labour Organisation: Geneva

Sisodiya, SR. Johnson, JL. and Grégoire, Y. (2013) Inbound open innovation for enhanced performance: Enablers and opportunities. Industrial Marketing Management. 42(5): 836–849

Walshok, ML, Shapiro, JD, & Owens, NJ. (2013). Unraveling the cultural and social dynamics of regional innovation systems. University of California. Retrieved from http://connect.org/email/global-connect/Reports/UnravelingSocialDynamicsJanuary2013.pdf

Yu, S.-H. (2013). Social capital, absorptive capability, and firm innovation. *Technological Forecasting and Social Change,* 80(7), 12611270.

7.2 Background and context literature

Briones JA (2012) Beyond Stage-Gate – repeating disruptive innovation, http://www.innovationexcellence.com/blog/2012/03/18/beyond-stage-gate-repeating-disruptive-innovation/

Capello R (2013) Territorial patterns of innovation and economic growth in European regions, Growth and Change, Special Issue: Knowledge, Innovation, and Regional Performance Territorial Patterns of Innovation in Europe. Guest Editor: Roberta Capello, 44(2):195–227

Caragliu, A. and Lenzi, C. (2013) Structural elements and dynamics in territorial patterns of innovation: A perspective through European case studies. Regional Science Policy and Practice, Special Issue: Territorial patterns of innovation: evidence from successful European case studies, 5(4): 369–383

DG Enterprise and Industry (2014) *Innovation Union Scoreboard 2014*, October, Brussels: Belgium

DG Enterprise and Industry (2014) *Regional Innovation Scoreboard 2014*. October, Brussels: Belgium

DG Enterprise and Industry (2010) *SME's access to public procurement markets in the EU,* Final Report, September

ESPON (2013), *Knowledge, Innovation, Territory* (KIT), Applied research report, 13 January 2013.

Glabman, M. (2009), Disruptive Innovations That Will Change Your Life in Health Care. Managed Care (January)

Innobarometer 2014: Lack of financial resources hinders the commercialisation of innovations, Press memo, European Commission, Brussels 27 May 2014

Johnson G, Scholes K, Whittington R. Exploring Corporate Strategy, 8th Edition, FT Prentice Hall, Essex, 2008

Kelly E (2015) EU awards grants to help less developed research institutes recruit talent. Science/Business 19 February 2015

OECD (2010) *Measuring innovation: a new perspective,* OECD, Paris.

Oldi CM and Olsson FA (2014). Gaining real impact from smart specialisation strategies: a concept outline. Paper given in the workshop: Rebooting regional policy: gaining real impact from smart specialisation strategies. wire2014

Rajan, A. Sullivan, R. Bakker, A. and van Harten WH (2012), Critical appraisal of translational research models for suitability in performance assessment of cancer centres, *Oncologist*, 17: e48-e57

Teece, D.,(2007). Explicating dynamic capabilities: the nature and micro-foundations of (sustainable) enterprise performance. *Strategic Management Journal,* 28 (3): 1319–1350.

Trippl M, Asheim B and Miörner J (2014), Identification of regions with less developed research and innovation systems, Working Paper at: https://ideas.repec.org/p/hhs/lucirc/2015_001.html

Trochim W, Kane C, Graham M et al. (2011), Evaluating translation research: A process marker model. *Clin Transl Sci.* 4:153–162.

Watson J, Worch S, Mylord H, Hartley M. (2007) *How the Health Sector can contribute to regional development: the role of health innovations.* Health ClusterNET Report 4

Watson J (Ed). (2006) *How the Health Sector can contribute to regional development: the role of local procurement.* Health ClusterNET Report 1

Annex A - Systematic review method

Figure 6 summarises the first 2 of 8 steps of this systematic review (key words and search strings). The search strings were applied to three database sources (PubMed, Google Scholar, MIT Technology Review n=1343 articles). It sought to identify relevant innovation policies, models and key capacities and competencies that are 'enabled' using a combination of search terms in the three databases. A second search included scientific terms & common expressions for enablers and their particular focus. In addition, the references and citations for a few papers were tracked that had been identified through the previous search method. The search was not limited to health innovation or to the year of publication.

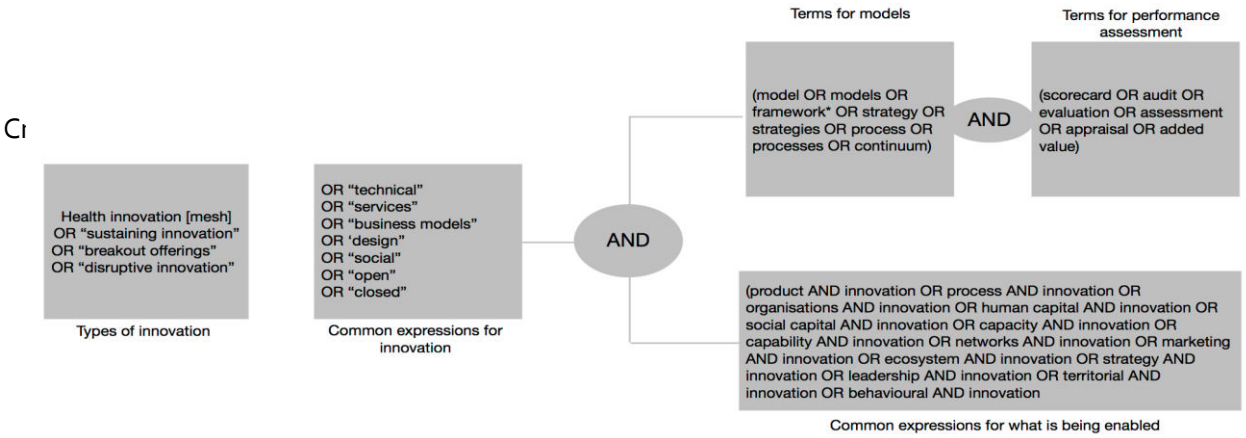

Figure 6: Search terms used to identify innovation models and associated enablers

Articles/reports were discarded from irrelevant journals/websites and if they focused on a sector with no discernable transferable value (leaving 767 articles). Then inclusion/exclusion criteria were created that matched the aim of the research (e.g. inclusion criteria such as enablers with a strong connection to regional innovations systems or the areas of medical/life sciences/ biomedicine/relevant innovation policy; systematic reviews, empirical evidence: exclusion criteria such as articles not written in English, book reviews/abstracts). Then articles/reports were evaluated against these inclusion/exclusion criteria. Those that remained (n=68 articles/reports) were divided into two lists: innovation enablers (n=39) and supporting health innovation literature (n=19). See '8 References' above and Annex B below that summarises articles/reports in the innovation enabler list. The former list was read in depth. Using the theory of the evaluation of strategic options by Johnson & Scholes the criteria were framed for evaluating the information presented in the articles/reports; they need to be evaluated for suitability and feasibility[60]. Aligned to this, the focus was on appraising how the papers present and discuss an enabler(s) in terms of: its main purpose; component(s) that can be evaluated; strategies to evaluate the identified components and testing of the chosen strategies in practical settings. To validate our focus we referred to a range of literature from both health and non-health sectors and medical and non-medical disciplines. Fifth generation R&D suggests that performance assessment strategies (or other measurement strategies) should

[60] Johnson G, Scholes K, Whittington R. Exploring Corporate Strategy, 8th Edition, FT Prentice Hall, Essex, 2008.

integrate the levels at which innovation enablers operate (ecosystem, intermediary and organisational). A fifth criterion based on acceptability was meant to check if models or individual enablers have been tested or applied in practice. Accordingly, the six criteria are:

- Defines the enabler(s) and describes its variables
- Identifies the level(s) at which an enabler(s) are activated
- Shows how enablers support the shift from basic research to R&D and onto commercialisation
- Explores the interplay of enablers and cultural dynamics
- Describes how the enabler(s) has been tested or applied in practice
- Shows how enablers are evaluated.

Annex B - Summary of evidence specific to enablers

Paper	Defines the enabler(s) and describes its variables	Identifies the level(s) at which an enabler(s) are activated	Shows how enablers support the shift from basic research to R&D and onto commercialisation	Explores the interplay of enablers and cultural dynamics	Describes how the enabler(s) has been tested or applied in practice	Shows how enablers are evaluated
Alexy O, Criscuolo P and Salter A (2009)	Intellectual Property protection	Ecosystem and organisational	Universities are joining large companies in insisting on their own IP terms prior to working with industry. Can take 18 months+ to negotiate a viable research collaboration agreement. Also companies investing in R&D tend to patent everything created in their research labs but some use only 10% of their patents but pay millions in annual renewal fees for 90%. This creates patent "thickets" that can inhibit collaboration. IP strategy becomes an inhibitor when IP is transformed from a means of capturing value of innovation to an end in itself.	No	Multi-year research project across industry sectors including medicine and life sciences actively practicing open innovation. 100`+ interviews, OI workshops and secondary data.	Studied OI, its relation to IP and effect on company performance. 2 variables (technological environment [calm or turbulent] and knowledge distribution [puddles or oceans]). Results: IP strategy enhances performance when it balances open and proprietary strategies, generates licensing revenue while fostering collaboration, avoids a one-size fits all approach
Almirall E, Lee M, and Wareham J (2012)	Livinglabs, Public-Private Partnerships	Intermediary	Livinglabs provide solutions by tapping into tacit knowledge to be incorporated into products and services, and validated in real-life environments.	No	Interviews with researchers and senior managers from 26 Livinglabs, participant observation in 3 Catalan Livinglabs projects and ENoLL	No
Bramwell et al (2012)	Absorptive capacity, human capital, intellectual property, venture funding, technology transfer, commercialisation	Ecosystem, intermediary and organisational	Part 1 – University-Industry linkages in regional innovation systems; Part 2 - Review of key policies and programmes that facilitate university-industry knowledge transfer and commercialisation in EU, USA and Canada; Part 3 – emerging best practices; Part 4 Building an Innovation Ecosystem	Movement of researchers between academia and industry, executive or entrepreneur in residence programmes, innovation campuses, industrial liaison programmes	Synthesis of current literature on university- industry knowledge transfer and regional economic growth.	Avoid assuming that one-size fits all when seeking to adopt models that work well elsewhere. "The key lesson to be drawn from this review is that institutions of higher education must work to align their efforts to improve knowledge transfer capabilities with the realities of the local innovation systems in which they are embedded.

Bruneel et al (2012)	Incubators	Intermediary	Older incubators need to improve their value proposition by updating their service portfolio while also imposing stricter selection criteria and introducing exit policies.	No	Explores if and how incubators evolve. Uses 2-step research design (i) in depth case studies of the supply side of 7 BIs of different generations (ii) interviews with 71 tenants. Plus additional data about both BIs and tenants from public material.	
Camisón C and Villar-López A (2012)	Organisational capabilities, social capital	Organisational	Maps the interplay of organisational level enablers at the R&D stage of product development	The importance of new management practices	144 completed questionnaires from Spanish industrial companies (71.5% = SMEs and 28.5% = large companies)	Variables for consideration include: 3 dimensions under organisational innovation; 1 each under product and process innovation capabilities. 1 under firm performance and 3 dimensions under environmental uncertainty
Camps, S., & Marques, P. (2014).	Social capital and its relationship with other innovation enablers	Organisational	Discusses differences in findings from 2 groups of respondents related to: social capital characteristics and innovation capabilities (product, process, marketing, strategic and behavioural)	No	Case study that shows how 3 dimensions of social capital (structural, relational and cognitive) influence a firm's innovation capabilities	The authors suggest that social capital acts indirectly through several innovation enablers directed by SC drivers. However, these might also be considered as a range of variables for social capital (e.g. goal alignment, collective action, communication, risk taking)
Cankaya A, Lassen A and Wandahl S (2010)	Innovation networks, value chain, co-design, user-driven innovation	Intermediary and organisational	The paper concludes that the subject of user-driven innovation in a supply and value chain network is not well covered in current literature. Specific gaps include: action plans for networks relying on user-driven innovation, information sharing between networks, ensuring that user input helps a whole network and not just one company, ensuring continuous improvement for user-driven innovation.	How to motivate users to co-create and co-design	8 step review process; defining key words, creating search strings, search strings through databases (1191 articles), discard articles from irrelevant journals (863 articles), develop exclusion and inclusion criteria, evaluate articles based on criteria defined (73 articles left), split articles in to A/B/C lists (A=27, B=27, C=19), analysis conducted based on the A list (6 categories) with B and C as co-creation and background to	No

					the topic.	
Capello R and Lenzi C (2013)	Social capital, infrastructure endowment, functional specialisation, agglomeration economies, funding (FDI and ESIF)	Ecosystem	Efficiency in taking advantage of innovation does not only link to the strength of the local knowledge base; rather, territorial patterns of innovation characterized by relatively low knowledge intensity can be relatively more efficient in grasping and exploiting innovation returns for growing.	No	Literature review on knowledge, innovation and regional growth. Used statistics from EUROSTAT for NUTS2 regions across the EU27. Empirical verification of territorial innovation patterns.	No
Chang, J., Chi, HR. Chen, MH. and Deng, LL. (2012)	Organisational capabilities, absorptive capacity	Organisational	Established companies need different sets of organizational capabilities to search, plan organise and prove radical ideas	No	112 Taiwanese firms responded at senior level to a postal survey (40% = micro-sized, 48% = SMEs and 11% = large). Data collected used to test 4 hypotheses.	Organisational capability has 4 variables that positively correlate with improvement in radical innovation performance in established companies: openness capability, integration capability, autonomy capability and experimentation capability.
Dzau et al (2012)	Ecosystem - Regulatory and legislative environment; financial rules and incentives with human capital goals. Intermediary - Equip patients and families for co-production; modernise professional education and training	Ecosystem and organisation	No	Yes. Proposes short and longer-term changes under each of the 4 enablers that should improve the interplay between enablers and cultural dynamics at ecosystem, organisation and community levels	Systematic literature review supported by non-empirical material from grey literature, expert interviews and 45 case studies	Variables to consider: reduce variation for standardised operating model; right-skilling the workforce; patients and communities as assets; optimise talent through technology; motivate people
Esterhuizen, D. Schutte, CSL.	Social capital, learning	Organisational and intermediary	Knowledge creation path with maturity levels	No	Discussed a practical organisational scenario but did not extend to	Long-term competitive advantage is found in the ability to constantly

And Toit ASA. (2012),	organisation, absorption capability				practical implementation of the framework	generate new knowledge.
Filieri, R., McNally, R., O'Dwyer, M., & O'Malley, L. (2014).	Social capital, learning organisation, absorption capability, networks	Intermediary and Organisational	Knowledge transfer through bridging ties helping to generate innovation	Yes. Communicating tacit knowledge between network members	Case study with an Irish pharmaceutical network (industry and universities). 4 phases of network development	No
HLG Secretariat (2014)	Intellectual Property Rights, `Public procurement, stakeholder collaboration, new R&D funding channels, tax policy	Ecosystem	Blueprint for inspiring and completing European innovation ecosystems produced by a HLG set-up under the Polish Presidency and completed under the Irish Presidency. Leans towards open innovation.	Overcome some of the barriers to and collateral effects of innovations through social acceptance, connectivity and inclusiveness including: Public-Private-People Partnerships, enlarging social innovation, innovating education and new instrument for collaborative governance		A need to integrate ex-ante and ex-post evaluations and to ensure that R&D investments are transformed into the market context.
INOLINK (2011)	Joint academic and university networks, Financial support including for feasibility studies, IP Management, Business advisory services, Support for innovation start-ups, knowledge exchange	Ecosystem, Intermediary, Organisational	Explores barriers to innovation and preferences for support services	No	Survey of 127 organisations in 10 regions 10 good practice feasibility studies for how to minimise risk on market entry including 3 from the Danube macro-region (Podravska Slovenia, North-east Bulgaria, North-east Romania)	How to provide more effective innovation support – introduce fast track procedures for administration and evaluation of proposals, one-stop shop system for innovation support but some dissatisfaction with current public support mechanisms e.g. limited human resources in ESIF intermediary bodies especially for support on co-financing

Institute of Global Health Innovation (2014)	Ecosystem- the regulatory environment, health system size, structure and finance, the innovation environment, the investment environment, infrastructure for ICT, the research environment. Intermediary – vision and strategy, incentives and rewards, funding for R&D and diffusion, transparency of research findings and data on demonstrable success, ICT capability, specific resources to identify and promote health care innovations, communication channels across health care, with industry and the public, development and renewal of healthcare standards and protocols.	Ecosystem and Intermediary	From the adopter perspective	Provides a framework for diffusion of healthcare innovation that shows the interplay of enablers and cultural dynamics. The latter include: patients and public as co-producers of wellbeing, concerns about outcomes and sustainability, adapting innovations to suit local contexts, champions who support change, virtuous cycles of innovation	Examined published indices and rankings of differing aspects of innovation and/or healthcare delivery. Academic literature review underpinning healthcare innovation and its diffusion. Detailed examination of 20 case studies at national and sub-national level. 20 interviews with health system leaders. Review by expert panel.	Regulatory environment (e.g. government funding of R&D, regulatory approval processes, governance of intellectual property). Health system (national expenditure, remuneration of heath care professional, skills levels). Innovation environment (attitudes to risk- taking and learning, focus on short, medium and long term goals and feedback and promotion of innovations). Investment environment (maturity of the investment market place, access to capital, government investment, private finance, grants and donations). ICT infrastructure (including network coverage and scope of provision in the market, data warehousing and analytics capabilities). Research environment (research and development spending, drug/medical technology patent applications, and the number and rankings of academic medical and research centres). Intermediary – ownership of adoption through focus on quality and continuous improvement, cash payments in combination with other incentives e.g. awards, professional recognition, accreditation programmes. Investments for

						introducing more cost effective or cost reducing innovations, social enterprises to generate self-funding, open access publishing, appropriate informatics capability to monitor innovation adoption, triple helix networks,
Kaasa A, et al (2007)	Social capital, Institutional quality	Organisational	No	No	Two stages of data analysis (1) Data drawn from the Innovation Union ScoreBoard and Eurostat (both 2007) to assess innovation activity and its utilisation in Europe (pages 13-18 for details). (2) measuring factors of innovation – social capital from various special surveys e.g. World Values Survey, International IDE database etc. Avoids using an overall index, 1 variable or 1 latent construct for social capital.	Generally, most dimensions of social capital and institutional quality have a positive effect on innovation. In some cases, formal institutions and different elements of social capital could substitute each other. The same holds for human capital. At the level of individual countries, however, the relations between innovation and influencing factors are not always so clear.
Kearney AT (2011)	Facilities and infrastructure, Favourable regulations and ease of doing business, Focused sector strategy, Access to capital and financing, Talent and technology development	Ecosystem	No	No	Studied 50 economic clusters globally and across sectors (including life sciences, IT and high tech)	Identified qualifying ecosystem enablers (enter field of competition) and differentiating ecosystem enablers (create a unique value proposition) that make economic clusters sustainable
Lambooij MS,	Stakeholder	Organisational	Focused on adoption of health	No	Quantified the preferences of	No

Hummel MJ (2013)	expectations		innovations. Stakeholder preferences reflect expected benefits rather than costs		stakeholder groups for 9 IT innovations in hospital care	
Leminen S, Westerlund M and Nyström AG (2012)	Livinglabs, networks	Intermediary	4 network types driven by open innovation: utilizer, enabler, provider and user-driven	No	103 semi-structured interviews with participants in and end-users from 26 Livinglabs in Finland, Sweden, Spain and South Africa plus secondary data	No
McGuirk H, Lenihan H and Hart M (2014)	Human capital	Ecosystem and organisational	To measure IHC they score the individual manager against 4 elements: education and training (binary variables), plus 2 intangible elements (willingness to accept change and job satisfaction. The study found that creating an enabling environment (both within the firm and the external environment in which the firm operates more broadly) to recognise and embrace IHC is critical as a determinant of small firm innovation. This supports the paper's hypotheses that small firms employing managers who participate in training and are willing to change are more likely to innovate.	No	The aim of the research is to extend the traditional measure of human capital by developing the concept of Innovative Human Capital (IHC). It builds on the traditional tangible measure of third level education by adding training, as well as the intangible attitudes and characteristics of the employee-manager including willingness to accept change in the workplace and job satisfaction. The research then proceeds to estimate the effect of IHC on small firm innovation and hence growth (jobs, sales and productivity). The empirical analysis is based on a large firm-level dataset extracted from the Irish National Centre for Partnership and Performance (NCPP) 2009 Workplace Survey.	
New South Wales (2010)	Networks, External knowledge, Internal knowledge, Market interactions, Access to professional and	Ecosystem, Intermediary, Organisational	The strategy sets out its drivers and enablers for innovation across key sectors. The enablers are if 2 types (i) Access to knowledge (skills to develop knowledge internally, networks,	No	Strategy developed through background research to describe the drivers and enablers of innovation, public and industry consultation, 5 case studies from	Evaluation of the implementation of the 7 recommendations will inform the development of the Innovation Initiatives by acting as inputs to the analysis of innovation blockages and

	technical business services, Access to finance, ICT, Logistics, Government support		market interactions, external knowledge from outside the region, external knowledge cross-industry, research institutions) (ii) Implementation tools (access to professional and technical business services, access to finance, ICT, logistics, government support) The types of drivers identified are actually more akin to enablers elsewhere		different sectors (agriculture, energy, manufacturing, tourism, wine)	the prioritisation of the key issues.
Niitamo VP (2009)	Livinglabs. Co-design by users	Intermediary	Finding complex solutions in evolving real life user-focused contexts. Fills the gap between research push and market pull.			No
Öberg, C., & Shih, T. (2014).	The logic of firms (priorities, interests and interactional goals of companies)	Organisational	Looks at development and commercialisation of innovation and what motivates different types of innovation (generic and novel)	No	Case study of drug development by a Taiwanese biopharmaceutical company	Divergent logic can inhibit ability of firms to commercialise innovations unless firms redefine their innovation goals or find incentives that meet the interests, priorities and interaction goals of other parties
Owen-Smith J. and Powell WW. (2004)	Knowledge networks, spillovers, Intellectual Property protection	Organisational	The authors explore how important non-structural features -such as the characteristics of the organizations that represent nodes in a network, geographic location, or the institutional underpinnings of the larger structure --alter the character of information flows through 'open channels' and 'closed conduits' in the biotechnology field in Boston	No	Primary explanatory data are drawn from a relational dataset of formal network connections involving 482 dedicated biotechnology firms for the period 1988- 1999. 3 The data on firms and inter-organizational arrangements were coded from *BioScan*, an industry publication that reports information on firms and the formal arrangements in which they are involved. Network variables – membership and position. Control variables = Boston	

					R&D ties and ties to NIH complex. The dependent variable, a count of patents assigned to those corporations, was developed using the United States Patent Office's online database. In sum, the authors find that two attributes -- geographic propinquity, and the institutional characteristics of key members in a network -- transform the ways in which an organization's position within a larger network configuration translates into advantage.	
Roper et al (2008)	Value chain	Intermediary	Modelling the complete value chain profiles the structure and complexity needed to translate knowledge into business value. It underlines the role of skills, capital investment and other resources (including intangibles) in the value creation. The value chain has 3 stages: knowledge production (in-house R&D, backward KS, horizontal KS, public KS, forward KS), innovation production (product or process) and exploitation via output production (labour productivity, sales growth and employment growth)	No	This modelling was done with a large group of manufacturing firms in Ireland and Northern Ireland. The Irish (IIP) provided information on innovation, technology adoption, networking and performance of manufacturing plants between 1991-2002 drawn from 4 linked surveys.	In both Ireland and Northern Ireland there is evidence of a positive innovation value chain with firm's innovation activities grounded in knowledge sourcing activity leading to improved business performance. Other factors play a role in this (e.g. internal resources and market environment) and shape the strength of each of the links in the value chain
ScanBalt (2013)	Scouting and early evaluation, business support and financing, implementation and marketing,	Ecosystem	The Innovation Agenda provides a flexible pathway for picking up early ideas and taking them through the phases that can take an idea and transform it into a marketable product or service	Considers the different geographical and cultural contexts in which the Agenda needs to be implemented by engaging with relevant stakeholders early on and	Development of a Macro-Region Innovation Agenda. 6 regional hearings, supported by a Network hearing in Brussels, a HealthPort Press study tour.	Where implementation of the Agenda can be monitored and evaluated: platform of young entrepreneurs and experts for early evaluation, innovation competitions, idea management platforms, effective

	education and qualification, regulation and procurement			driven by principles of openness and collaboration.		forms of transnational financing, transnational and cross-sectoral mentoring, one-stop shop for SMEs, transnational market implementation, strategic communication, SME tailored courses, initiatives to support clinical trials including SME support, early HTA assessment,
Seppänen S (2008)	Learning organisation, networks, social capital, R&D intensity, human capital, finances, physical infrastructure	Organisational and intermediary	With human capital indexes measure potential and not processes or outputs. Employment indicators offer a narrow science-based picture of the producers of innovation. Also, a focus on quantitative measures does not reveal the quality of competencies. A focus on patents for innovation performance narrows the types of innovation considered	Operational cultural factors that facilitate cooperation and trustful-interaction leading to institutionalisation of interactive innovation	13 indexes describing the competitiveness and innovation of regional innovation systems	No
Sisodiya, SR. Johnson, JL. and Grégoire, Y. (2013)	Social capital Relational capability enhanced by network spillovers and flexibility	Organisational and intermediary	No	No	8 field interviews with senior people followed by testing relationship hypotheses with 204 business-to-business high-tech firms and secondary data	Ability of a firm to maintain and develop external connections in a knowledge rich environment is a critical enabler. In particular, relational capability enhances benefits from open innovation where network spillovers are greater.
Trippl M, Asheim B and Miorner J (2015)	Human capital, infrastructure, knowledge bases (analytical, synthetic, symbolic)	Ecosystem	No	No	Critical appraisal of RIS 2014, Regional Innovation Monitor and OECD Regional database. Provide only a partial picture of RIS potential and performance empirical and largely ignores advances made in conceptual debates on specificities of less-developed regions	No
Walshok, ML,	Social capital,	Intermediary	S&T innovation and	Place-based characteristics:	Case studies of Philadelphia, St.	No

Shapiro, JD, & Owens, NJ. (2013).	networks, absorption capacity, learning organisations,		commercialisation in dynamic innovation environments	who champions, resource assets determine outcomes, building specific and general links, motivations and competencies of mentors and advisors	Louis, and San Diego. Mixed methods used	
Yu, SH. (2013).	Social capital, absorptive capability	Organisational	No	No	Tested their impact on innovation performance	Evaluated number of patents submitted, date of submission and patents approved

Annex C - Summary of territorial innovation patterns in EU regions

In contrast to the Innovation Union ScoreBoard and the Regional Innovation ScoreBoard the ESPON *Knowledge, Innovation and Territory* report (2013) introduced a different conceptual framework for understanding spatial innovation patterns. This relates to earlier work by Caragliu and Lenzi (2006) that set out a conceptual approach to the notion of territorial patterns of innovation[61]. Taken with the results of the more recent KIP report (ESPON 2013) this might have implications for how S3 performance at regional levels is measured and why some enablers might be more important than others for modest and moderate innovator regions.

In the ESPON report, territorial patterns of innovation were defined as the combination of territorial specificities (context conditions) and the different modes of performing the different phases of the innovation process[62]. A related paper by the lead KIT researcher confirms that, the analysis of the same sector in different regions of three EU 27 countries shows that territorial elements have a more fundamental effect on the emergence of specific patterns of innovation with respect to sector characteristics[63]. In addition, regions can engage into upgrading as well as downgrading trajectories in their knowledge and innovation acquisition and creation processes, witnessing the adaptability and usefulness of the territorial patterns of innovation framework to read regional innovation dynamics[64].

The map below shows a large variety of possible innovation patterns. None of these patterns is by definition superior to another. Each territorial pattern may provide an efficient use of research and innovation activities generating growth. The ESPON Report (2013) describes each of these five patterns in the following way[65]:

A. European science-based area describes regions, which are strong in producing knowledge and innovation in the field of general-purpose technology. They have high R&D endowment and science-based local knowledge, and a high degree of knowledge coming from regions with a similar knowledge base. These regions are mostly located in Germany, with the addition of Vienna, Brussels, and Southern Denmark;

B. Applied science area comprises regions that are strong in knowledge production, R&D and applied science, with a high degree of knowledge coming from regions with a similar knowledge base. This type of regions is mostly located in central and northern Europe, namely in Austria, Belgium, Luxembourg, Switzerland, Germany, Estonia and some capital regions in other countries;

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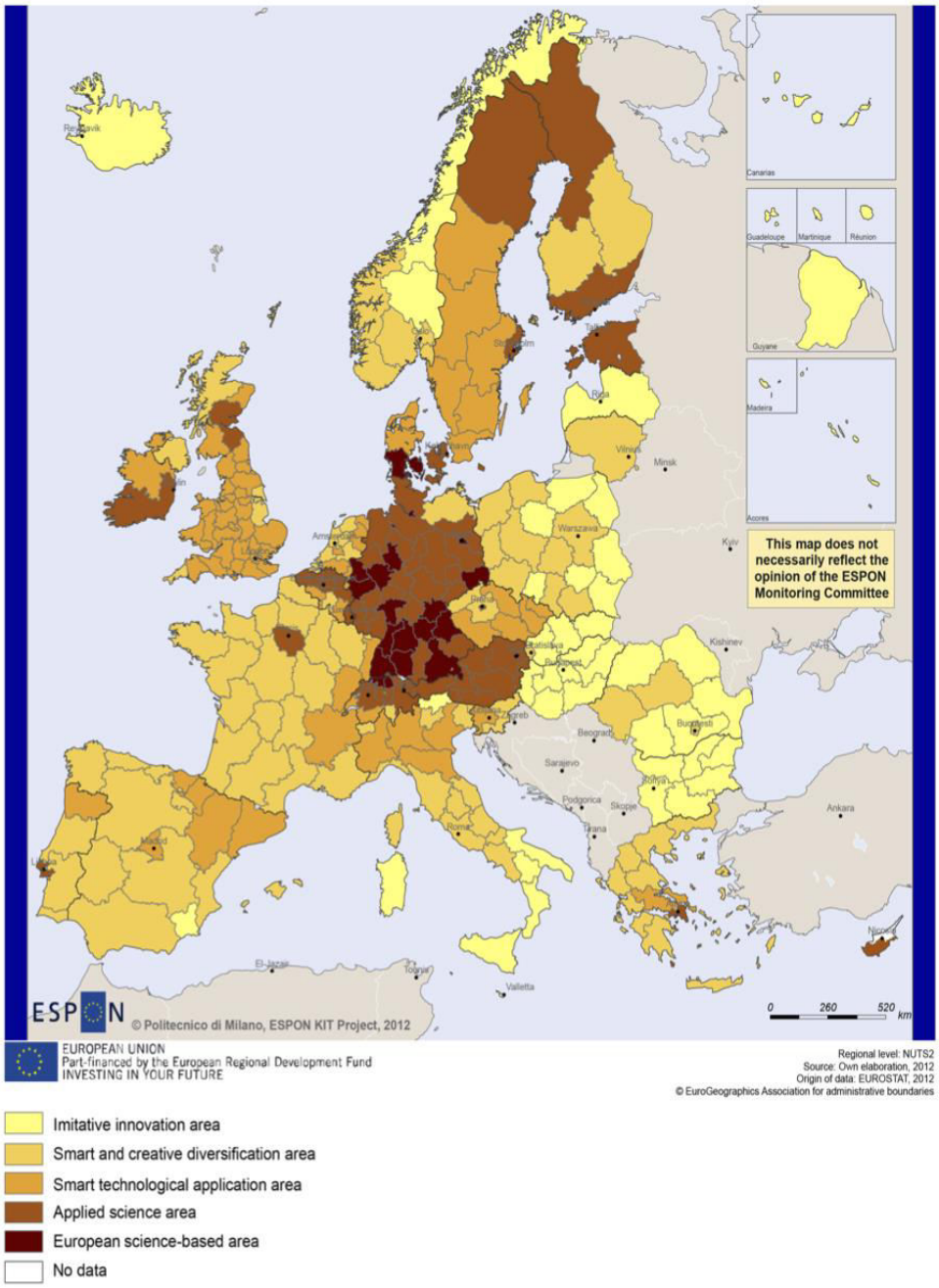
[61] Caragliu, A. and Lenzi, C. (2013) Structural elements and dynamics in territorial patterns of innovation: A perspective through European case studies. Regional Science Policy and Practice, Special Issue: Territorial patterns of innovation: evidence from successful European case studies, 5(4): 369–383

[62] ESPON (2013) Knowledge, Innovation, Territory (KIT). Applied research report, 13 January 2013.

[63] See also: Capello R (2013) Territorial patterns of innovation and economic growth in European regions, Growth and Change, Special Issue: Knowledge, Innovation, and Regional Performance Territorial Patterns of Innovation in Europe. Guest Editor: Roberta Capello, 44(2):195–227

[64] This notion is supported by research conducted across three cities in the USA with high performing RIS: Walshok, ML, Shapiro, JD, & Owens, NJ. (2013). Unraveling the cultural and social dynamics of regional innovation systems. University of California. Retrieved from http://connect.org/email/global-connect/Reports/UnravelingSocialDynamicsJanuary2013.pdf

[65] ESPON (2013) p.17 and 19



C. Smart technological application area characterises regions with both high product innovation rates and creativity, which helps to translate external basic science and applied science knowledge into innovation. They have a limited degree of local applied science and R&D endowment. This group includes mostly agglomerations in EU15, such as the Northern parts of Spain, Northern Italy, the French Alpine regions, the Netherlands, Czech Republic, Sweden and the UK;

D. Smart and creative diversification area describes regions with low degrees of local diversified applied knowledge and internal innovation capacity. At the same time, they have high degrees of local skills, creativity and entrepreneurship, also drawing external knowledge. These regions are mainly located in Mediterranean countries, but also in Eastern Europe, including Slovakia, Slovenia, Poland and Czech Republic;

E. Imitation area comprises regions with low knowledge and innovation intensity, entrepreneurship, and creativity. However, they have high attractiveness and innovation potentials. Most of these regions are located in newer EU Member States, such as Bulgaria, Hungary, Latvia, Malta, but also in several regions of Italy, Poland, Romania, and Slovakia.

The range of innovation patterns explains the failure of a 'one size fits all' policy to innovation. Table 4 below shows how RIS 2014 rankings and ESPON 2013 territorial patterns compare as an example of this. While there is some complementarity between RIS 2014 performance categories and ESPON KIT innovation patterns, there is not a complete match.

Innovation patterns typical for each specific area have to be identified with reference to how Smart Specialisation Strategies (S3) are applied. These insights can facilitate the development and better implementation of innovation policies. However, to move in this direction, the measurement of efficiency and effectiveness of each pattern of innovation on growth is necessary.

Moreover, the implication of this territorial dimension to S3 is a need to identify appropriate benchmarking opportunities when assessing the impact of enablers improving performance.

EU Member State and Region	RIS Performance category (2014)	Territorial pattern of innovation (ESPON 2013)
Bulgaria		
Severna I iztocha Bulgaria	Modest	Imitative innovation area
Yugozapadna I yuzhna tsentralna Bulgaria	Modest	Imitative innovation area
Croatia		
Sjeverozapadna	Moderate	-
Sredisnja I Istocna (Panonska)	Modest	-
Jadranska	Modest	-
Czech Republic		
Praha	Moderate	Applied Science area
Strední Cechy	Moderate	Smart and Creative Diversification area
Jihozápad	Moderate	Smart Technological Application area
Severozápad	Moderate	Smart and Creative Diversification area

Severovychod	Moderate	Smart Technological Application area
Jihovychod	Moderate	Smart Technological Application area
Strední Morava	Moderate	Smart Technological Application area
Moravskoslezsko	Moderate	Smart Technological Application area
Estonia		
Estonia	Follower	Applied Science area
Hungary		
Közép-Magyarország	Moderate	Imitative Innovation area
Közép-Dunántúl	Moderate	Imitative Innovation area
Nyugat-Dunántúl	Moderate	Imitative Innovation area
Del- Dunántúl	Modest	Imitative Innovation area
Észak-Magyarország	Modest	Imitative Innovation area
Észak-Alföld	Modest	Imitative Innovation area
Dél-Alföld	Moderate	Imitative Innovation area
Latvia		
Latvia	Modest	Imitative Innovation area
Lithuania		
Lithuania	Moderate	Smart and Creative Diversification area
Poland		
Lódskie	Modest	Imitative Innovation area
Mazowieckie	Moderate	Smart and Creative Diversification area
Malopolskie	Moderate	Smart and Creative Diversification area
Slaskie	Modest	Smart and Creative Diversification area
Lubelskie	Modest	Imitative Innovation area
Podkarpackie	Moderate	Imitative Innovation area
Swietokrzyskie	Modest	Imitative Innovation area
Podlaskie	Modest	Imitative Innovation area
Wielkopolskie	Modest	Smart and Creative Diversification area
Zachodniopomorskie	Modest	Smart and Creative Diversification area

Lubuskie	Modest	Smart and Creative Diversification area
Dolnoslaskie	Moderate	Smart and Creative Diversification area
Opolskie	Modest	Imitative Innovation area
Kujawsko-Pomorskie	Modest	Imitative Innovation area
Warminsko-Mazurskie	Modest	Imitative Innovation area
Pomorskie	Modest	Smart and Creative Diversification area
Romania		
Nord-Vest	Modest	Imitative Innovation area
Centru	Modest	Imitative Innovation area
Nord-Est	Modest	Imitative Innovation area
Sud-Est	Modest	Imitative Innovation area
Sud-Muntenia	Modest	Imitative Innovation area
Bucuresti-Ilfov	Moderate	Imitative Innovation area
Sud-Vest Oltenia	Modest	Imitative Innovation area
Vest	Modest	Imitative Innovation area
Slovenia		
Vzhodna	Moderate	Smart and Creative Diversification area
Zahodna	Follower	Smart Technological Application area
Slovakia		
Západné	Moderate	Smart and Creative Diversification area
Stredné	Moderate	Smart and Creative Diversification area
Vychodné	Modest	Imitative Innovation area

Table 4: Contrasting RIS 2014 rankings and ESPON 2013 territorial patterns