RE-ACT

FOUNDATIONS FOR SELF-ASSESSMENT – HEINNOVATE FOR RIS3

Research Report

Co-funded by the Erasmus+ Programme of the European Union

Content

1. Introduction

This Research Report (RR) is the outcome of Work Package 1 (WP1) in the shared project titled "self-reflection tools for smart universities acting regionally" (RE-ACT)[1] which involved five partner institutions: Porto Business School (as project coordinator – Portugal), Corvinus University of Budapest (Hungary), Technical University of Košice (Slovak Republic), Babes-Bolyai University of Cluj Napoca (Romania), and University of Macerata (Italy) – with methodological consultancy help from SERN (Startup Europe Regions Network).

WP1 included a cross-analysis to investigate the potential of the HEInnovate[2] tool for RIS3. It consisted of a Literature Review (LR) and fieldwork activities. As a result of the research activities, the partners elaborated several statements describing the higher education institutions' (HEIs') contribution to Research and Innovation Strategies for Smart Specialisation (RIS3), which will be discussed during the validation workshops in the partners' countries, as well as integrated in the HEInnovate for RIS3 tool that represents the next step of the RE-ACT project.

In the introduction, the purpose of the report, the research design, and the structure of the document are presented.

1.1. Purpose of the Research Report

This document summarises the results of the first work package of the project. The report has a double purpose: first, it launches the research towards various fields of regional studies so that the research team can gain insight into the different questions and key concepts of regional innovation, regional strategy, the role of HEIs, etc., in an exploratory manner. Secondly, it draws the most important conclusions of the different research methods in a well-structured summary in order to support the validation workshops.

This step of the WP1 will be addressed to regional actors from the different nodes of the quadruple helix framework.[3] Validation workshops will be organised at the end of the research process for collecting additional feedback on the research findings and identifying key takeaways.

Inputs collected in the workshops will be gathered and considered for the development of the Guidelines for HEInnovate for RIS3.

1.2. Research design, methodology

The report follows the logic of WP1, as outlined in the project. General exploration of the topic in a broader sense was done by collecting, reviewing and summarising the most

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[2] Higher Education Innovation

[3] Quadruple helix framework describes relations and interactions between universities, industry, government and civil society. (Carayannis & Barth & Campbell, 2012)

important and relevant scientific literature. The findings of the LR showed the strengths and weaknesses of HEIs and their current and potential future contribution to RIS3.

Because of the exploratory nature of the research, the research team decided to use qualitative methods to discover the key issues (in accordance with the application form of the project). The different stakeholder groups, however, required different measurement approaches in order to contribute effectively towards the research goal.

A Delphi technique in three-round questionnaires was carried out to analyse the value HEInnovate can add to RIS3 as well as to identify potential improvements to its contents from the participants' perspectives. In addition, interviews took place with public authorities or other organisations responsible for RIS3 processes at both regional and national levels. These addressed HEIs' engagement in and contribution to previous RIS3 processes and expectations as to their involvement in current and future RIS3 design, implementation and monitoring, as well as other related processes.

The results of the LR, Delphi technique and interviews are presented and discussed in this research report.

1.3. Structure of the Research Report

This research report contains five chapters including the introduction, plus four annexes to reinforce the research results presented in the main paper. The second chapter describes the scope and the context of the research, a knowledge of which is essential to understanding the rationale and the aim of the research, and just as importantly, the way it connects to other similar projects. The third chapter introduces the research methodology; it also dedicates a section to the effects of COVID-19 pandemic on the project. The fourth chapter presents the results of the research activities, highlighting the key elements in relation to the goal of the RE-ACT project. The final chapter concludes the overall findings of the various elements of the first work package. The Annex section includes a glossary of key terms and abbreviations, the literature review, the report of the Delphi techinque, and the report of the interviews.

2. Research context and objectives

This section describes the general context of the research activities undertaken in the framework of WP1 of the RE-ACT project. It gives a short overview on the background of the research and its rationale, as well as its proposed contribution, briefly outlining the research steps. In addition, the sub-chapter presents the aim of the research, the research hypothesis and the subsequent research questions for each one of the research activities carried out. Moreover, the project's connection with other projects and programmes is highlighted.

2.1. Background and rationale

Smart specialisation strategies or RIS3s are a new approach to growth and development through innovation and a tool of Cohesion Policy. Regulation (EU) No 1303/2013[4] defines them as "national or regional innovation strategies which set priorities to build competitive advantage by developing and matching research and innovation own strengths to business needs in order to address emerging opportunities and market developments coherently, while avoiding duplication and fragmentation of efforts." These strategies are place-based, result-oriented and tailored to local/regional needs, context and economic potential (McCann, 2015).

As a concept, smart specialisation advocates for a non-neutral identification and vertical prioritisation of areas that can be targeted by policy interventions in order structurally to transform them through research and innovation (Foray, 2015). The identification of such priority areas involves a bottom-up process, with emphasis placed on entrepreneurial discovery, interactively involving "entrepreneurs in the broadest sense" (Foray, 2015; p. 40). The process of entrepreneurial discovery relies on the so-called quadruple helix approach, facilitating interaction between representatives of industry, of research and education organisations, of government or public administration, as well as of citizens, consumers and workers (European Union, 2012). Quadruple helix stakeholders should also be represented in RIS3 governance structures. Setting up governance structures and identification of priority areas are steps of RIS3 design, along with the analysis of the socio-economic context; the definition of a shared strategic vision; the elaboration of a policy mix and action plan, as well as the design of a monitoring and evaluation system (European Union, 2012).

Implementation of RIS3s can be financed from various public and private sources (European Union, 2012); however, elaboration and implementation of such strategies have become closely connected with Cohesion Policy. RIS3s were set as *ex ante* conditionality for using and declaring European Regional Development Fund (ERDF) expenditures under Thematic Objective 1 – Promoting research, development and innovations – in the 2014-2020 programming period (Foray, 2015). For the 2021-2027 financial exercise, RIS3s are an enabling condition for Policy Objective 1 – A smarter Europe by promoting innovative and smart economic transformation (Proposal for Regulation COM, 2018/0196).[5] For 2014-2020, this specific *ex ante* conditionality applied to 169 out of 205 ERDF financed programmes, mainly regional Operational Programmes (Tolias, 2019). Ten Member States have elaborated both national and regional strategies, six only regional RIS3s, while twelve EU countries decided to design only national strategies (Larrea *et al*., 2019). Regarding the member states covered by this RE-ACT project, Italy, Portugal and Romania officially developed both

[4] Regulation (EU) No 1303/2013 of the European Parliament and of the Council of 17 December 2013 laying down common provisions on the European Regional Development Fund, the European Social Fund, the Cohesion Fund, the European Agricultural Fund for Rural Development and the European Maritime and Fisheries Fund and laying down general provisions on the European Regional Development Fund, the European Social Fund, the Cohesion Fund and the European Maritime and Fisheries Fund and repealing Council Regulation (EC) No 1083/2006, OJ L 347, 20.12.2013, p. 320–469, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32013R1303.

[5] Proposal for a Regulation of the European Parliament and of the Council laying down common provisions on the European Regional Development Fund, the European Social Fund Plus, the Cohesion Fund, and the European Maritime and Fisheries Fund and financial rules for those and for the Asylum and Migration Fund, the Internal Security Fund and the Border Management and Visa Instrument, COM/2018/375 final - 2018/0196 (COD), https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2018%3A375%3AFIN.

national and regional RIS3s, while Hungary and Slovakia only national RIS3s. However, both in Hungary and Slovakia some of the NUTS II regions voluntarily developed RIS3s. Since 2015 the smart specialisation approach has started to be adopted outside the EU as well, both in Europe – by countries covered by the EU Neighbourhood and Enlargement Policy and the European Economic Area – and in other continents like Africa, America, and Australia.

The smart specialisation approach is in line with modern theories on regional development, which view innovation and entrepreneurship developments as crucial to economic growth and argue for policies that are place-sensitive and differentiated, depending on regional capabilities (McCann, 2015). HEIs have an important role in innovation and place-based development, both from the perspective of knowledge generation and dissemination, i.e. "they are not just providers of education or conductors of research, but also have a wider role, (Larrea *et al.*, 2019) which includes generating and attracting talent, collaborating with local business, and facilitating innovation, entrepreneurship and competitiveness", i.e. are "a source of regional demand and employment, a source of highly skilled employees and a source of invention and innovation" (Beer *et al.*, 2020; p. 27). Thus, the role of universities and higher education institutions is linked with their first two missions – education and research -, but also to their Third Mission (TM). The TM regards universities as "engines that contribute to the social, economic and cultural development of the regions in which they operate, by transferring knowledge and technologies to industry and society at large"; moreover, it is closely connected to the entrepreneurial university concept (Compagnucci & Spigarelli, 2020), as well as the concept of the civic university described by Goddard (2009) and Goddard *et al.* (2016). Such a role involves engagement and dedication towards addressing economic and social needs that have an internal dimension as well as an external one, realised through cooperation with other types of actors at regional, national and international levels (Edwards *et al.*, 2017).

Particularly in the case of smart specialisation, the literature underlines the central role universities should play in the implementation of RIS3s, based on priorities defined at a regional level and by adopting a more anticipatory, active and strategic role in promoting knowledge transfer to society, instead of remaining in a distant "ivory tower" (Fonseca & Salomaa, 2020). In addition, universities, as part of the quadruple helix, should be actively involved in strategy design (European Union, 2012). The Renewed EU Agenda for Higher Education also highlights that HEIs should play a wider role in local and regional development, thereby (a) facilitating connections between academics, entrepreneurs and public authorities, (b) aligning their educational offer to needs identified in smart specialisation strategies, (c) seizing opportunities for innovation in priority sectors, and (d) helping local businesses and other organisations to understand and adopt new ways of thinking.

Recognising the key role HEIs can play in RIS3 design and implementation not only as knowledge producers and disseminators, but also acting as 'boundary spanners' that can bridge or link research, education and innovation (the 'Knowledge Triangle'), the Joint Research Centre of the European Commission (JRC) implemented a project called Higher Education for Smart Specialisation (HESS) in partnership with DG Education and Culture.

Results of this project underline that universities can contribute to RIS3 design and implementation from an education, research and third mission perspective, in ways such as:

- education for the development of quadruple helix partnerships, for enhancing the innovation skills of graduates and for improving the competencies of human capital, through adult learning programmes;
- participation in EDPs, as key actors involved in the process, bringing both an entrepreneurial contribution and a research contribution to a bottom-up process oriented towards solving the problems of businesses and society;
- participation in RIS3 higher level or strategic governance structures, as managers of the process, in cooperation with other regional stakeholders;
- contribution to the definition of a shared vision for RIS3;
- involvement in strategy monitoring, not just in the design of the system, but also in the monitoring activity (collection and analysis of data), as well as through the development of skills and knowledge necessary for performing the monitoring activity (Edwards & Marinelli, 2018).

However, the same handbook edited by Edwards and Marinelli (2018) underlines the HEIs' need for support for more effective involvement in the smart specialisation process, especially when it comes to achieving more efficient cooperation with businesses and other regional actors, noting, for example, that frameworks of performance assessment should be changed, incentives offered for career development should be assured, administrative burdens should be reduced and funding instruments should be aligned to HEIs needs, etc. While part of the support should come from the outside, for instance on behalf of organisations responsible for RIS3 as a policy in terms of financing, HEIs should also adapt and undergo internal changes in order to become more engaged and involved in regional development through smart specialisation. More effective participation would involve a strategic vision in this sense and institutional change at the level of HEIs enabling them to engage in co-creation dynamics with actors from the helix, as underlined in a JRC report (Arregui-Pabollet *et al.*, 2018).

There are several tools (see Table 1) that help universities to assess their advancement in becoming more engaged and active players in regional development. Such tools are also offering support to further actions to be taken by HEIs in this sense.

Table 1 – Tools that help universities to assess their advancement in becoming more engaged and active players in regional development (Source: authors)

Tool	Description	Website
TEFCE – Towards a European Framework for Community Engagement in Higher Education	The objective of the TEFCE project is to develop innovative and feasible policy tools at the university and European level for supporting, monitoring and assessing the community engagement of higher education institutions	https://www.tefce.eu/toolbox
U-Multirank project – Universities compared	U-Multirank is a multidimensional, user-driven approach to the international ranking of higher education institutions. It compares the performances of HEIs in the five dimensions of university activity: (1) teaching and learning, (2) research, (3) knowledge transfer, (4) international orientation and (5) regional engagement.	https://www.umultirank.org/
Governor Self-Assessment Tool	This resource addresses the challenges and rewards of being a governor in higher education. This tool helps to confirm the strengths they bring to the task and also to identify areas for developing knowledge and understanding of what is required in the dynamic and changing world of higher education.	http://govsat.lfhe.ac.uk/
Higher Education Institutional Capacity Assessment Tool (HEICAT)	This tool is designed to help HEIs gauge their performance across a range of management and academic functions by evaluating the extent to which they meet a series of good practise criteria.	https://www.irex.org/resource/higher-education-institutional-capacity-assessment-tool-heicat
Advance HE	The Advance HE board is dedicated to helping higher education shape its future, enhancing organisational performance to deliver sustainable change; developing and connecting people in order to deliver impact; accrediting achievement to be recognised; supporting transformative leadership and management, teaching and learning, equality, diversity and inclusion, and effective governance.	https://www.advance-he.ac.uk/

One of the most advanced tools is HEInnovate, developed through a joint initiative of the European Commission and OECD, with the aim "to support higher education institutions to empower students and staff to demonstrate enterprise, innovation and creativity in their teaching, research and third missions." A key element of HEInnovate is a free self-reflection tool, currently used by more than 1100 HEIs across the world, organised around eight dimensions:

1. Leadership and Governance
2. Organisational Capacity: Funding, People and Incentives
3. Entrepreneurial Teaching and Learning
4. Preparing and Supporting Entrepreneurs
5. Digital Transformation and Capability
6. Knowledge Exchange and Collaboration
7. The Internationalised Institution
8. Measuring Impact

Universities can capitalise on the results of the self-assessment along the eight dimensions in order to propose and implement actions and measures that help them in becoming more innovative and entrepreneurial. To this end, HEInnovate also offers a guiding framework, additional resources and training materials, as well as support on behalf of experts for all HEIs (Universities, University Colleges, Polytechnics, etc.). While this tool in its current form is very beneficial for supporting a better involvement of universities in regional development through innovation and entrepreneurship, including smart specialisation, it was not particularly tailored to RIS3 as a new approach towards innovation policies. Further development of this instrument from a RIS3 perspective would have a practical relevance, since it could support HEIs in rethinking and repositioning their strategies by aligning their internal structures and actions towards a more efficient involvement in the design and implementation of smart specialisation strategies, in effect, by participating in the smart specialisation process. This would not only reinforce their role as key actors in regional development and as 'boundary spanners' or a point of liaison between the knowledge production and knowledge exploitation side of their regional innovation systems, but it could also be beneficial for the HEIs in the EU from the perspective of absorbing European, and especially Cohesion Policy, funds. Besides the practical relevance, the research undertaken within the RE-ACT project can also contribute to further enriching the literature on the role of universities in regional development and smart specialisation strategy design and implementation. Additionally, it can fill a gap regarding the use of self-reflection tools in the context of smart specialisation.

2.2. Aims of the research

The background context and rationale of the RE-ACT project showed HEIs' relevance in innovation and place-based development through knowledge generation and dissemination, as well as through interaction with other stakeholders involved in such processes.

In line with project objectives, this research emphasised the role of entrepreneurial HEIs in innovation-driven regional development employing a smart specialisation approach. This role is linked to their first two missions (education and research), but also to their third mission, namely their contribution to social, economic and cultural development (knowledge and technology transfer, civic engagement). Being a part of the quadruple helix, universities should be actively involved in the Smart Specialisation Strategy design and implementation. Moreover, they should efficiently interact with other actors involved in the regional innovation system during the process. However, HEIs face particular challenges and encounter specific problems linked to this involvement both internally and externally. Thus, for a more effective involvement, they need support. This support is necessary for the HEIs' more efficient cooperation with businesses and other regional actors like policymakers, local public authorities, etc. In addition, it entails making appropriate changes at an internal level, in ways that include adjusting internal strategies, procedures, and incentive systems.

The HEInnovate self-reflection tool helps HEIs to assess their level of advancement in terms of becoming more engaged and active players in regional development. However, this tool could be further developed to support HEIs in rethinking and repositioning themselves, in aligning their internal strategies, structures and actions towards a more efficient involvement in the design and implementation of regional and national Smart Specialisation Strategies.

Against this background, the RE-ACT project proposed to develop, test and implement a new online self-reflection tool: HEInnovate for RIS3. The main aim is to further exploit the potential of HEInnovate from the perspective of RIS3. Results should support HEIs in having a more effective involvement in the design and implementation of RIS3, as well as contribute to a more efficient interaction of HEIs with other stakeholders from the innovation system. While initial emphasis was placed on stakeholders from the Triple Helix, this has been extended to quadruple helix during the early stages of the reasearch, in line with the RIS3 approach.

Based on the approved application form, the whole project is based on the following **research hypothesis**:

> *New dimensions, statements and support resources should be developed and added to HEInnovate to tailor the tool according to RIS3, serving as a guide and facilitating the organisational changes and collaborative processes HEIs should undertake in the smart specialisation process*.

Drawing upon these premises and the hypothesis, extensive research was undertaken covering the potential role of HEIs in RIS3 and, connected to that, the importance of HEInnovate as a self-reflection tool for HEIs from the perspective of the role they should play in regional development through smart specialisation.

The **main research questions** RE-ACT project wants to answer are:

How should HEInnovate change in order to be more in line with the RIS3 approach, and contribute to a more efficient involvement of HEIs in the RIS3 process?

How can HEInnovate support the strengthening of the role of HEIs as actors in the regional innovation system?

Consequently, Task 1.1 in WP1 was elaborated in order to direct a research process consisting of different strongly interconnected phases which tried to answer specific sub-questions relevant for the research:

Phase 1: literature review

What is the potential role of an entrepreneurial HEI from the perspective of RIS3 design and implementation in relation to each one of the 8 HEInnovate dimensions?

Phase 2: Delphi technique with experts in HEInnovate/RIS3

Which benefits for HEIs derive from their involvement in RIS3 design and implementation?

What is the potential role HEIs can play in RIS3 design and implementation?

What should be done to improve HEIs' ability to operate in RIS3 in the context of the Quadruple Helix?

Is HEInnovate perceived as a useful tool by HEIs?

What is its potential concrete application?

How should the tool be improved to allow HEIs to better operate in RIS3?

Phase 3: interviews with national/regional public authorities involved in RIS3 processes

What should be HEIs' contribution to RIS3 design and implementation, taking into consideration:

- their knowledge and expertise and their role according to the third mission as well as education and research?

- their interaction with other stakeholders from the Quadruple Helix both from regional and extra-regional level? In what terms should their contribution change to contribute more effectively and efficiently to achieving smart specialisation objectives in line with regional needs?

The methodological approach undertaken in relation to each phase of the research is presented in Chapter 3. The present report synthetically presents and summarises findings, so that these may be fed into the validation workshops. These events will aim to validate results with a larger group of stakeholders than those involved in the initial phases of the research, and also to collect further data and information that – along with research findings – will be used to develop the new conceptual outline for HEInnovate for RIS3.

2.3. Connections with other projects and programs

Other existing projects and programs (such as HEInnovate) aim to design and implement useful tools for HEIs to carry out self-reflection in order to improve their level of local engagement and development, relations with the territory and the business world. Among these, some of the projects very similar to HEInnovate are:

Beyond Scale – Promoting entrepreneurship and innovation in higher education at practice and policy levels

https://www.beyondscale.eu/

The main aim of this project is to strengthen the links between education, research and business. The project seeks to create a community of practice among the higher education institutions and their stakeholders, thereby promoting practical entrepreneurial experiences and activities focused on strengthening the links between education, research and business. It utilises the HEInnovate self-assessment platform to drive entrepreneurial and innovative change across a range of education and engagement activities in higher education institutions.

Beyond Scale has three objectives:

1. Development of the entrepreneurial capacity of higher education institutions in a pan-European community of practice;
2. Further development of the HEInnovate approach;
3. Document practices of organisational development and institutional change in the light of using the HEInnovate and similar tools, with a view to their later use as learning models for higher education actors and policymakers, and as input to the academic debate.

UASIMAP – Mapping Regional Engagement of Universities of Applied Sciences

https://uasimap.eu/

UASiMAP project aims to develop a self-reflection tool which will measure UAS local engagement and development of their further strategies. The project will also promote and communicate higher education institutions' contribution to society and the regional community, based on the experience and insights of key stakeholders from across the whole European Union. The project will also collect several good practices of successful UAS engagement on the local level.

The main goal of the UASiMAP project is to map and further support the regional engagement activities of European professional higher education institutions, in particular Universities of Applied Sciences (UAS).

THEI2.0 - Towards HEInnovate2.0: From assessment to action

http://www.thei2.eu/

The project will develop an increased and improved version of the HEInnovate tool developed by the European Commission and OECD with the aim of offering the HEInnovate user a set of new features. This augmented version aims to support decision making by the decision-makers of higher education institutions, in their various fields of intervention, in order to make them more innovative and entrepreneurial, above all allowing greater involvement, participation and communication by the people who define them.

3. Methodology

This chapter clarifies which approach has been adopted by the research team in addressing the research problem. The theoretical foundations that guided the definition of the methodology are summarised in 3.1; then methods, tools, samples and research processes are introduced.

3.1. Theoretical background of the research

In designing the research approach, the research team focused on the three main questions elaborated by Creswel (2003):

- *Which knowledge claims are made by the researcher?*
- *What strategy of inquiry will inform the procedures?*
- *What methods of data collection and analysis will be used?*

Knowledge claims chosen by the research team mix *social constructed* and *pragmatic knowledge*. This kind of approach allows researchers to choose between qualitative or quantitative methodologies, according to the specific emerging needs and project's aims (Creswell, 2014). In fact, social constructivism highlights the social implications of knowledge creation (Perkins, 1999) and the active role of researchers; on the other hand, pragmatic knowledge is problem-centred, practice-oriented and flexible (Kaushik and Walsh, 2019).

For what concerns the *strategy of inquiry*, a *mixed research approach* has been chosen, by including both a qualitative and quantitative perspective, with the aim to provide a more complete understanding of the research problem. Mixed-method research offers powerful tools for investigating complex processes and systems (Creswell *et al*., 2003; Creswell, 2014; Tashakkori and Teddlie, 2003). Moreover, it gives the opportunity to enhance the value of the research (Bryman, 2006): qualitative data can be used to assess the validity of quantitative findings; at the same time, qualitative inquiry can inform the development or refinement of

quantitative instruments, or generate hypotheses in the qualitative component for testing in the quantitative component (O'Cathain *et al*., 2010).

As for *methods* adopted, the project team has developed a methodology that includes different data collection and analysis instruments, by combining desk and field activities.

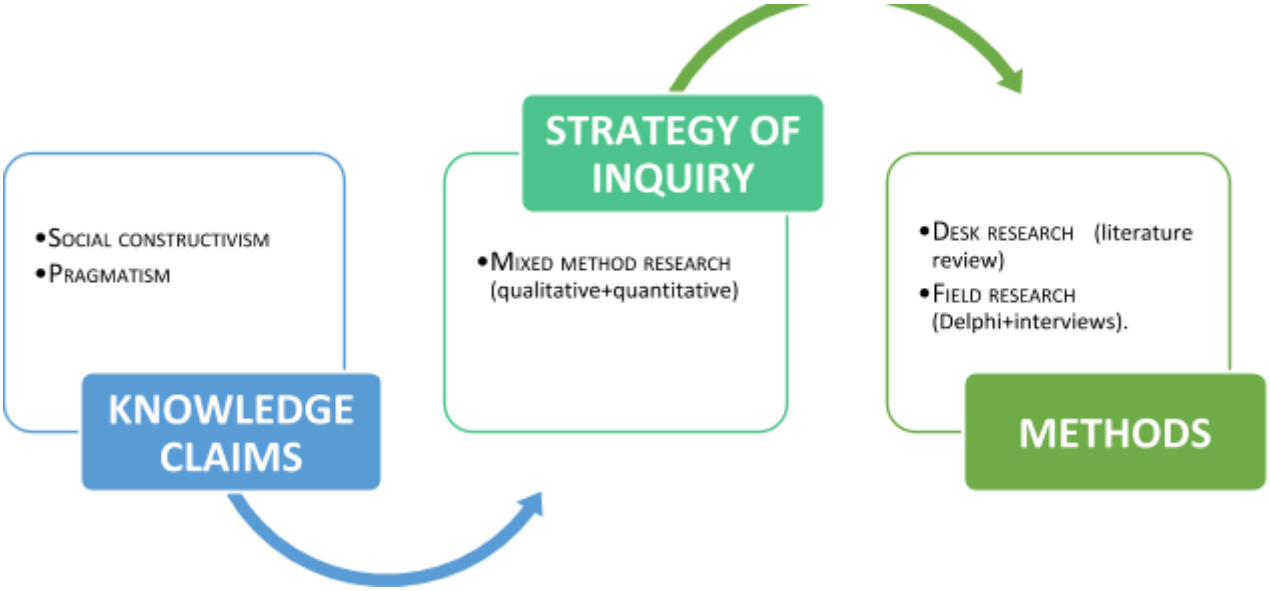

Figure 1 – The design of the research approach (Source: authors, based on Crewell model)

3.1.1 Desk research

The research began with a desk research activity, a literature review in particular which focused on the role played by higher education institutions in their local and regional environment. Two main perspectives have been considered: the level of involvement in RIS3, and the level of knowledge and use of HEInnovate self-assessment tool. Relying on these premises, the LR aimed at answering the following main research question: *what is the potential role of an entrepreneurial HEI from the perspective of RIS3 design and implementation in relation to each of the 8 HEInnovate dimensions?*

In accordance with the constructivist and pragmatic approach of the research (see 3.1), the LR played a supporting role in the whole research activity. In fact, it has not been employed only at the initial stages of the research for identifying hypotheses to test and the methodology to be implemented as required by traditional methodologies; rather it supported the knowledge creation and was usefully employed to build the next steps of the research and to interpret emerging data and information.

Starting from these theoretical premises, existing literature has been explored in order to:

- *collect* data and models about the role of HEIs in the edge of third mission activities and contribution to social innovation;
- *focus* on the entrepreneurial university's model to foster social innovation and implement RIS3;

- *explore* the role played by entrepreneurial HEIs in planning and implementing their country's or region's RIS3;
- *analyse* the eight HEInnovate dimensions in the light of RIS3.

Each member of the research consortium performed its own review, starting from a shared research protocol; a data collecting tool was created in order to collect coherent information; then all collected data have been gathered into a shared database built through the contribution of all the university partners in order to be functional to the aims of the project and the next steps of the research.

3.1.2 Field research

Based on the findings from the LR, field research activities were carried out, in order to collect data from RIS3 and HEInnovate perspectives and consider the point of view of HEIs, RIS3 experts and public authorities or managers involved in the definition and implementation of strategies for regional development and smart specialisation.

Delphi technique

First, tools for implementing a Delphi technique have been built.

Delphi technique is a *consensus building exercise*, aimed at conducting detailed examinations and discussions about a specific issue for the purpose of goal setting, policy investigation, or prediction of future scenarios (Dalkey, 1972; Ludwig, 1997; Hsu and Sandford, 2007). A panel of selected people who are considered experts in the specific topic of investigation is involved in a series of questionnaires, based on multiple iterations (Hsu and Sandford, 2007).

The Delphi exercise was specifically aimimg for:

1. *exploring* the role of HEIs in the regional innovation system and in the design and implementation of RIS3;
2. *identifying* who, within a certain university, should be responsible for cooperating in the regional innovation system and implementing RIS3;
3. *analysing* the potential value added that HEInnovate self-assessment tool can bring for RIS3;
4. *defining* the possible outline and content of an upgraded version of HEInnovate, supporting HEIs to participate more effectively in regional/national smart specialisation processes.

As foreseen by the Delphi technique (Ludwig, 1994; 1997), research activities were organised in three separate questioning rounds. In each round, participants answered a set of questions which was returned to the research team which collected and summarised answers in order to propose a statement of the position of the whole group for every participant. In round 1 (May–July), some general open-ended questions were asked; in round 2 (July–mid October), answers were summarised and formulated into more specific Likert items; in round 3 (mid October–early November), answers were finally summarised and formulated in agree/disagree items.

Semi-structured interviews

At the end of the Delphi process, interviews with representatives from public authorities and/or organisations responsible for or involved in RIS3 processes were carried out, in order to explore a further point of view and deepen knowledge of the topic of interest.

The protocol of a semi-structured interview was accepted, so as to have a list of topics and open-ended questions to use as a guide; at the same time, the semi-structured interview protocol allowed interviewers to stray from the guide and follow topical trajectories and enable the respondent to feel free to express their views in their own terms (Galletta, 2013; Newcomer *et al.*, 2015).

Interviews were aiming for (Figure 2):

1. *exploring* HEIs contributions (knowledge, design, implementation, monitoring);
2. *analysing* expectations about HEIs;
3. *identifying* issues that HEIs should focus on;
4. *mapping* existing networking opportunities between HEIs and other RIS3 stakeholders;
5. *assessing* opportunities for revision and implementation of HEIs involvement in RIS3.

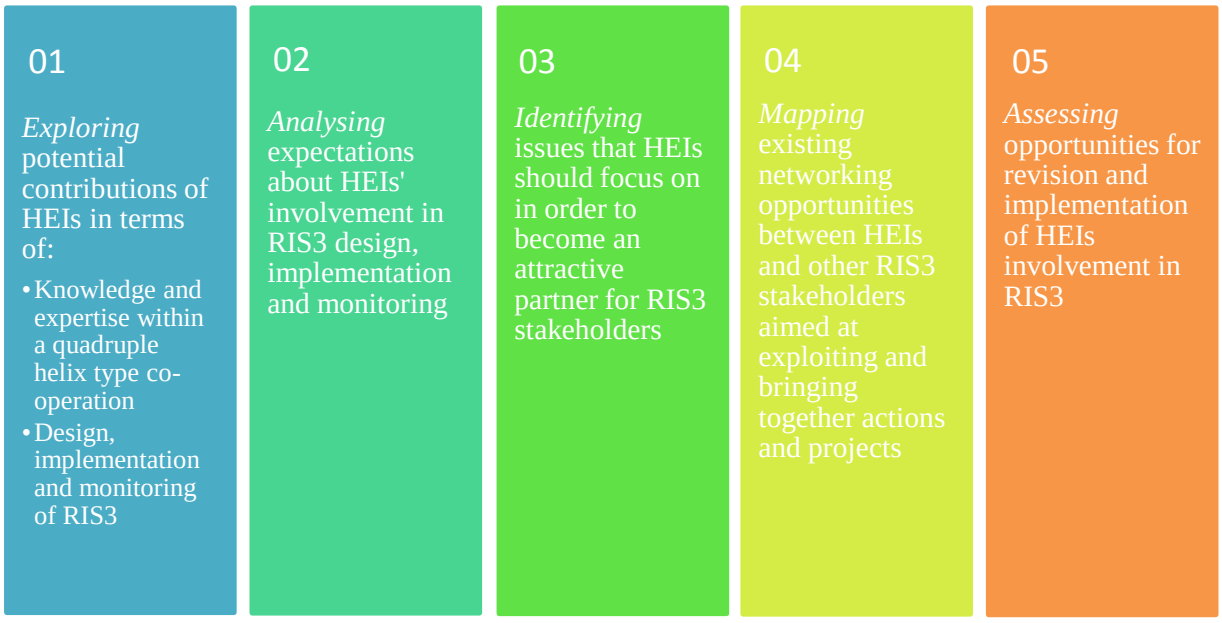

Figure 2 – Main goals of the interviews (Source: authors)

All interviews were carried out between the end of October and the middle of November.

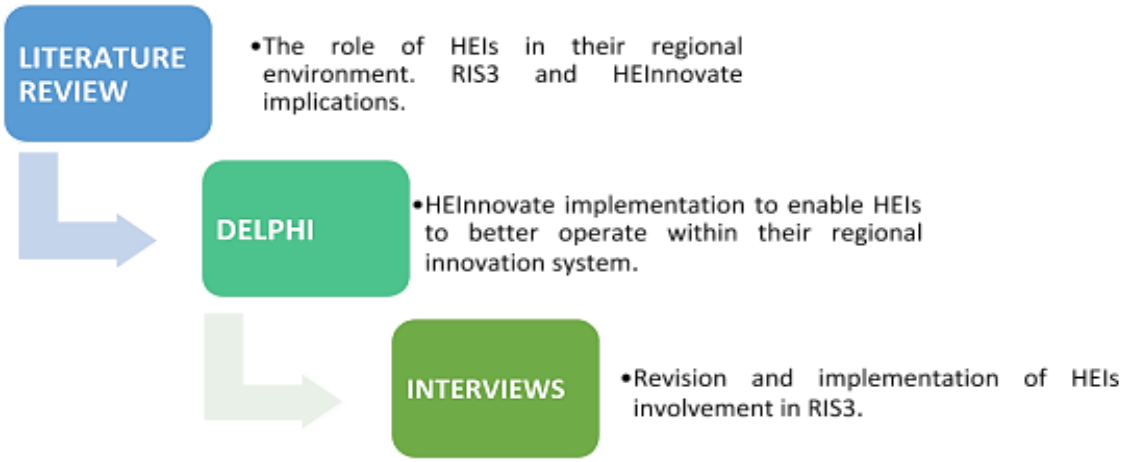

Figure 3 – The research process (Source: authors)

3.2.Sample

Methods adopted for data collection and specific protocols developed for every step of the research will be detailed in sections 3.3, 3.4 and 3.5. In this paragraph, the dimensions and the main peculiarities of the sample taken into consideration are detailed.

As for the desk research activity, a *corpus* of literature consisting of 98 English-language documents was set; the list contains conceptual papers, literature reviews, single or multiple case studies and technical, policy or project reports. The selected papers both applied qualitative and quantitative analysis methodologies.

Considering the double perspective (RIS3 and HEInnovate) adopted, and the multiple points of view to be analysed (HEIs, public authorities/managers working with RIS3), the field research involved three clusters of targets, corresponding to the main stakeholders of RE-ACT project. The point of view of each actor and its level of involvement in RIS3 processes or HEInnovate (or both) have been analysed through the Delphi exercises and the interviews (Table 2).

Table 2 – Field research sample (Source: authors)

Cluster		Description	Main profiles	Research activity
Cl. 1	Experts in the field of RIS3	People involved or working in the field of RIS3.	Project managers, technical experts, persons in charge of regional innovation strategies, etc.	Delphi exercise
Cl. 2	Experts in the field of HEInnovate	People working in HEIs who already know and use HEInnovate self- assessment tool, as experts or facilitators.	Researchers, professors, administrative staff members, etc.	Delphi exercise
Cl. 3	Public authorities and/or organisations responsible for or involved in RIS3 processes	People involved with various levels of responsibility, at national or regional level, in the design, implementation or monitoring of RIS3 processes	Ministries of innovation and technology, heads of the department of Regional Development, persons responsible for RIS strategies, policy technical officers, etc.	Interviews

Experts in the field of RIS3 (Cl. 1) and HEInnovate (Cl. 2) have been involved in the Delphi exercise. As shown by Table 3, 19 experts, coming from the 5 European countries involved in the RE-ACT project have been submitted to the 3 questioning rounds. As for their field of expertise, 10 of them are experts in the field of RIS3 and 7 work in HEIs; among them, 2 are experts in HEInnovate and 1 is expert in both RIS3 and HEIs.

Table 3 – Delphi exercise participants (Source: authors)

Expert	**Country of origin**	**Area (s) of expertise**		
		RIS3	**HEIs**	**HEInnovate**
Ex.1	Hungary		**X**	
Ex.2	Hungary	**X**		
Ex.3	Hungary		**X**	
Ex.4	Hungary	**X**		
Ex.5	Italy	**X**		
Ex.6	Italy	**X**		
Ex.7	Italy		**X**	**X**
Ex.8	Italy	**X**		
Ex.9	Portugal		**X**	**X**
Ex.10	Portugal	**X**		
Ex.11	Romania	**X**		
Ex.12	Romania	**X**		
Ex.13	Romania		**X**	
Ex.14	Romania		**X**	
Ex.15	Slovakia	**X**	**X**	
Ex.16	Slovakia	**X**		
Ex.17	Slovakia		**X**	
Ex.18	Slovakia		**X**	
Ex.19	Slovakia		**X**	

The interviews involved 26 public authorities or other organisations responsible for or involved in RIS3 processes at national or regional level, identified as key informants in the field of RIS3 implementation. Table 4 illustrates the country of origin of each key informant, by specifying its role/profile and the level (regional or national) of its involvement in RIS3.

Table 4 – Key informants involved in the interviews (Source: authors)

Key informant	Country of origin	Profile	Level of involvement in RIS3
K.I. 1	Hungary	Expert in the field of RIS3	Regional
K.I.2	Hungary	Expert in the field of RIS3	National
K.I. 3	Hungary	Expert in innovation systems	National
K.I. 4	Hungary	Officer at Ministry of Innovation and Technology	National
K.I. 5	Hungary	Officer at the National Office of Research, Development and Innovation	National
K.I. 6	Hungary	Officer at Ministry of Innovation and Technology	National
K.I. 7	Italy	Policy technical officer - S3 Agrifood	Regional
K.I. 8	Italy	Officer at Regional Agency for Technology and Innovation	Regional
K.I. 9	Italy	Officer at Regional Council dealing with innovation, research and competitiveness.	Regional
K.I. 10	Italy	Officer at the regional managing authority dealing with Digital Agenda and RIS3	Regional
K.I. 11	Italy	Director of the Department of Resources and Organization of the Regional Accounting Service ERDF-FSE Managing Authority Service	Regional
K.I. 12	Romania	Head of the Department of Regional Development at Regional Development Agency responsible for RIS3	Regional
K.I. 13	Romania	Experts in the field of RIS3 at Regional Development Agency responsible for RIS3	Regional
K.I. 14	Romania	Expert in the field of RIS3 at Regional Development Agency responsible for RIS3	Regional
K.I. 15	Romania	Expert in HEI participation in RIS3 at Regional Development Agency responsible for RIS3	Regional
K.I. 16	Romania	Expert in the field of RIS3 at Regional Development Agency responsible for RIS3	Regional
K.I. 17	Portugal	Director of the Regional Coordination and Development Commission	Regional
K.I. 18	Portugal	Director of the Strategic Planning of the Regional Coordination and Development Commission	Regional
K.I. 19	Portugal	Mayor	Regional
K.I. 20	Portugal	President of National Innovation Agency	National
K.I. 21	Slovakia	Responsible for RIS3	National
K.I. 22	Slovakia	Responsible for RIS3	Regional
K.I. 23	Slovakia	Expert in the field of RIS3	Regional
K.I. 24	Slovakia	Head of the Department of Regional Development	Regional
K.I. 25	Slovakia	Expert in the field of RIS3	Regional
K.I. 26	Slovakia	Expert in the field of RIS3	National

3.3.Literature Review

A reasoned literature review was prepared, starting from a database shared by partners consisting of 67 contributions and then widening the research until a total of 98 papers: 7 academic books, 49 articles, 4 book chapters, 3 conference proceedings, 4 EU

Guides/Handbooks, 5 best-practice examples, 3 policy briefs and 23 policy reports. They responded to the overall purpose of the study that was to investigate the potential contribution of entrepreneurial HEIs to RIS3 through the analysis of its relationships with the 8 dimensions of HEInnovate.

Themes and key-words related to RIS3 and HEInnovate dimensions were: entrepreneurial HEIs; civic universities; engaged universities; HEIs' third mission; regional governance; education; technology transfer and digitalisation; knowledge co-creation; impact measurement; sustainability and local development; entrepreneurship; innovation (e.g., technological innovation, eco-innovation, social innovation); smart communities; Triple Helix; mode 3/quadruple helix; university-business cooperation (UBC).

3.4.Delphi survey

From May to early November 2020, a three-round Delphi study was carried out. The Delphi survey results are always very much determined by the composition of the expert group, so special attention had to be paid to the selection of participants. The Delphi research included experts from universities (who may not have sufficient experience with RIS3) as well as experts on regional innovation policy (with less knowledge on the current internal set-up and culture of universities and the HEInnovate tool). Moreover, the questions were focused on the possible use of HEInnovate in creating an extended self-assessment tool with the working name "HEInnovate for RIS3." Finding experts who are proficient in all of the above topics is quite problematic. Therefore, each of the partners' key tasks was to identify the best possible participants in the Delphi survey to find consensus on critical issues in three rounds. In preparation of the second and third rounds, it was necessary to analyse the respondents' previous opinions and answers in detail and use them to identify common views objectively, sensitively, and validly and thus prepare new questions accordingly.

The experience and knowledge of experts from the field of management and strategic planning of universities, as well as from the implementers of regional innovation strategies (RIS) have been used and combined. The framework of higher education institutions is country-specific and diverse, and so is the willingness of universities to participate in the regional innovation system. At the same time, the implementation of the RIS3s is considered more or less successful in countries and regions.

The participating countries have also differenciated in the preferred territorial levels of the policies: national, regional or both. The project consortium comprises countries from Western and Eastern countries in Europe, with different historical experiences, path dependences, innovation performance, centrally or regionally governed. Therefore, common consensus views could be expected in some respects, but also very different due to the considerable differences in the dimensions mentioned. Hence, it could not be expected that the experts would reach a unanimous consensus on some questions.

Types of questions in the Delphi survey

The first round consisted mainly of open-ended questions, and experts were encouraged to express their views in a narrative form. Methods of qualitative research (thematic analysis)

were used to analyse their answers, which succeeded in identifying opinions with majority agreement and preparing the second round of the survey. Only the closed questions were repeated, and questions asking the degree of agreement with the statements from the thematic analysis were utilised in the second round. Finally, in the third round, the project partners had prepared closed dichotomous questions based on agreement with the statements based on the previous two rounds. The total number of participants was 19, an average of four for each of the five countries. In these circumstances, the Delphi survey after the third round reached more than 75% agreement on some statements, which can be considered a useful result.

Figure 4 shows an overview of the three rounds of the survey process.

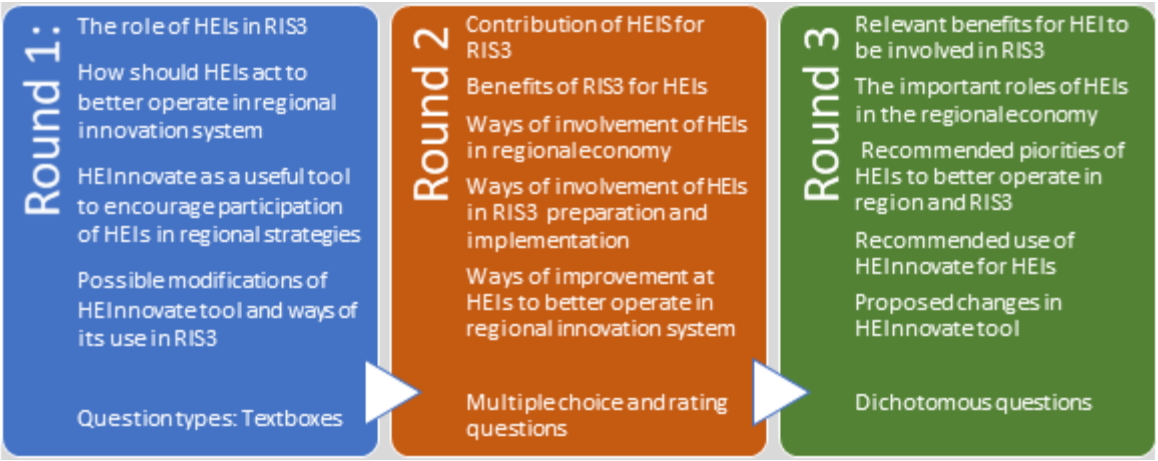

Figure 4 – The Delphi process (Source: authors)

3.5.Interviews

Following the project plan, the research group was to conduct 25 interviews, 5 in each partner country, with representatives of public authorities or other organisations who lead RIS3 processes at regional or national level. The aim of the interviews was to explore the experiences and needs of the public sector specifically, regarding the involvement of HEIs in RIS3.

Both levels provide with useful information about what policy responsible organisations would need from HEIs in practice. In the interviews, the discussion focused on the engagement and contributions of HEIs in RIS3 processes, the role of HEIs in future RIS3s, implementation and monitoring of these strategies, etc.

The concept behind the interview design was to gain insight into certain key motives through open and semi-guided questions. The main focus areas were as follows:

- How successful was the RIS3 regarding its aims?
- What theoretical value added can be expected from HEIs (e.g., educational function, planning and implementation)?
- Can HEIs play any roles besides their main functions in the regional ecosystem?
- HEIs do not necessarily have the proper competences to join regional partnerships. In the event of this, which dimensions or capacities should be changed or developed?

To gain sufficient information to these questions, a consortium member created a first version of the interview with 15 questions. The partner institutions reviewed the draft in written form, and the research group organised several online discussions to improve the list of questions. The final version included 11 questions which could be answered by the interviewees in approximately 60 minutes.

Each partner institutions had individually to select and invite the 5 interviewees – with the above-mentioned qualifications –, choose a platform to conduct the interviews, and decide which language they would use (either their mother tongue or English), as well as whether they wanted to transcribe the interview or just provide a summary. Finally, each partner shared the contents of the interviews conducted with the others.

The analysis of the interviews was delivered on two levels. First, the partners were asked to summarise the results of each interview and elaborate an overall summary of all of their own interviews, following the logic of the questions. Answers to all questions—one by one—were to be presented in approximately half-page summaries that contain both the agreements (harmonising points) and contradictions among the interviewees.

Secondly, to conclude the experiences and practices in general in the different countries, the partners were asked to send their 5-page summary of all interviews. The conclusions of the interviews (see Annex 4) contains all the important information, best practices, deficiencies, future opportunities and areas of improvement that can help HEIs to play a more significant role in regional planning and innovation.

3.6.The impact of COVID-19 on the research activities

COVID-19 impacted the planned research activities from two points of view: the temporal organisation and the way in which the research activities were carried out.

Concerning timing, the explosion of the pandemic created an initial climate of uncertainty, which led to a delay in carrying out the research activities. This aspect especially concerned the contacts with the stakeholders (experts and key informants) who were to be involved in the Delphi technique and in interviews. In fact, public institutions, RIS3 responsible organisations and HEIs were closed for several months and they had to adapt their core activities to an online format, something which caused a significant amount of extra work. Therefore, participants' openness and willingness to participate deteriorated as compared to economically (and socially) non-critical periods. In some countries, it was extremely difficult to engage stakeholders using the Delphi technique and responses to the questionnaires were considerably late. Regarding the interviews, stakeholders were more responsive, but this task was also delayed due to the late implementation of the Delphi technique. Priority experts are, in any case, always difficult to reach, so it took many of the partners a month to perform the interviews instead of two weeks as originally planned.

Despite these revisions with respect to the initial research protocol, the existence and content of the research activities were not changed.

4. Outcomes of the applied research methods

4.1.Summary of the Literature Review

The role of Entrepreneurial HEIs in place-based and innovation-driven regional development with special focus on RIS3 strategies

The LR focused on the entrepreneurial and innovative profile of HEIs, by considering their internal actions and their cooperation with economic and social partners.

The topics addressed within this chapter are: RIS3 and HEInnovate; the entrepreneurial university and its potential role in RIS3; entrepreneurial HEIs' contribution to social innovation; the potential role of entrepreneurial HEIs in RIS3 for each dimension of HEInnovate.

The LR aimed to answer the following research question:

What is the potential role of an entrepreneurial HEI from the perspective of RIS3 design and implementation in relation to each of the 8 HEInnovate dimensions?

The results and conclusions (mainly based on the contributions by Clark, 1998; Kolb & Kolb, 2005; Heinonen & Poikkijoki, 2006; Carayannis & Campbell, 2009; Davey *et al*., 2011; Leminen *et al*., 2012; Minola *et al*., 2016; DEI Working Group, 2017; Edwards *et al.*, 2017; Rubens *et al*. 2017; Arregui-Pabollet *et al*., 2018; Edwards & Marinelli, 2018; Hazelkorn & Edwards, 2019; Towers *et al*., 2020) highlighted the HEIs' contribution to RIS3, through the description of the nature and territorial level of the relationships ideally built to this purpose and their links to HEInnovate's dimensions.

Leadership and governance

The HEIs may play an important role in RIS3 higher-level governance structures by adopting quadruple helix approaches and by supporting bottom-up processes. Their contribution supports the definition of strategic shared visions, objectives and the design of smart specialisation priorities as well as the elaboration of an action plan. They collaborate with regional authorities by engaging in and experimenting with different governance models. For the effectiveness and efficiency of the institution, they should count on the power balance between the central level and the different departments/faculties (academic community and administration).

The leadership and governance level works for building international institutional partnerships, also aimed at fostering participation in European and international RDI projects.

Organisational capacity: funding, people and incentives

To contribute to RIS3 design and implementation, HEIs need a support structure (governance system, human capital, financial resources and physical infrastructure). From a funding perspective, many activities that are carried out are mainly funded and regulated by national provisions. A reward system and incentives could support the engagement of staff members from different departments/faculties of the institution in research and innovation activities.

Moreover, interdisciplinarity and a sense of belonging could be enhanced through the collaboration among different departments/faculties from the same HEI: this could lead to a positive "cross-fertilisation" between different research topics and teaching methods.

Entrepreneurial teaching and learning

The HEIs act as a channel of intellectual capital through the processes of knowledge creation and dissemination. They train human capital for RIS3 priority areas and the global economic challenges of the 21st century. They could also play a role in attracting talents and in contributing to upskilling the existing workforce. They contribute to the Entrepreneurial Discovery Process (EDP) and the RIS3 objectives through education providing graduates with innovation skills, in line with the RIS3 priorities. In this context, students and teachers can be involved in entrepreneurship experiential classes and projects; moreover, they can collaborate to provide concrete solutions to stakeholders from the industry.

Preparing and supporting entrepreneurs

The HEIs collaborate with local businesses and communities to enhance their capacity to be innovative and competitive. Living-labs are a way of HEIs' in-place collaboration and engagement with different stakeholders. Students and researchers are involved in testing and prototyping, combining theory with practice and collaboratively dealing with the real cases of local businesses.

Digital transformation and capability

HEIs may cooperate with research and technology centres to enhance the exchange of knowledge and its set of technology services and participate in Digital Innovation Hubs (DIHs) by offering services supporting the digitalisation of economy and society.

Knowledge exchange and collaboration

The HEIs may contribute to regional innovation policies by helping to transfer regional economic, technological and institutional capacities to wider society as they play anticipatory, active and strategic roles through their research activity. This contribution is enhanced by their participation on smart specialisation platforms. They could play a role in the EDP, lending support to the development of the quadruple helix approach as well as contributing to the identification of local competitive advantages and regional strategies and resources. Being able to interpret contexts and challenges, they could initially contribute to shaping a shared vision for the RIS3 strategy and S3 priority areas. Thus, they could be facilitators among regional partners through networking and collaboration, focusing on promoting sustainability and social engagement. Through their collaboration with businesses, they could conduct research for technology and innovation transfer and they could help to maximise financial returns in the region. They could also take care of community challenges and activities, by becoming catalysts of local development, knowledge transfers and spill-over and re-engaging citizens in a process of local democracy. To do so, they need to take an active part in innovation ecosystems by also addressing labour market needs, fostering social links, and maximising the use of available resources. More directly, entrepreneurial HEIs could stimulate internal staff to open up to the business world by being a partner in the entrepreneurial ecosystem. They could also take part in technology transfer infrastructures

that permits co-creation, co-design or collaboration between different quadruple helix stakeholders (e.g., living labs). Such interactions among local sectoral actors can support the creation, prototyping, validating, and testing of new technologies, services, products, and systems in real-life contexts.

The internationalised institution

To this aim, HEIs could develop partnerships and relationships by participating in European and international RDI projects and Knowledge and Innovation Communities (KICs). They play a role in connecting the regions to external sources of knowledge through their international networks: in this sense, they also combine international orientation and local commitment, especially in terms of education. Students and academic staff from the same institution can engage in international projects or exchanges.

Measuring impact

The HEIs should contribute to the monitoring and evaluation of RIS3: they may do it through data analysis and by training human capital to work as data analysts. They can refer to international/national models for measuring and identifying impact indicators, outcomes, results and context indicators. Moreover, by taking part in bottom-up approaches towards shaping a strategic shared vision, objectives and smart specialisation priorities, they can contribute to the identification of indicators for a monitoring and evaluation system. It is of pivotal importance for HEIs to measure their contribution as an institution as a whole to the local context, and to analyse and share the results of their collaboration with both internal and regional stakeholders.

4.2.Summary of the Delphi technique

Introduction

This section summarises the overall conclusions of the Delphi questionnaire based on the answers provided in Round 3, highlighting the statements and ideas that generated wider consensus among experts. Among the 19 answers from Round 3, it was considered "consensus" for each question when at least 14 respondents stated to "agree" with a given option.

Before looking into the conclusions, some considerations should be made.

- Given the complexity and wideness of the theme, it may be difficult to extract conclusions pointing at one direction. It should be considered, for example, that participating experts are from different countries/regions and act in different realities, which can result in very different views, e.g., on the role of universities.
- The lack of consensus in some of the themes/questions may be a sign that there is a lack of mutual knowledge and understanding between universities and regions and that something should be done in this field.
- As for the questions/themes where a consensus was not clear, these could be further explored in future activities of RE-ACT, such as the validation workshops or the igniting events.

Themes on which consensus was achieved

Role and involvement of HEIs in the regional innovation system

A. **Relevant benefits** for HEIs resulting from the involvement in the regional innovation system and the design and implementation of RIS3 are…

…HEIs can contribute with methodological support for the RIS3 design (by providing information and data for the analysis) and they can also bring knowledge regarding new technologies and RDI trends. Additionally, they can be involved in the definition of priorities and actions, as well as in project development. (All respondents agreed)

…HEIs are better able to understand the research, innovation and education needs of local companies and learn more about social challenges. This allows HEIs to orient research towards the needs of businesses and society and present the services of the university to regional actors. (17 out of 19 respondents agreed)

B. The **most important role and involvement** of HEIs in the regional economy, regional innovation system and RIS3 should be…

…actively participate in formulating and implementing the RIS3 strategy (16 out of 19 respondents agreed)

…key role in entrepreneurial discovery processes and interaction/cooperation with business environment, i.e. active role in the design and implementation of RIS3 starting from the entrepreneurial discovery and development of S3 priorities, and continuing with projects to support implementation of smart specialisation. (16 out of 19 respondents agreed)

C. An **also important** role (but less important than the ones above) of HEIs in the regional economy, regional innovation system and RIS3 should be to…

…engage in pro-active dialogue and collaboration with economic actors and other key stakeholders to contribute to the strategic planning and implementation of RIS3, as well as to strengthen HEIs role in the innovation ecosystem. (18 out of 19 respondents agreed)

…promote cross-sector RDI cooperation and provision of innovation infrastructures (16 out of 19 respondents agreed)

D. **Less important roles** for HEIs in the regional economy, regional innovation system and RIS3 should be…

Liaison/facilitator role for inclusive growth (15 out of 19 respondents agreed)

E. To enhance the ability to operate in a regional innovation system, in regional strategic planning and specifically in RIS3, **HEIs should give priority to** the following:

…provide highly skilled human capital, as well as ideas and solutions to future economic, social and technological challenges. (18 out of 19 respondents agreed)

…prepare students especially for solving economic, social and technological challenges in the future mainly by enforcing interdisciplinary approaches. (18 out of 19 respondents agreed)

…develop services linked to RDI and business support, like TT and innovation services, start-up support, acceleration, etc. (16 out of 19 respondents agreed)

F. To enhance the ability to operate in a regional innovation system, in regional strategic planning and specifically in RIS3, it is **less of a priority** for HEIs to…

...have a long-run perspective in the planning and fine-tuning of priorities and actions, act based on a long term vision in the process, and have a long term commitment. (15 out of 19 respondents agreed)

…improve internal communication. (15 out of 19 respondents agreed)

HEINNOVATE

A. Regarding the **role of HEInnovate for HEIs' participation** in regional strategies it is clear that…

…HEInnovate helps the process of evaluation of HEIs' strengths and weaknesses across multiple dimensions that, in turn, helps to identify areas for improvement. (19 out of 19 respondents agreed)

…HEInnovate offers a basis to encourage HEIs' participation in regional strategies, but for successful participation, other aspects need to be considered, including the development of soft skills, the commitment of staff and integration of dimensions into internal documents and procedures, etc. (15 out of 19 respondents agreed)

B. Please state **how much you use HEInnovate** for the purposes indicated (Note: 11 of the 19 respondents do not use HEInnovate, i.e. 8 respondents use HEInnovate):

Formulation of strategic documents and design of internal procedures. (7 out of 8 respondents who use HEInnovate)

Active participation in events. (6 out of 8 respondents who use HEInnovate)

As a more general self-assessment tool in my Faculty/University. (6 out of 8 respondents who use HEInnovate)

Statements that did not generate consensus – themes for further exploitation?

In this section, we highlight the most relevant questions that did not generate a consensus among experts. We suggest, these items should be further explored in other activities of WP1, e.g., LR, interviews, validation workshops. Questions regarding HEInnovate revealed less consensus: this might be because several experts do not use HEInnovate, or because they do not have a fixed opinion on the subject.

Question: ***At the university, responsibility for cooperating in the regional innovation system and implementing*** **RIS3 should be from…**

The rector/vice-rector/top management.

Technology Transfer Offices or a transfer agency.

A "one-stop-shop" concept dedicated unit and committee within the university.

Comment: In Round 2, the answers to this question did not reveal a trend. The scale given was 1 to 5 (strongly disagree to strongly agree). All options given had a majority of favourable answers, which may imply that experts think the responsibility from the three "stakeholders" should be given as a possible answer.

Question: ***Less important roles for HEIs in the regional economy, regional innovation system and RIS3 should be…*** *…Monitoring, coordination and governance role*

Comment: Although it was not clear from Round 2 that "Monitoring, coordination and governance role" was one of the most important roles for HEIs, in Round 3, experts also did not validate the idea that this role is less important for HEIs. It could be useful to clarify if HEIs should have this kind of role.

Question: *Although I use HEInnovate for other purposes, I don't use it to:*

Organise our own events, seminars, meetings, etc.

Consult and apply training materials for self-assessment.

Self-evaluate the collaboration (and promote exchange) with other regional actors.

Comment: Most respondents chose the option "I don't use HEInnovate." Among the remaining ones, there was a 50/50 split among "agree" and "disagree." This can reflect a lack of knowledge about HEInnovate and its tools, or that the use of HEInnovate is more restricted to the options stated in section 2.2 above. It would be useful to clarify this with a wider group of HEInnovate users.

Question: If I could change something in HEInnovate, I would most probably…

…add new instruments to foster the dialogue among regional stakeholders and to have feedback from all of them.

…bring more focus on entrepreneurial teaching.

…add the use of popular smart tools to be adopted at regional level (e.g., new education forms, A.I., S2B marketing...).

…add more instructions on how to use the results of HEI and how to proceed in the future based on the results.

Comment: Among all options given, at least 16 of the 19 respondents stated "Agree" or "Don't know/don't use HEInnovate," meaning that no more than 3 stated to disagree. However, also none of the answers collected more than 10 votes on "agree" (the two first options collected 10 votes). Again, this can reflect a lack of knowledge about HEInnovate or an uncertain opinion on what should be changed/added to the tool. It could be useful to better explore these possible changes in HEInnovate through dialogue with stakeholders.

Question: In HEInnovate I would not…

…add more indicators for HEIs' evaluation

…add more dimensions/sub-dimensions

Comment: As in the previous question, although a majority of respondents (9) agreed with both options, also a significant number (7 for both options) stated "Don't know/don't use HEInnovate," and only 3 disagree.

Possible follow up

Regarding the questions explored in section 2 (on which consensus was achieved), we propose to:

- Cross-validate with other research tools (LR, interviews) and in validation workshops if the same or similar trends can be identified;
- Discuss and clarify how these trends should impact the upcoming activities of the project, e.g.:
    - Should HEInnovate be reinforced based on what is considered to be the most important role and involvement of HEIs in the regional economy, regional innovation system and RIS3?
    - Should the activities/contents to be developed under WP2 and WP3 seek to reinforce the aspects considered more relevant for HEIs to better able to operate in a regional innovation system, in regional strategic planning and specifically in RIS3?

Regarding the questions explored in section 3, and especially those related to HEInnovate, we suggest that they be discussed in the validation workshops.

4.3.Summary of the interviews

The Interviews were the last step of the research process. Between the end of October and the middle of November, semi-structured interviews have been conducted with 26 experts from public authorities or organisations responsible of RIS3 design and implementation at the level of some regions in Hungary, Italy, Portugal, Romania and Slovakia. The interviews protocol included 11 questions based on 4 main issues/research objectives (Table 5).

Table 5 – The interview protocol: main issues to be investigated, research objectives, list of questions (Source: authors)

Main issues to be investigated	Research objectives	Questions
Impact and challenges of RIS3	Understanding the interviewer's perceptions about the impact of RIS3 on regional development and the main problems and challenges to be faced	*Q0*-How do you consider the progress/results of (national/regional) S3/RIS3? What are the most important challenges to improve performance and impact?
HEI's contribution to RIS3	Exploring potential contributions of HEIs to RIS3 in terms of: knowledge and expertise within a Quadruple Helix type co-operation design, implementation and monitoring of RIS3;	*Q1*-How could HEIs ideally contribute to the development and implementation of RIS3, i.e.: What kind of services should HEIs provide? Which resources, competencies should HEIs mobilise and what should they do for a more efficient involvement suitable to each of the main steps of RIS3 design and implementation?
		Q2-What kind of other services offered by HEIs are/could be important for the stakeholders in the national/regional innovation ecosystem and for the ecosystem as a whole in line with the objectives of RIS3?
		Q3- In your opinion, which contribution can HEIs give in terms of knowledge and expertise within a Quadruple Helix type co-operation (between key actors of the national/regional innovation ecosystem), characteristic to RIS3?
HEI's involvement in RIS3	Analysing opportunities related to HEIs involvement in RIS3 design, implementation and monitoring	*Q4*- What do you think HEIs should focus on to become an attractive partner for RIS3 stakeholders in the RIS3 related planning and implementation activities or in facilitating Quadruple Helix cooperation/ interaction in general?
		Q5- How do HEIs respond to human capital needs of the region/country in smart specialisation areas? What are the most burning human capital/competency needs of the region/country in smart specialisation fields? What kind of cooperation arrangements can lead to responsive HEI training supply/services?
		Q6- How do HEIs respond to the RDI needs of the region/country in smart specialisation areas?
		Q7- Do you think that, at national/regional level,

		are there any existing networking opportunities between HEIs and other RIS3 stakeholders in order to capitalise on/exploit and bring together their actions and projects?
		Q8- How do universities contribute to linking the region/country to international sources of knowledge, especially through participation in formal and informal European and global R&I networks?
		Q9- What are the key funding opportunities and incentives that universities would need to support the enhancement of regional competitiveness and contribute to the smart specialisation objectives through R&D and innovation?
Opportunities for revision and implementation	*Assessing* opportunities for revision and implementation of HEIs involvement in RIS3 in the light of the current and next programming period.	*Q10* - Taking into consideration the experiences from the current (2014-2020) programming period what do you expect for the next one (2021-2027)? How can the involvement of HEIs be improved in RIS3 revision and implementation for/during 2021-2027? How should HEIs prepare themselves to be more efficiently involved?

As for the ***impact and challenges of RIS3*** (*Q0*), Italian respondents agreed about the positive impact of S3. Among general problems, a lack of transparency (Slovakia) and coordination (Slovakia, Romania and Hungary) was signalled. Communication and collaboration were also considered as problematic (Hungary), as well as the understanding of smart specialisation (Romania) and RIS3 (Hungary) concepts, that are usually oversimplified and misunderstood. In some cases, RIS3 progress was slow and affected by a lack of continuity (Italy) and the prevalence of several smaller projects (Hungary). Some respondents also linked RIS3 to R&D, innovation, competitiveness, qualification (Portugal) and fund allocation issues (Hungary, Portugal). Concerning the challenges, Italian respondents agreed on the fact that relationships among all the actors involved in RIS3 (and especially between HEIs and businesses) should be improved. In this sense, main challenges are: breaking the ongoing sectoralism, improving implementation mechanisms and coordination (Slovakia), systematising relationships to give continuity to projects (Italy) and establishing a proper monitoring system for the 2021-2027 RIS3 (Romania).

As for **HEI's contribution to RIS3**, and specifically the role they could play in the development and implementation of RIS3 (Q1) and other services they can offer to the national/regional innovation ecosystem (Q2), it is expected that HEIs should be involved in the main steps of strategy design and implementation, but also in identifying specialisation priorities and implementing projects, offering feedback on the analysis, participating at EDPs and in different strategy governance structures, and contributing to process monitoring and

evaluation (Portugal, Romania). HEIs should be open to cooperating with stakeholders in the initial phase of RIS3 creation, to communicate and coordinate their needs, strategic goals, solutions and ideas (Slovakia). HEIs were also considered pivotal in shaping a new vision and scenarios (Italy). In this sense, universities should become the main catalysts of innovation and sources of knowledge generation and transformation for communities, by supplying technology transfer services (Romania). HEIs could play a role in raising the attitude to multidisciplinarity and contamination, to bring together complementary skills and professionalisms, to combine technology and business knowledge (Italy). HEIs can also play an important role in terms of infrastructures: opening research infrastructure for business demanders can be a significant HEIs contribution to the development and implementation of RIS objectives (Hungary, Romania and Slovakia). The importance of RIS3 was also highlighted in the context of the renewal process of HEIs, making it more innovative and relevant to today's challenges. (Hungary). Concerning HEIs contribution in terms of knowledge and expertise (*Q3*), universities can act as hot spots: by listening to their territory to gain insights on specific local needs, through their international networks they collect the best experiences and potential solutions and they spread them in the territory, following the "think global, act local" philosophy (Hungary). Participatory activities could be also organised to adapt contents and curricula to business needs (Italy Portugal, Romania). This adaptation of curricula to the real-life needs would also be important, as well as offering innovation and technology transfer related education specially to master students, PhDs and post-docs (Romania). Even if crucial, this adaptation is not easy to achieve, since universities are slow in adapting their supply of fields of study to the demand of businesses and business sector actors do not really know what services universities can offer (Hungary). For this reason, interpersonal relationships between researchers and entrepreneurs are important for successful collaborative projects (Hungary).

As for **HEI's involvement in RIS3**, in order to become attractive partners for RIS3 stakeholders (*Q4*), HEIs should build strong bonds with territories (Italy). To do so, they should understand how to communicate knowledge and disseminate the results of their studies and researches (Italy, Slovakia) and promote their offer (Romania). HEIs should also focus on their core activities, by aligning teaching activities on regional needs and local priorities, by enhancing research and development capacities throughout the connection to the R&D ecosystem and by considering the technology transfer processes as a priority (Portugal). Concerning how HEIs respond to human capital needs of the region in S3 (*Q5*), the need for a specific training and capacity building was highlighted (Italy). A critical point is the lack of capacity of absorption of graduates and PhDs, with a high risk of brain drain (Italy, Slovakia). For this reason, a strategy aiming at attracting and retaining the most talented people within the region is critical (Slovakia). Moreover, HEIs should have a proactive and flexible attitude (Hungary, Portugal). Even if HEIs usually prefer starting courses in fields they have competences in those fields where a demand arises (Hungary), they should conceive education in line with the needs of the market, by developing specialisations that are requested on the market and not continuing to deliver graduates that cannot find a workplace in their field of expertise (Romania). Specifically, they should focus on global technological and civilisation trends, and accordingly adapt and build skills (Slovakia). As for the way how

HEIs respond to the RDI needs of their region/country (*Q6*), respondents focused on the lack of a system of continuous planning: HEIs intervention and collaboration within projects in some cases occur only for one-shot innovative projects and when costs cover is foreseen (Italy, Hungary). HEIs should be better involved in RDI and cooperate more with businesses, especially SMEs (Romania). In this sense a set of initiatives and incentives for the transfer of scientific knowledge from academia to the business world and a mix – staff that contacts / collaborates with companies and other external entities, and staff that has no external relations are needed (Portugal). The opportunity of a particular (joint) research unit at HEIs, devoted to RIS topics has been signalled (Slovakia). A heterogeneous picture emerged about the mapping of existing networking opportunities between HEIs and other RIS3 stakeholders aimed at capitalising and bringing together actions and projects (*Q7*). Italian respondents all agreed that HEIs and other RIS3 have many networking opportunities. In contrast, in Romania, besides a very few cases, there are no such events on regional level, or in case there are, they do not have any impact. In Portugal, governance meetings were considered a good opportunity to join forces and share knowledge and ideas, even if but the real networking opportunities occur through the implementation of joint projects (i.e., in the application of the funds in co-promoted projects). Slovak experts mentioned that networking opportunities have always been there: several forums and partnerships were created via project activities, even if such forums and partnerships were mostly limited to the project's outputs. Hungarian experts mention the Territorial Innovation Platform which are operating in 8 locations. As for the way how HEIs contribute to linking the region/country to international sources of knowledge (*Q8*), according to all the interviewees, HEIs have an excellent level of internationalisation, linking the region to international sources of knowledge through European projects. In Portugal, experts stressed the importance of HEIs' participation on European projects and their connection to international knowledge networks, such as the European Intelligent Specialization Platform and the Vanguard Initiative. In Romania, Slovakia and Hungary, all respondents underline that participation in Horizon 2020 projects is a good way of creating networks and linking universities to external sources of knowledge. Concerning funding opportunities for HEIs, in order to support the enhancement of regional competitiveness and contribute to the smart specialisation objectives through R&D and innovation (*Q9*), according to all respondents, there are many funding opportunities at regional level, especially for innovation, regional development and the agricultural sector. However, several problems have been identified as for the use of these resources. Generally, for an HEI is challenging to obtain funding because of internal university regulations that are sometimes strict and full of bureaucracy. Sometimes there is a lack of commitment because of complexity. As a bottleneck all respondents in Romania mention the big co-financing rates that are applied to RDI projects, due to the application of state aid rules for industrial research and experimental development. These high co-financing (50%) rates prevented universities in the current period from developing their ideas and actually applying for funding. Two regions highlight the fact that absorption of EU Funds on behalf of universities will be pending the adaptation of HEIs to the new framework characterising the 2021-2027 period. For Slovakian respondents, an idea to fund and support initiatives regarding RDI activities related to the key RIS priority areas, could be the creation of a common regional (financial) tool/mechanism is.

As for **opportunities for revision and implementation** of HEIs involvement in RIS3 in the light of the current and next programming period (*Q10*), all respondents agreed that for the 2021-2027 programming period, HEIs should be more involved and should play an active role in the territory they are located. First, it is pivotal to encourage the participation of regional actors in the revision of actual RIS3 and in the implementation of the next one. Therefore, it is crucial to create capacity building programmes targeted at the social economy actors of the regional ecosystem (Portugal). Regions should be available to assist the process of partnership creation between all the components of the quadruple helix (Italy). Also, a better involvement of HEIs in S3 strategy creation and in the evaluation of the previous period is necessary (Hungary). HEIs should act as "entrepreneurial universities" to be able to reflect the needs of market and non-market actors in the focus of their R&D activities, but also in the setting of education (Slovakia) and researchers should be offered incentives for their involvement in R&I projects (Hungary, Romania, Portugal) and for effective RIS3 implementation. The improvement of cooperation with the business and public sectors was also mentioned (Hungary). Specifically, HEIs should be more involved in cooperation with businesses, *i.e.* being open at an institutional level to cooperate, being interested in creating partnership with businesses, being able to develop bankable projects and in addition, attract private sources of financing, analyse market needs, develop technology transfer services/establish technology transfer offices (TTOs) and elaborate and present their offer based on market needs (Romania).

5. Overall findings – HEInnovate for RIS3

5.1. Main findings of the research report

Findings presented in previous chapters provide inputs that are useful to assess to what extent HEIs can contribute to RIS3 and the importance of a self-assessement tool – HEInnovate in particular – to this purpose.

Since the research activities had different orientations and thematic approaches, in the case of the LR, the connection with the 8 dimensions of HEInnovate and the relation with RIS3 was self-evident. In the case of the Delphi survey and the interviews, this connection depended on the interpretation of the results by the research team.

Nevertheless, for each step of the research, a group of preliminary statements was retrieved and organised according to the 8 dimensions of HEInnovate. In Table 6 (see below), the source of the statements is also indicated.

The statements will be further elaborated and then selected by the research team in order to be validated during the validation workshops as they will be the basis for the development for the "HEInnovate for RIS3" tool.

Table 6 – Statements resulting from research activities sorted by HEInnovate dimensions (Source: authors)

Dimension/Statements	Literature review	Delphi survey	Interviews
I. Leadership and governance			
1. The leaders from the HEI take part in the higher level governance structure of RIS3.	X		
2. The HEI counts on power balance between the central level and the different departments (academic community and administration) for the effectiveness and efficiency of the institution.	X		
3. The HEI is strategically committed to implement its third mission, i.e., to contribute in solving the needs of businesses and society.			X
4. The leadership of the HEI fosters European and international institutional partnerships and participation in R&I oriented networks.	X		
5. The HEI leaders are committed to ensure the HEI's participation in all RIS3 phases (design, implementation, monitoring and evaluation).			X
6. The HEI leaders are committed to support participation of relevant HEI staff at entrepreneurial discovery processes (EDP), identifying specialisation priorities.		X	X
7. The HEI has a clear and fast decision-making process, eased by administration, in order to take part in RIS3 related activities.			X
8. The HEI leadership encourages cooperation and collaboration with all stakeholders.			X
9. The HEI supports open governance models.			X
II. Organisational capacity, people, incentives	**Literature review**	**Delphi survey**	**Interviews**
1. The HEI counts on a support structure (management and administration system; human capital, financial and physical resources) to contribute to RIS3 design and implementation.	X		
2. The HEI has dedicated and qualified personnel that supports academia and researchers in attracting funds for R&I and for commercialising their research results.	X		
3. The HEI has an organisational structure facilitating technology transfer and collaboration between academia and society and businesses, especially if connected with smart specialisation priority areas.	X		
4. The HEI promotes multidisciplinary cooperation among different departments/faculties to encourage contamination between different research topics and teaching methods, in line with business and society needs.	X		
5. There is a rewarding system and incentives offered to engage the members from different departments of the institution in research and innovation activities			X
6. The HEI is oriented and open to provide highly skilled human capital, ideas and solutions to future economic, social and technological challenges in line with RIS3 vision and objectives.		X	
7. The HEI performs analysis and foresight activities, forecasting what will be the needs of the future, in order to provide a proactive, rather than a reactive, response (in terms of teaching, researching and other activities).			X
8. The HEI harnesses funding and cooperation opportunities as triggers of change and to become more responsive to society and business needs.			X

9. The HEI has dedicated personnel that cooperates with RIS3 responsible organisation(s) and disseminates relevant information towards HEI staff involved in R&I and gathers, centralises data and information available at the level of HEI feeding into the RIS3 process.			X
10. The HEI has dedicated personnel that cooperates with RIS3 responsible organisation(s) and disseminates relevant information towards HEI staff involved in R&I.			X
11. The HEI has dedicated personnel that cooperates with RIS3 responsible organisation(s) to gather, centralise data and information available at the level of HEI feeding into the RIS3 process.			X
12. The HEI has dedicated infrastructure and equipment for collaborative R&I and technology transfer, assuring access to relevant Quadruple Helix stakeholders, including students, e.g. Living Labs.			X
13. The HEI contributes to and supports experimentation with new RIS3 governance (stakeholder involvement) models.			X
14. The HEI performs analysis and elaborates studies to support strategy design.			X
III. Entrepreneurial Teaching and Learning	**Literature review**	**Delphi survey**	**Interviews**
1. The HEI contributes to the development of human capital necessary for businesses from RIS3 priority areas, adapting its curricula according to market needs.		X	
2. The HEI provides students with R&I skills.	X		
3. The HEI creates and delivers education programmes for further development of employees of businesses from RIS3 priority areas.	X		
4. The HEI offers targeted training for employees of businesses in order to learn how to efficiently use and exploit equipment using latest technologies.	X		
5. The HEI creates and delivers education programmes that are building the capacity of actors participating in the regional innovation ecosystem to foster links and cooperation between the knowledge production and knowledge exploitation sub-systems.			X
IV. Preparing and Supporting Entrepreneurs	**Literature review**	**Delphi survey**	**Interviews**
1. The HEI collaborates with local businesses and communities to enhance their innovative capacity.	X		
2. The HEI offers access to entrepreneurs and their staff to R&I facilities and support on behalf of researchers to test, validate and prototype new products (experimental development, industrial research).	X		
3. The HEI offers access for entrepreneurs to own research results.	X		
4. The HEI encourages collaborative research by involving students and academia to perform R&I according to the needs of businesses.	X		
5. The HEI supports own researchers, including students, in developing spin-offs for the commercialisation of own research results.	X		
6. The HEI develops services to support R&I, including TT, as well as connected business and innovation support services (market study, business plans, business scale-up, access to funding, acceleration, etc.).		X	
7. The HEI contributes to the regional R&I needs through the establishment of spin-offs with scientific and technological base.			X

V. Digital Transformation and Capability	Literature review	Delphi survey	Interviews
1. The HEI cooperates with research and technology centres to enhance the exchange of knowledge and its set of technology services.	X		
2. The HEI participates in or creates Digital Innovation Hubs by offering services supporting the digitalisation of economy and society.	X		
3. The HEI develops free MOOCs in line with business and society needs and in order to foster the development of the regional innovation ecosystem.	X		
4. The HEI contributes to RIS3 implementation by bringing knowledge regarding new technologies and RDI trends.			X
VI. Knowledge Exchange and Collaboration	**Literature review**	**Delphi survey**	**Interviews**
1. The HEI participates on smart specialisation platforms.	X	X	
2. The HEI participates in Vanguard Initiative or other similar interregional/supraregional initiatives.			X
3. The HEI cooperates and interacts during the EDP with other stakeholders, supporting the development of Quadruple Helix partnerships.	X		
4. The HEI collaborates with business in joint R&I projects.	X		
5. The HEI takes care of community challenges and activities by becoming catalysts of local development and knowledge transfer.	X		
6. The HEI acts as a facilitator among regional partners through networking and collaboration, by promoting sustainability and social engagement.	X	X	
7. The HEI is oriented towards company needs in terms of research, innovation and education, and presents its services to regional actors.	X	X	
8. The HEI has a pro-active dialogue and collaboration with economic actors and other key stakeholders to contribute to regional development.	X		
9. The HEI has long-term relationships with all actors of the Quadruple Helix.			X
10. The HEI has formal ties with relevant RIS3 stakeholders.			X
11. The HEI has informal ties with RIS3 stakeholders.			X
12. The HEI has prompt responsiveness to the requests of stakeholders.			X
13. The HEI rapidly adapts its educational and R&I offer to the needs specific for the regional smart specialisation areas.		X	
14. The HEI cooperates with regional government.			X
15. The HEI has industrial/cooperative PhDs (building bridges between industry and the academia).			X
16. The HEI facilitates new cooperation opportunities (for example organising networking events).			X
VII. The Internationalised Institution	**Literature review**	**Delphi survey**	**Interviews**
1. The HEI is partner in European and international R&I projects.	X		
2. The HEI initiates European and international partnerships/projects to solve regional needs.	X		
3. The HEI combines international orientation and local commitment linking the region to external sources of knowledge through projects and joint R&I activities.	X		
4. The HEI contributes to the internationalisation (scaling-up) of the economic activities in the RIS3 priority areas.			X
5. The HEI has access to global trends, which allow it to assume a proactive role in modernising its educational and R&I offer.			X

6. The HEI maintains its international collaborations after the projects' lifetime.			X
VIII. Measuring Impact	**Literature review**	**Delphi survey**	**Interviews**
1. The HEI contributes to the monitoring and evaluation of RIS3 through data analysis.	X		
2. The HEI contributes to the development of RIS3 monitoring systems through proposing new indicators and data collection techniques.	X		
3. The HEI contributes to the identification of suitable indicators for the RIS3 monitoring and evaluation system.	X		
4. The HEI has a system to evaluate the impact of its own activities on businesses and community.	X		
5. The HEI supports RIS3 monitoring through the provision of information and data.			X
6. The HEI measures the impact of its own activities on RIS3.			X
7. The HEI provides tools and methods to assess the impact of RIS3 on regional development.			X
8. The HEI analyses the matching between its competencies and RIS3 priorities.			X

As shown in table 6, results highlighted that some of the HEInnovate dimensions, in the context of RIS3, are more relevant than others; these are represented by a higher number of statements. Indeed, the "knowledge exchange and collaboration" dimension received the largest number of findings as the most outward oriented dimension of HEInnovate, while digitalisation, internationalisation and measurement attracted less attention.

A further discussion about the 8 dimensions is presented in the following paragraphs.

5.5.1 Leadership and governance

Leadership and governance challenges were mainly addressed by the LR and the interviews. The interviews provided detailed requirements for HEIs as organisations but addressed the leadership challenge only to a meagre extent. Concluding the applied three research methods, the role of leadership must not be underestimated. To avoid fragmented individual or departmental level one-shot external cooperations and projects, the management of the institution has to be aware of what RIS3 means, and the management has to commit the institution to be active player within the design and delivery of the RIS3 framework and process. To set long-term strategic objectives, the leadership has to be informed how an HEI can contribute to RIS3 and what the university can expect from the cooperation and activities. The referred literature addressed many issues related to the culture of leadership, the role of top-down and bottom-up processes, with an accent on the entrepreneurial discovery, interactively involving stakeholders in the broadest sense (Foray, 2015). In the design phase, participating in the EDP process is a key. Aligned with this, during the implementation phase, the university should be aware of the selected sectoral priorities. The institutional strategies as a key tool to long term university-wide commitment, should not have low status, and lost focus when implementing it. As part of cohesion policy planning, the conditionality of RIS3 strategies put stronger emphases on the methodology of planning. In the context of higher education, social and economic engagements and the provision of more responsive education and research became a clearly articulated expectation.

5.5.2 Organisational capacity, people and incentives

Interviews, in line with the LR, emphasised that, in case of an effective leadership, the balanced top-down and bottom-up approach and a collaborative organisational culture can strongly support RIS3 efforts. The RIS3 related organisational capacities and features can trigger participation in the respective strategic efforts of the university. The continuous professional development of the academic and administrative staff, including the competence development needed for the entrepreneurial and outreach activities, can contribute to capacity building. Both the LR and the interviews confirmed that besides proactive and flexible attitudes, readiness for multi- and interdisciplinary cooperation also helps to prepare for the technology challenge. These are key transversal competencies. In case of the core functions of a HEI, those institutions become easier part of the regional innovation ecosystem which are more sensitive what the market needs, and responsiveness is a key commitment. However, beyond education and research, the organisation of the HEI can demonstrate the preparedness for further external services. Technology Transfer Offices, Innovation Centres, Corporate Relation Offices are to translate or transfer knowledge assets of the institution to marketable services. The interviewees emphasised that those tasked with pursuing cooperation with external partners often confront a lack of flexibility, recognition and incentives. Successful knowledge transfer cannot ignore a repository of knowledge areas reflecting on RIS3 priorities and a support mechanism that inspires departments to share their information and better orientate toward university business co-operations. The necessary financial input is often missing. Within a longer-term strategic interpretation, it can be considered as a priority for investment.

Government and public sector ties are essential (primarily in the transition and less developed regions) due to the fact that the Structural and Investment Funds give priority to the RIS3 related projects, especially in the present 2021–27 budgetary period. The Delphi survey did not demonstrate consensus concerning the extent to which HEIs are to play a role in the regional innovation system.

5.5.3 Entrepreneurial teaching and learning

Entrepreneurial teaching and learning are frequently set as a priority dimension in the strategy of many HEIs. The LR, applying the entrepreneurial university model for teaching and learning, emphasised how important it is to prepare graduates with entrepreneurial competences, combining practical and theoretical knowledge, as well as disciplinary content with business competences. Boundary crossing is a key challenge in modernising learning and teaching. Graduates leaving the university with competitive skills can contribute to the capacity of the region to deliver RIS3 related tasks (Kempton *et al.*, 2013). Innovative teaching and learning is closely related to the presence of entrepreneurial mindset. The related pedagogical approaches can be conducted *in*, *for* or *through* entrepreneurship. Beyond business education or directly teaching RIS3 related knowledge, action, project, programme or research-based education can also develop innovation skills. The indirect efforts as social innovation and social entrepreneurship challenges strengthen the entrepreneurial skills as well. Start-up incubation is a service providing special learning and development opportunities for students whose business ideas have growth potential. Slower and more

inclusive learning opportunities can be provided with colourful extracurricular activities, as jump-starter competitions, business case events, entrepreneurial clubs or practice-based research projects, working on corporate or public sector assignments. Entrepreneurial teaching and learning can be extended to the academic and administrative staff, as part of the capacity building to better respond to RIS3 needs. To be linked to the regional economy, interviewees mentioned joint curriculum development, industrial/cooperative PhDs, internship places and future employment opportunities for students. Healthy fluctuations of academics and corporate employees can also contribute to entrepreneurial teaching and learning, as well as smoother collaboration in the RIS3 context.

5.5.4 Preparing and supporting entrepreneurs

An entrepreneurial university prepares and supports entrepreneurs complementing entrepreneurial learning and teaching. The above mentioned incubation is a usual support for early phase business creation. The entrepreneurial services were often mentioned across the interviews in the context of cooperation between universities and local companies. The HEIs, on the basis of their supportive technology transfer infrastructure (such as living labs), support the creation, prototyping, validation and testing of new technologies, services, products and systems in real-life contexts between quadruple helix stakeholders. There are other opportunities as well, e.g., various TTOs that have role in assisting researchers and students with results that can be commercialised.

The universities were highlighted as potential contributors to regional and sectoral business challenges. The participation in EDP at local level is an opportunity to enhance the knowledge about the actual business challenges, especially in the RIS3 priority areas. The outreach of services helps understand how market and the companies work, and helps universities launch enterprises, especially those for commercialisation of research results (i.e., spin-offs). Offering know-how, especially for SMIs, provides the basis for future cooperation projects. The advanced business - university collaborations mean a win – win situation for both sides, through the valorisation and promotion of entrepreneurship (Davey *et al*., 2011).

5.5.5 Digital transformation and capability

Digitalisation is an overarching innovation trigger and area of, innovation. However, the technology challenge seems to be so obvious in the 21st century research and innovation stakeholders, that only a few statements highlighted this issue during the interviews. Although most inventions in a student start-up competition create IT solutions, most of the business management challenges are supported by complex digital solutions, and many RIS3 priorities relate to technology advancement, neither strengths nor critical obstacles have been identified in this area. The COVID-19 situation is one of the most critical factors impacting the implementation of the React project, and paradoxically this resulted in a breakthrough in the digitalisation of service provision in HEIs. Although many aspects of the technology enhancements were at first considered temporary, their impact on working and learning in a digital environment now look set to become long lasting.

To be part of a digital innovation hub means great potential. The process of digital transformation has been identified as an important opportunity for the implementation of

RIS3 (European Union, 2012). Digital skills go beyond the technical know-how and STEM and include transversal skills. In this aspect the European Digital Competence Framework (DIGCOMP) is a key reference document of the EU.

One of the consequences is the profound changes in learning habits and how research is conducted and disseminated.

5.5.6 Knowledge exchange and collaboration

Due to the external orientation of this dimension, this led to the most meaningful and the largest number of research findings (in case of each research method). The role of knowledge exchange is closely related to the responsiveness of the HEI. The adaptation of the curriculum and RDI activities to business needs are key challenges for many HEIs.

Research on cutting edge technology solutions can help universities to develop competitive skills for their students and prepare the institutions to cooperate with the business sector. It is not obvious that a HEI follows contemporary business challenges or that companies fully rely on a university in the field of research and development. The good examples demonstrate the possibility of progressing in this field. An inventory and communication of the knowledge assets and services that the HEI can offer for its RIS3 partners, "one-stop shop" service provision, fast and transparent decision making, cutting red tape, are features that our interviewees highlighted as triggers for more and stronger collaboration with RIS3 partners. Many of the earlier mentioned issues can support knowledge exchange and collaboration with business partners. Regular communication, dedicated matchmaking events, joint projects, forming innovation platforms with the quadruple helix partners are are all crucial for progress.

Here again the research findings underline the importance of dedicated units and competences with the HEI, well-defined role of the TTO, linking the transformation of scientific knowledge to economic value within the context of RIS3.

Both the LR and the interviews confirmed that the knowledge of spatial aspects, the territorial specificities are a key for a HEI which is ambitious in the field of regional development.

The promotion of what a HEI has or can provide for the business sector can mobilise innovative solutions. The interviews mentioned the role of social media and EDP processes. Exchanging good practices and other similar activities as the Vanuard initiative can help identify priority areas for smart specialisation by applying a four-step methodology (learn-connect-demonstrate-commercialise). Finally, beyond company needs, more and more HEIs may take part in responding to community challenges, contributing to the solution of social problems in cooperation with regional governments and social partners. The current research activities have highlighted many activities beyond teaching and research that are relevant for the HEIs' partners. In the RIS3 context universities often appear as a consultancy, a business service provider or a maintainer of an infrastructure that can be hired or jointly operated with a regional RIS3 partner.

5.5.7 The internationalised institution

Universities are traditionally open to international or even global knowledge networks. The Delphi survey confirmed that this is valuable for the regional stakeholders, because the networking opportunities and the access to internationally competitive technologies and RDI trends are crucial to their progress.

The international programmes and projects, especially those which can be run with external stakeholders, have a higher reputation and according to the studies of JRC, these projects promote alignment between the local, regional, national and European levesl and contribute to competitive and sustainable growth in the thematic areas identified in the RIS3 process. The prospective programmes and international forecasts provide sufficient scientific foundations to understand present and future challenges, technology and RDI trends.

Internationalisation makes entrepreneurial universities to be more proactive and attractive for their partners, especially those with entrepreneurial mind-sets. The local and global strategic partnerships are more attractive for investors, promotes international visibility and recognition of the innovative services and logistic of the campuses (Minola *et al.*, 2016). There are many European funding sources that support RDI activities of universities, and also contributing to their successful participation is the RIS3 process.

5.5.8 Measuring Impact

According to the LR as well as the interviews, HEIs can contribute to the monitoring and evaluation of RIS3 activities through gathering and analysing data as well as by providing training for data analysts. HEIs research can also play a role with reviewing effective monitoring systems, offering models for multilevel governance, supporting cooperation between quadruple helix actors (Edwards & Marinelli, 2018). The development of RIS3 related SMART indicators can also be a contribution.

More and more HEIs develop sophisticated performance assessment systems that are also able to measure the success of university-business cooperation, community engagement and RIS3 involvement. The measurement of student success and the social impact of responsible research provide alternatives to several key academic metrics. There is an extensive literature by the European Union, the OECD and the international organisations of HEIs, as the European University Association or the EURASHE.

In spite of the strategic importance of the measurement impact, HEIs have still a huge potential to develop the quantitative assessment of their performance. This also helps decision making with quantified evidence. During the 2021–27 budgetary period, according to the forecasts, robust financial investments can be expected in the field of regional development and smart specialisation. The increased community funding entails an accountability challenge that will raise the importance of reliable indicators and measurement techniques.

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ANNEX

Annex 1: Glossary of key terms

Entrepreneurial discovery process (EDP)

Some of the key features that have been pointed out by leading scholars and policy makers dealing with innovation policies to define what EDP is about are:

The EDP is an inclusive and interactive bottom-up process in which participants from different environments (policy, business, academia, etc) are discovering and producing information about potential new activities, identifying potential opportunities that emerge through this interaction, while policymakers assess outcomes and ways to facilitate the realisation of this potential.

The EDP pursues the integration of entrepreneurial knowledge fragmented and distributed over many sites and organisations, companies, universities, clients and users, specialised suppliers (some of these entities being located outside of the region) through the building of connections and partnerships.

The EDP consists of the exploration and opening up of a new domain of opportunities (technological and market), potentially rich in numerous innovations that emerge as feasible and attractive.

Entrepreneurial mindset

A way of thinking for approaching problems, implementing innovations, finding solutions, sharing ideas and making change happen (Nadelson *et al.*, 2018). Sometimes referred to as 'entrepreneurial thinking'.

Entrepreneurial University

Entrepreneurial University is defined as a university that have the ability to innovate, recognize and create opportunities, work in teams, take risks and respond to challenges, on its own, seeks to work out a substantial shift in organizational character so as to arrive at a more promising posture for the future. In other words, is a natural incubator that provides support structures for teachers and students to initiate new ventures: intellectual, commercial and conjoint. (Clark, 1998; Kirby 2002; Etzkowitz, 2003; Currero, Urbano 2006)

Entrepreneurship

Acting on opportunities and mobilising resources to create social, cultural, or economic value for others (Bacigalupo *et al.*, 2016). Entrepreneurship can take place in any context, including but not limited to; communities, private sector or public sector. It includes creating a new business or being entrepreneurial within an existing organisation, sometimes referred to as **'intrapreneurship'.**

https://itali.uq.edu.au/resources/employability-and-entrepreneurial-education/entrepreneurial-education/entrepreneurial-education-glossary

Smart Specialisation

Conceived within the reformed Cohesion policy of the European Commission, Smart Specialisation is a place-based approach characterised by the identification of strategic areas for intervention based both on the analysis of the strengths and potential of the economy and on an Entrepreneurial Discovery Process (EDP) with wide stakeholder involvement. It is outward-looking and embraces a broad view of innovation including but certainly not limited to technology-driven approaches, supported by effective monitoring mechanisms.

Source: https://s3platform.jrc.ec.europa.eu/what-is-smart-specialisation-

Start-up

A new business in the early stages of development, based on an innovative product, service or business model. Sometimes referred to as a business 'venture'.

https://itali.uq.edu.au/resources/employability-and-entrepreneurial-education/entrepreneurial-education/entrepreneurial-education-glossary

Third-Mission of Universities

It refers to an additional function of the universities in the context of knowledge society. The university is not only responsible for qualifying the human capital (Education – the first mission) and for producing new knowledge (Research – the second mission). Universities must engage with societal needs and market demands by linking the university's activity with its own socio-economic context. Today universities develop their strategies around these three missions. Academics debate negative effects and the effective integration of these missions in a coherent institutional framework.

Source: https://www.igi-global.com/dictionary/universitys-third-mission/51708

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Annex 2: Literature review

The role of Entrepreneurial HEIs in place-based and innovation driven Regional Development

with special focus on RIS3 strategies

Literature review

1. Introduction

This Literature Review is the first step of a scientific inquiry process that will be conducted within the Erasmus+ forward looking project with the acronym RE-ACT. The project, entitled "Self-reflection Tools for Smart Universities Acting Regionally" aims to exploit the potential of existing self-reflection tools, particularly HEInnovate[6], to enhance the participation of Higher Education Institutions (HEIs) in the design and implementation of RIS3 (research and innovation strategy for smart specialisation). Smart specialisation is an innovative place-based approach to research and innovation policy, that aims to boost growth and jobs in Europe, by enabling each region to identify and develop its competitive advantages, through a bottom-up process, involving academia, researchers, industry, public administration institutions and civil society in this process[7]. HEInnovate programme, launched in 2013 and promoted by the European Commission and OECD, is a guiding framework that aims to support HEIs in being or in becoming innovative and entrepreneurial. The programme developed a self-reflection tool to assess HEIs' entrepreneurial profile.

To carry on their activities, entrepreneurial HEIs are part of and engaged in a collaboration system, which plays a pivotal role in shaping strategies and actions supporting regional development and innovation, taking into consideration social and business needs. Internal relationships, on one hand, are built at a governance and managerial level (e.g.: among offices, administrative staff, scholars and students), external relationships on the other, with academic, economic and social partners, locally and internationally. This type of participation of HEIs refers to and covers not only the first two missions - education and research -, but also to their third mission, that stems from the concept of entrepreneurial university.

When this literature review refers to the third mission of HEIs, the authors use the term with a broad meaning, taking into account the local/regional economic, social, cultural and environmental aspects of life, and argue that HEIs may have a major role in responding to the related challenges. Thus, from the perspective of the RIS3, the present literature review performed in the framework of RE-ACT project, the social relevance and impact of any particular entrepreneurial initiative is taken into consideration. In line with this commitment

[6] HEInnovate website: www.heinnovate.eu (last retrieved: 02/11/2020)

[7] European Commission, What is Smart Specialisation? https://ec.europa.eu/regional_policy/sources/docgener/guides/smart_spec/strength_innov_regions_en.pdf (last retrieved: 02/11/2020).

to both the extension of the application of the HEInnovate tool and the interpretation of the smart specialisation related opportunities of HEIs, the RE-ACT project puts a strong emphasis on social responsibility.

In other words, RE-ACT puts the accent on the entrepreneurial profile of universities with these extensions. The entrepreneurial and innovative profile of HEIs, beyond internal actions, also refers to their cooperation with economic and social partners. Such cooperation with other stakeholders may lead to a positive impact on the economy and answers to market needs. This is the prior link to RIS3. Additionally, another link with RIS3 is social innovation and community engagement, i.e. a support in solving societal challenges. Engagement towards the needs of industry and challenges faced by the community are essential components of the third mission of HEIs.

The literature review presented here aims to set the theoretical foundations for the project's following considerations and work phases, as moving from its conclusions, a Delphi technique and interviews to (public) authorities/organisations responsible with RIS3 will be designed and conducted. This will be done in order to get feedback from regional and national RIS3 and HEInnovate experts from partners' countries on the main conclusions of the present literature review, as well as to grasp additional or more detailed information necessary for achieving project objectives. The nature of these feedbacks relates to entrepreneurial HEIs' contribution to RIS3 and to the use and implementation of HEInnovate as a self-assessment tool from a RIS3 perspective.

Relying on these premises, this literature review aims to answer the following main research question: what is the potential role of an entrepreneurial HEI from the perspective of RIS3 design and implementation in relation to each of the 8 HEInnovate dimensions?

To complete this task, the members of the consortium mapped the related literature, to set the key concepts that provide a solid basis for assessing the present state of play and to propose future development measures. The aim of this study is to understand and interpret the typical structures and processes of this particularly challenging field, in which HEIs have to identify their potential role to enhance participation in planning and implementing their country's or region's RIS3.

This contribution is structured as follows:

Chapter 2 presents the general background and context of this review, by deepening RIS3 and HEInnovate concepts. Chapter 3 describes the methodology applied to run this literature review. Chapter 4 is the core part of the literature review. It starts from the presentation of the concept of entrepreneurial university (4.1) and its relationship with the potential role in RIS3 (4.2) and its contribution to social innovation (4.3). Then, sub-chapter 4.4 focuses on the potential role of entrepreneurial HEIs in RIS3 for dimension of HEInnovate (4.4.1 – 4.4.8). Finally, results are discussed and summarised (Chapter 5), by highlighting the HEIs' potential contribution to RIS3 and the related internal and external relationships that are built by entrepreneurial HEIs and that may support this contribution. Finally, the conclusions (Chapter

6) are presented, highlighting also the links of this literature review to other work packages of RE-ACT project.

2. Background

HEInnovate, Smart Specialisation Strategies and the role of Universities

The HEInnovate programme was launched in 2013 by the joint initiative of DG EAC (Directorate of the European Commission) and the OECD. HEInnovate is a guiding framework that aims to support all higher education institutions (Universities, University Colleges, Polytechnics etc.) in being or in becoming innovative and entrepreneurial. Particularly, "it aims to support higher education institutions to empower students and staff to demonstrate enterprise, innovation and creativity in their teaching, research and third missions"[8].

A key element of HEInnovate is its free self-reflection tool. This tool is currently used by more than 1100 higher education institutions (HEIs) across the world, and it helps HEIs to identify and assess their capabilities in the following dimensions:

1. Leadership and Governance
2. Organisational Capacity: Funding, People and Incentives
3. Entrepreneurial Teaching and Learning
4. Preparing and Supporting Entrepreneurs
5. Digital Transformation and Capability
6. Knowledge Exchange and Collaboration
7. The Internationalised Institution
8. Measuring Impact

The inquiry presented in Chapter 4 was structured according to these 8 dimensions of the HEInnovate self-assessment tool. Self-assessment, along the 8 dimensions is meant to support universities in becoming more entrepreneurial and innovative.

Although entrepreneurship mainly refers to business development, it can also represent the skills and activities that contribute to managing open challenges, undertaking risk and uncertainty. In this respect the entrepreneurial behaviour and culture of the academic community, as well as the administrative staff of HEIs, may not only help to launch enterprises but also contribute to solving industrial/sectoral problems, exploiting the business potential of the corporate partners. Becoming entrepreneurial can also be relevant for community engagement, helping to contribute to managing complex social problems (Šćukanec & Farnell, 2019).

Innovation compared to entrepreneurship is an even more open concept, referring to new products, services, new processes, or structural solutions with the promise of positive impact

[8] See the link: https://www.oecd.org/industry/smes/heinnovate.htm (last retrieved: 02/11/2020).

on value creation in the economy or in every segment of society (social innovation). The Oslo Manual distinguishes between innovation as an outcome (an innovation) and the activities by which innovations are fostered (innovation activities). The Oslo Manual, 2018 edition, defines innovation as "a new or improved product or process (or a combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process)". This general definition provides a more precise formulation for use by businesses, which represent the main focus of the manual (OECD, 2018). For the RE-ACT project, especially in case of internal development challenges (e.g. in the field of new forms of research management or teaching and learning), innovation could also be assessed whether it can shape or replace existing routines (Halász *et al.*, 2015).

Throughout the European Union, the current approach to innovation is smart specialisation. The European Commission defines smart specialisation as a novel way of policy development and implementation that aims to boost growth and jobs in Europe by enabling each region to identify and develop its competitive advantages. Based on the principle of partnership and a bottom-up approach, smart specialisation brings together local authorities, academia, businesses and the civil society, to work together for the implementation of long-term, place-based and innovation led economic growth strategies supported by EU funds[9].

Smart specialisation, as a concept, was proposed in the Knowledge for Growth expert group, initiated by former Research Commissioner J. Potočnik, linked to discussions about raising the attractiveness of European regions for foreign R&D location (Foray, 2015). "The notion […] describes the capacity of an economic system […] to generate new specialities through the discovery of new domains of opportunity and the local concentration and agglomeration of resources and competencies in these domains", by merging the existing industrial base with scientific resources, competencies and new technologies (Foray, 2015; p. 1).

Smart specialisation, as an approach towards policy development and implementation, became strongly interconnected with Cohesion Policy, in the context of its reform for the programming period 2014-2020, shaped by:

a) the conclusions of the Barca report, advocating for a 'place-based' approach to policy design, based on 'bottom-up' processes, applying 'multi-level' governance models and 'space-sensitive' and 'result-oriented' solutions, as well as;

b) the latest theories on development policies, placing innovation at the core of economic development and growth (McCann, 2015).

As a policy, smart specialisation advocates for a non-neutral identification and vertical prioritisation of areas that can be targeted by policy interventions, in order to "concentrate resources of the development of those activities that are likely to effectively transform the existing economic structures through R&D and innovation". (Foray, 2015; p. 3).

[9] European Commission, What is Smart Specialisation? https://ec.europa.eu/regional_policy/sources/docgener/guides/smart_spec/strength_innov_regions_en.pdf (last retrieved: 02/11/2020).

In the context of Cohesion Policy, Smart Specialisation Strategies were defined by Regulation (EU) 1301/2013 of the European Parliament and of the Council of 17 December 2013 as national/regional Research and Innovation Strategies for Smart Specialisation (RIS3) that aim to "build competitive advantage by developing and matching research and innovation own strengths to business needs to address emerging opportunities and market developments in a coherent manner, while avoiding duplication and fragmentation of efforts[10]." These strategies became ex-ante conditionality for financing research and innovation projects from the European Regional Development Fund in the 2014-2020 programming period (Foray, 2015), contributing to the achievement of the objectives of the EU Strategy 2020 towards a smart, sustainable and inclusive growth. To support the design of such strategies the European Commission developed a methodological guidance (European Union, 2012). Additionally, a dedicated platform was established by the European Commission offering further tools and additional guidance also incorporating the 'Eye@RIS3 database'[11] and thematic platforms that facilitate cooperation between regions (McCann & Ortega-Argilés, 2016) in the fields of energy, agri-food and industrial modernisation[12].

For the 2021-2027 programming period, national or regional smart specialisation strategies maintain their importance from the perspective of Cohesion Policy, being an enabling condition for ERDF expenditure made under Policy Objective 1 – A smarter Europe by promoting innovative and smart economic transformation[13]. However, besides ERDF, financing for projects that are in line with smart specialisation objectives can come from various private and public sources, including other funds under the Cohesion Policy, the Common Agricultural Policy, as well as Union Initiatives, such as the Horizon Programme (European Union, 2012).

The design and implementation of RIS3s, involves "putting in place a process whereby [...] a dynamic of new speciality development, related to existing production structures, can be facilitated thanks to punctual and targeted governmental interventions in order to support in a preferential way the most promising new activities in terms of discovery, experimentation, potential spillover and structural changes […] "in the form of diversification, transition, modernisation or the radical foundation of industries and/or services" (Foray, 2015; p. 1-2). Particularly, RIS3 design involves going through 6 steps, i.e.:

1. analysis of the regional (socio-) economic context and of scientific and R&I potential;

2. setting up of a governance structure to ensure the participation of quadruple helix stakeholders and strategy ownership, as well as the application of a bottom-up process during strategy design;

[10] European Commission, Cohesion Policy 2014-2020. https://ec.europa.eu/regional_policy/sources/docgener/informat/2014/smart_specialisation_en.pdf (last retrieved: 02/11/2020).

[11] This database is gathering information on smart specialisation priority areas and niches of European regions and/or countries that developed RIS3s.

[12] See the link: https://s3platform.jrc.ec.europa.eu/thematic-platforms (last retrieved: 02/11/2020).

[13] Annex IV of the Proposal for a Regulation laying down common provisions, COM/2018/375 final - 2018/0196 (COD). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2018%3A375%3AFIN (last retrieved: 04/12/2020).

3. definition of a vision shared by key actors from the regional level and setting strategic objectives for the future;

4. identification of smart specialisation priority areas on the right level of granularity based on economic and scientific strengths and stakeholder input;

5. elaboration of a policy mix, action plan and a roadmap to support strategy implementation, *i.e.* containing actions that support innovation in smart specialisation areas, as well as other measures, like digitalisation of society and economy, green growth, social innovation and uptake of key enabling technologies, etc.;

6. design of a monitoring and evaluation system with a robust list of indicators to measure results and performance, as well as to support strategy revision (European Union, 2012).

Entrepreneurial Discovery Process (EDP) lies at the heart of strategy design. It is "an interactive process" through which "entrepreneurs in the broadest sense (innovative firms, research leaders in higher education institutions, independent inventors and innovators)" act together to discover "new activities", *i.e.* "domains of R&D and innovation in which a region is likely to excel, given its existing capabilities and productive assets" (Foray, 2015; p. 40).

HEIs, as organisations that are active in the generation and dissemination of knowledge, have an important role in innovation and place-based development, *i.e.* "They are not just providers of education or conductors of research, but also have a wider role, which includes generating and attracting talent, collaborating with local business, and facilitating innovation, entrepreneurship and competitiveness", *i.e.* are "a source of regional demand and employment, a source of highly skilled employees and a source of invention and innovation" (Beer *et al.*, 2020; p. 27). To this end "universities […] carry a wide array of expectations:

- their teaching is expected to enhance human capital for the modern economy;
- their research seeks to maximise financial returns through commercialisation, profit-making, technology and innovation;
- they are often expected to engage with local businesses and communities to enhance local capacities for economic expansion while raising competitiveness" (Beer *et al.*, 2020; p. 26).

Education and research have long been recognised as activities undertaken by universities. Additional roles that are or should be assumed by HEIs in this context are usually referred to as the 'third mission'. The Third Mission (TM) means that HEIs "are becoming engines that contribute to social, economic and cultural development of the regions in which they operate, by transferring knowledge and technologies to industry and to society at large" and "consists of wide-ranging and recurring concepts such as the 'entrepreneurial university, 'technology transfer' and 'Triple Helix Model (THM) partnerships'", as well as to "an array of activities performed by higher education institutions which seek to transfer knowledge to society in general and to organizations, as well as to promote entrepreneurial skills, innovation, social welfare and the formation of human capital [...] the development of science and society

through various forms of communication and social engagement" (Compagnucci & Spigarelli, 2020). Compagnucci & Spigarelli (2020) argue that the "concept of the entrepreneurial university [...] is acknowledged as being the earliest model of the TM" and "prioritizes the combination between academic research and business needs and imperatives".

3. Methodology

A reasoned literature review was prepared, by selecting a number of papers responding to the overall purpose of the study, namely the willingness to investigate the potential contribution of entrepreneurial HEIs to RIS3 through the analysis of its relationships with the 8 dimensions of HEInnovate.

Starting from a shared database built through the contribution of all the University partners of the RE-ACT project, an initial corpus of literature consisting of 67 scientific articles, papers and studies was set. In detail, the following studies were used: 7 academic books, 49 articles, 4 book chapters, 3 conference proceedings, 4 Eu-Guides/Handbooks, 5 good practice examples, 3 policy briefs and 23 policy reports.

Analysis carried out by the partners from CUB, UBB and UNIMC, who revised the literature and further extended its array to a total number of 98 papers. The final list contains conceptual papers, literature reviews, single or multiple case studies and technical, policy or project reports. The selected papers both applied qualitative and quantitative analysis methodologies. The work performed by CUB and UNIMC was partially supported by BBU.

The groups of themes and key-words identified for the selection of reviewed papers are:

- HEIs' modes of engagement: entrepreneurial HEIs; civic universities; engaged universities; HEIs' third mission;
- HEIs contributing to RIS3 (including relationships with HEInnovate): regional governance; education; technology transfer and digitalisation; knowledge co-creation; impact measurement; sustainability and local development; entrepreneurship; innovation (e.g. technological innovation, eco-innovation, social innovation); smart communities;
- models of collaboration: triple helix; mode 3/quadruple helix; university-business cooperation (UBC).

4. Literature Review

4.1. The Entrepreneurial University

In the literature, there are several definitions of an entrepreneurial university. In their paper, Guerrero *et al.* (2006) based on Clark (1998), Kirby (2002) and Etzkowitz (2003), define the entrepreneurial university as an HEI having the "ability to innovate, recognize and create

opportunities, work in teams, take risks and respond to challenges, on its own, seeks to work out a substantial shift in organizational character to arrive at a more promising posture for the future. In other words, it is a natural incubator that provides support structures for teachers and students to initiate new ventures: intellectual, commercial and conjoint" (Guerrero *et al.*, 2006; p.6).

Furthermore, Gibb *et al.* (2014) write that: "entrepreneurial higher education institutions are designed to empower staff and students to demonstrate enterprise, innovation and creativity in research, teaching and pursuit and use of knowledge across boundaries. They contribute effectively to the enhancement of learning in a societal environment characterised by high levels of uncertainty and complexity, and they are dedicated to creating public value via a process of open engagement, mutual learning, discovery and exchange with all stakeholders in society - local, national and international."

Among these contributions, the work carried out by Etzkowitz (2013) represents a benchmark that can be compared to the model of the Civic University (Goddard, 2009; Goddard *et al.*, 2016) (Table 1).

According to Etzkowitz (2013; p. 491) 4 propositions can describe the entrepreneurial university:

1. Interaction. The entrepreneurial university interacts closely with industry and government; it is not an ivory-tower university isolated from society;
2. Independence. The entrepreneurial university is a relatively independent institution; it is not a dependent creature of another institutional sphere;
3. Hybridization. The resolution of the tensions between the principles of interaction and independence is an impetus to the creation of hybrid organizational formats to realize both objectives simultaneously.
4. Reciprocity. There is a continuing renovation of the internal structure of the university as its relation to industry and government changes, and of industry and government as their relationship to the university is revised.

According to Goddard *et al.* (2016) the civic university consists of the following 7 dimensions:

TABLE 2 - THE CIVIC UNIVERSITY DIMENSIONS (GODDARD ET AL., 2016)

Dimensions	**Description**
SENSE OF PURPOSE	Creating an impact for society by addressing societal challenges or specific problems, both global and local. Creating benefits to defined groups, networks and communities and

	considering them as co-investigators and a source for knowledge.
ACTIVE ENGAGEMENT	Collaboration and dialogue to achieve social and economic development goals and enhance teaching and research. Internal collaborations: among academics in different disciplines. External collaborations: with other public and private organisations (education institutions, governments, business and cultural organisations).
HOLISTIC APPROACH	Engagement is an institution-wide activity that integrates the core activity of academics and enhances teaching and research. Students may benefit from it and be involved with the local community to improve knowledge, employability opportunities and active citizenship.
SENSE OF PLACE	The civic university is well integrated within the territorial tissue where it is located: the place is a "living laboratory" providing specific opportunities to develop the work and impact.
WILLINGNESS TO INVEST	Projects are built up to enhance the impact of research in universities beyond the academy and campus, by involving the academic and working staff in activities funded with internal or external resources.
TRANSPARENT AND ACCOUNTABLE	Civic responsibility: indicators and benchmarks to assess the performances, clear communication of its mission and vision and impact to stakeholders.
INNOVATIVE METHODOLOGIES	Innovative methodologies and approaches to tackle societal challenges such as social innovation and entrepreneurship programs and collaborations among academics and academic and other organizations.

In the following table (Table 2), a comparison between the two models is provided.

TABLE 3 - A COMPARISON BETWEEN THE ENTREPRENEURIAL AND CIVIC UNIVERSITY'S MODEL (RETRIEVED FROM EDWARDS ET AL. (2017) AND FURTHER ELABORATED BY THE AUTHORS)

Model	**The entrepreneurial university (Etzkowitz, 2013)**	**The civic university** **(Goddard, 2009; Goddard *et al.* 2016)**
Characteristics	Strong focus on research, technological innovation, commercialisation and business development which involves mobilising the resources of the	Engagement embedded across the whole institution, providing opportunities for students, businesses and public institutions; managed to

	university for the benefit of the economic development of the city or region.	facilitate institution-wide engagement with the city and region of which it is part; operates on a global scale but uses its location to form its identity.
Related concepts	Triple helix, science parks, technology transfer, incubators	Engaged research and teaching, science with and for society, quadruple helix, smart specialisation
International networks/tools	Campus Engage; Talloires Network; U-Multirank; Global University Network for Innovation (GUNI); HEInnovate; University-Industry Innovation Network (UIIN)	

As affirmed by Etzkowitz (2013; p. 507), "the entrepreneurial university incorporates the teaching and research academic models and takes them to the next stage of development, integrating forward and reverse linear models into a renewed 'social contract' between the university and the larger society, for creating economic and social enterprises as the quid pro quo for large-scale funding of the academic enterprise." On the other side, the concept of the civic university (Goddard, 2009; Goddard *et al.*, 2016) has a stronger place-based dimension, also related to a broader commitment with the civil society. As outlined by Edwards *et al.* (2017), the concept of entrepreneurial HEI adopted by HEInnovate is closer to the concept of the civic university (Goddard, 2009; Goddard *et al.*, 2016) than that of the entrepreneurial university (Etzkowitz, 2013).

More in general, entrepreneurship can be a major issue of the HEI's strategy to turn itself into an entrepreneurial organisation, which has agreed vision, a set of values and a clear mission for the medium and long-run, which need to be translated into concrete actions. In terms of mission, Diaconu & Dutu (2014) affirm that a modern university, working in its economic and social environment, plays a triple role: learning and teaching, running scientific research and serving the community. According to the author, the social engagement with the community forms an effective part of the HEI's mission and can be relevant for all countries in the EU.

4.2. The role of Entrepreneurial Universities in RIS3

According to the guidelines, set at European level, universities have, over time, progressively taken an entrepreneurial approach in their regional engagement. This is undoubtedly evident through the growth and development of technology transfer offices, incubators and science parks able to combine the business world with research. At a political level, this aspect has been increasingly demanded in order to link structural funds to research and innovation activities (Goddard *et al.*, 2013). Universities are considered an enormous potential for

developing knowledge. They are expected to play a central role in the implementation of the Smart Specialisation Strategy, based on the priorities of their region (Fonseca & Salomaa, 2020).

In fact, regional innovation policies consider HEIs useful for building regional economic, technological and institutional capacity (Audretsch, 2014; Brown, 2016). This approach requires universities to take a more anticipatory, active and strategic role in promoting its transfer to society, instead of remaining in a distant "ivory tower" (Fonseca & Salomaa, 2020).

An entrepreneurial university can be more in line with the guiding principles of S3 if it acts as a facilitator among regional partners and if it promotes an appropriate institutional culture based on research, risk and discovery (Salomaa, 2018). In this way, it can also easily identify economic opportunities. According to Santos and Caseiro (2015) a sustainable entrepreneurial ecosystem is possible, thanks to the interaction between entrepreneurial universities and RIS3.

Undoubtedly, less developed regions have shortcomings that make it difficult to support innovation and knowledge translation efforts in the productive sector. Iacobucci (2014) states that regions with weak research infrastructure need support in research and innovation policy to improve infrastructure problems.

Therefore, the role of an entrepreneurial university becomes crucial and of organizational support "promoting an entrepreneurial culture within the region and among regional actors able to strengthen competitiveness and regional development" (Fonseca & Salomaa, 2020; p. 13).

4.3. Entrepreneurial HEIs and Social Innovation

Entrepreneurial HEIs integrate and coordinate innovative activities across the institution and beyond. The transition to the "entrepreneurial" status is a long process, influenced by the involved actors at regional, national and upper-national level and by the relationships among them (Albulescu *et al.*, 2014).

In practical terms, to achieve this status, an HEI:

1. ensures the integration of innovation policies in the institutional, governmental practice;
2. stimulates the creation and development of public-private R&D partnerships;
3. encourages the transfer of new knowledge to all users (Albulescu *et al.*, 2014).

Innovation can also be social, and social innovation is somehow related to entrepreneurial HEIs and to the concept of social responsibility. A model of the university's social responsibility, based on six dimensions is here provided (Dima *et al.*, 2013).

These dimensions are:

1) alumni-oriented projects;
2) inter-university cooperation;
3) university – high-schools / other institutions cooperation;
4) community-oriented university – business environment cooperation;
5) community-oriented international cooperation;
6) socio-cultural and ecological projects.

The entrepreneurial dimension in HEIs and its embedded approach to innovation relate, somehow, to the concept of "social responsibility". Thus, the concept of social innovation is also important when it comes to this kind of institution. Social innovation can be described as the practical development of 'solutions' towards social challenges, thus, as a process of social change which entails the development of the capacities, assets and resources of particular communities (Caulier-Grice *et al.*, 2012). From a sociological perspective, it is defined as a "creative, collaborative, and targeted change of social practices" (Domanski & Kaletka, 2017).

The S3 guide to Social Innovation (2013) highlights that social innovation consists of open approaches addressed to problem-solving, based on knowledge-sharing and multi-disciplinarity. It is mainly bottom-up, being participative and also focused on the empowerment of citizens and users. It is expert-led, demand-led and tailored, as most solutions have to be adapted to local circumstances and personalised to individuals" (European Commission, 2013).

According to Abbott *et al.* (2015), the university can contribute to social innovation in different ways:

- by providing knowledge (it could be already existing or something co-created with the affected community) which helps progression to move the process forward;

- by making its resources available (e.g., direct financial support or access to university infrastructure and assets in the innovation process);

- by involving other actors in supporting the social innovation process (e.g., by advising social innovators on how to access external knowledge resources, or persuading others to support participation in a social innovation).

According to Busacca (2018), the role of entrepreneurial universities in social innovation, more than being related to the production of knowledge or the assessment of the quality of the initiatives is that of brokers of knowledge: by using their reputation and their vast knowledge about the topics addressed, they are charismatic, trustworthy and reliable actors acting as a bridge among people and stakeholders' networks in a specific context (universities, industry, government and civil society), and facilitate the interactions among them.

4.4. HEInnovate's eight dimensions

4.4.1. Leadership and Governance

According to the HEInnovate definition of the leadership and governance area, to develop and concretely act according to an entrepreneurial culture, HEIs should consider several factors: as entrepreneurship is an asset of the HEI's strategy and an HEI is intended as a driving force for entrepreneurship and innovation in regional, social and community development, there is a commitment at a high level for the implementation of the entrepreneurial agenda. In this sense, the entrepreneurial activities are coordinated and integrated within the HEI on the base of a model. Moreover, all the faculties and units are supported and encouraged by the central level in acting entrepreneurially (see: HEInnovate.eu).

In terms of institutional leadership and governance, particularly in regions where local governments are fragmented and unable to act beyond their immediate boundaries, HEIs as key anchor institutions can play an important role in building social relations. These can contribute to the regional innovation system and the formulation and implementation of RIS3 (Kempton *et al.*, 2013).

Strong leadership is, then, one of the key factors to facilitate the development of an entrepreneurial HEI. Entrepreneurship is not only a statement in HEIs' mission (OECD, 2012), but it involves practical aspects. As Williams & Kluev (2014; p. 591) affirm, indeed, "the debate on entrepreneurial university is not merely academic; it presents a practical challenge to university leaders in moving their institutions to a more entrepreneurial mode".

To guarantee effective leadership and governance, Clark (1998) emphasised the importance of the "steering core". Its composition embraces central managerial groups and academic departments. It integrates new managerial values and traditional academic ones. This theoretically simple expectation is hard to manage in practice. In the study, according to some institutions, internal decentralisation is the main condition to strengthen institutional governance. Others focused on centralization with a set of interconnected committees responsible for the distribution of accessible resources. Other HEIs tried to learn new ways to coordinate the independent departments. The author, finally, suggests that nothing is more important than designing and implementing a coordination power in a reasonably adaptive and proactive manner. The collegial forms must dominate the personal relations of governance, building more on "we" instead of "I". Regular feedback mechanisms can serve learning and quality improvement purposes. It is important to secure the equilibrium between central and departmental interests, as well as to keep the power balance acceptable between the academic community and the administration.

In terms of HEIs governance related to RIS3, a report by the JRC (Arregui-Pabollet *et al.*, 2018) identified HEI governance factors that can influence research performance and regional engagement, under several internal and external dimensions (Table 3).

TABLE 4 - HEIS GOVERNANCE INTERNAL AND DIMENSIONS (SOURCE: FURTHER ELABORATED FROM ARREGUI-PABOLLET ET AL., 2018)

Internal Governance dimensions	**Description**
Mission attainment (whole university, faculties, institutes)	Characterize, measure and display organisational activities, processes, and achievements to encourage improvement (annual report and qualitative measurements for performance assessment and future goals)
Scientific (Specialization/Technical) Advisory Board	Advice and implementation of suggestions from independent scientific/technical experts (the level of independence is important)
Human Resources	Defined, documented, and incentivize career path for scientists (fair assessment of merit; transparency in hiring; clear incentives and guidelines for the whole organisation; rewards in response to goals achieved)
Financial distribution	Transparent conditions and incentive-driven financial distribution for scientists (merit-based financial distribution policy)
Operational feedback processes	Mechanism to assure quality control through the integrity of established processes (a set of rules help management to guide operations)
Innovation potential	Institutional support for processes, incentives, and training to promote innovative activities
External governance dimensions linked to the implementation of RIS3	**Description**
RIS3 and regional involvement	The participation of the university in the design and the implementation of the smart specialisation strategy RIS3 are requested + The alignment of smart specialisation areas chosen in the RIS3 and the participation in Horizon 2020 programme

Results show that universities with the best governance system are not always involved in local regional innovation policies. Even though they have a certain autonomy in terms of governance, they depend on national funding and regulations and it influences the outcomes of their activities. Therefore, HEIs' governance system should work on a better combination of international orientation and local engagement, especially in terms of education, in order to better respond to the skills and competences needed in the region. Moreover, RIS3 should be better embedded in universities governance systems to strengthen the strategic access to funding and in emphasizing synergies between ESIF and Horizon 2020 (Arregui-Pabollet *et al.*, 2018).

4.4.2. Organisational Capacity: Funding, People and Incentives

According to the HEInnovate definition of the organisational capacity, "if an HEI is committed to carrying out entrepreneurial activities to support its strategic objectives, then key resources such as funding and investments, people, expertise and knowledge, and incentive systems need to be in place to sustain and grow its capacity for entrepreneurship" (see: HEInnovate.eu).

According to Paiva *et al.* (2019), the entrepreneurial and innovative HEI continuously aims to develop its organizational capacity and in doing so seeks to eliminate barriers and constraints within the organization itself. The goal is, therefore, to provide incentives to all individuals (entrepreneurship champions, staff, students and stakeholders) that promote the entrepreneurial agenda to develop innovation and build relationships with stakeholders beyond academic boundaries.

Becoming an entrepreneurial university requires organizational skills, good staff and substantial incentives; it requires establishing external relations with stakeholders to exchange knowledge and organize training courses for entrepreneurs (OECD, 2012). It is a circumstantial organisational development process which needs both bottom-up and top-down approaches, with the university management, seeking to expand the university's funding base, partly in response to government policies and initiatives (Bienkowska *et al.*, 2016).

However, these processes often face problems and challenges. According to a report of EURASHE (Healy *et al.*, 2014), some of the problems encountered in terms of organizational capacity are as follows and are also shared by other authors (Wilson, 2008; Rubens *et al.*, 2017; Etzkowitz *et al.*, 2000; Marginson & Considine, 2000; Towers *et al.*, 2020) in literature:

- missing financial conditions: obtaining funding for entrepreneurial activity is still an open challenge: in Europe, most funding still comes from governments (Wilson, 2008) but designated public funding is limited. Companies and foundations are not yet incentivised to invest in research activities (Towers *et al.*, 2020);

- university complexity: these processes are often influenced by the complexity of the university organization and sometimes by unclear bureaucratic decision-making structures (Etzkowitz *et al.*, 2000; Marginson & Considine, 2000);

- lack of relevance of the outdated curricula: although the attempt to incorporate entrepreneurial activities into academic programs has increased in recent years, it has emerged that "entrepreneurial curricula lacked a clearly defined set of entrepreneurial learning outcomes that provided little structure and directionality to students' learning and development" (Towers *et al.*, 2020; p. 885);

- lack of communication and cooperation with external stakeholders and local communities (Towers *et al.*, 2020; Rubens *et al.*, 2017). There is considerable attention to teaching and learning activities and knowledge transfer, but not to business incubation, causing deficiencies in the development of entrepreneurial skills and capacity-building (Towers *et al.*, 2020).

To face these challenges, "HEIs need to invest and develop the organizational and governance structure that will support the third mission and promote entrepreneurial activities. These measures include human, financial and physical support" (Rubens *et al.*, 2017; p. 367). To this aim, all internal stakeholders, staff as well as the university's management, members and students have a role in supporting an HEI's entrepreneurial agenda and their interactions initiating institutional change (multi-actor organization) (Wakkee *et al.*, 2019).

Certainly, the process of building dynamic entrepreneurial and innovative capabilities requires time, trust, engagement and commitment (Klofsten *et al.*, 2019) but, first of all, it is necessary to promote the entrepreneurial culture within HEIs. Rubens *et al.* (2017) argue that faculties must understand the importance and role of the academic entrepreneur by including entrepreneurship in the mission and strategic plan of the university and developing reward systems to encourage all those who engage in these activities. This was also shared by Bienkowska *et al.* (2016), stating that encouraging and rewarding entrepreneurial behaviour in all staff members, reinforces the commitment to developing as an innovative HEI. It is, therefore, important to invest in the development of human entrepreneurial and innovative skills (Klofsten *et al.*, 2019).

Universities must invest and develop a support structure able to manage the third mission. An *ad hoc* organizational structure would be able to take care of entrepreneurial activities autonomously, to improve their economic, human and bureaucratic management. Besides, it is necessary to diversify the sources of funding, seeking support also from individuals, local businesses, state and federal sources.

To this purpose, it is useful to develop alliances and partnerships inside and outside the university. "An important aspect of being an entrepreneur is the ability to not only innovate but also be proactive in forming partnerships" (Rubens *et al.*, 2017; p. 367). Collaboration between departments of different disciplines within the same university is important to generate new creative ideas and thinking and exchange knowledge. At the local level, universities need to be part of the community in which they reside, feeling part of it, to contribute but at the same time increase their local resource base (Rubens *et al.*, 2017; Towers *et al.*, 2020).

All these practices are important to support the entrepreneurial activities of an HEI, to reduce tensions, to involve different collectives in order to achieve excellence in research and teaching (Klofsten *et al.*, 2019).

Box 1. Best practice - The role of TTOs in Germany

One of the best practices across the EU is represented by German universities. In this case, the technology transfers services and the role of the Technology Transfer Office (TTO) has been defined as crucial.

The role of TTOs or any dedicated capacities in HEIs is essential as acting as a trigger of the utilisation of knowledge (Bienkowska *et al.*, 2016). However, the operation of these offices has been generating critical assessments as well. These units face tremendous difficulties partly due to their complex tasks, partly because of their fragile legitimacy, especially in the classical academic environment. A further difficulty is that the administrative power and focus are often over position the Intellectual Property and Licencing issues, instead of the demanding challenges of becoming an internal agent, facilitator of entrepreneurial change, and a one-shop-stop access point between the capacities of the university and the needs of the external social and economic partners. In Germany, TTOs became operationally more efficient since they were taken out from the internal organisational structure of the universities, i.e. they were constituted as separate entities owned by universities. Thus they had a separate budget, they were more flexible administratively and financially and could apply direct and immediate incentives to researchers and academia to engage in such innovative and entrepreneurial activities (Krattiger *et al.*, 2007).

4.4.3. Entrepreneurial Teaching and Learning

According to the HEInnovate definition, "entrepreneurial teaching and learning involves exploring innovative teaching methods and finding ways to stimulate entrepreneurial mindsets. It is not just learning about entrepreneurship; it is also about being exposed to entrepreneurial experiences and acquiring the skills and competences for developing entrepreneurial mindsets" (see: HEInnovate.eu).

Entrepreneurship education aims to develop students' mindsets, behaviours, skills and capabilities, which will create the entrepreneurs of the future (Chang & Rieple, 2013; p. 226). It is about stimulating entrepreneurship in the form of new venture creation or in the economic renewal of existing ones (Blenker *et al.*, 2013). According to the authors, the balance and reciprocal influence among three elements characterise successful entrepreneurship education or learning:

1) target group and purpose;

2) teaching or learning process;

3) the university as a whole and its strategies in relationship with entrepreneurship.

For what concerns the first element, teaching can be *about* or *for* entrepreneurship, and it depends on the purpose and target: there is the need to understand whether the entrepreneurial action has to be intended as a practical activity or an academic subject (Laukkanen, 2000; Gibb, 2002). It can also be experienced in the classroom setting in order to integrate knowledge, experience and action within one entrepreneurship programme (Heinonen & Poikkijoki, 2006).

There are several pedagogical approaches which can be conducted "in", "for" or "through" entrepreneurship (Donnellon *et al.*, 2014), but in order to stimulate an entrepreneurial behaviour some authors argue that the former two need to be integrated with the latter, namely the "through" one, which entails the students' engagement in actual venture creation (Gibb, 1996; Ollila & Williams Middleton, 2011) and can be described as an action-based entrepreneurship education (Donnellon *et al.*, 2014). It means that students become leaders in real entrepreneurial and business activities and, thus, develop their entrepreneurial capability. Entrepreneurial capability entails personal, organizational and societal components and in particular identity and knowledge (related to individuals) and networks, legitimacy and localness (related to the context) (Obrecht, 2011; Donnellon *et al.*, 2014). The development of an entrepreneurial identity is important for gaining entrepreneurial capability. Identity is influenced by the context and by social ties. Conflicts, storytelling and narratives also participate in the identity creation (Donnellon *et al.*, 2014).

About the second element, it can be said that an entrepreneurial learning experience gives opportunities to expand important competences. Through their teaching programmes, the universities can enhance the skills and competencies of staff working in the field of economic development through training, consultancy services and supply of graduates, thus improving the capacity of the region to deliver RIS3 related tasks (Kempton *et al.* 2013).

An entrepreneurial HEI, combines practical to theoretical knowledge through different forms of learning in respect to the target groups and supports personal development and the development of the ability for self-organisation and self-learning (Blenker *et al.*, 2013). It provides a range of learning opportunities, on the one hand facilitating open-ended, innovative teaching and learning, developing soft skills, on the other hand providing courses/learning activities/projects that are relevant.

Among the learning approaches applied in entrepreneurial education, experiential learning (Kolb & Kolb, 2005) and hybrid approaches, which combine traditional teaching with collaboration with real business people (Heinonen & Poikkijoki, 2006), such as live projects, can be mentioned. The latter consider real-time, real-world problems as educational tools (Gibb, 2002). The application of these hybrid methods could help in bridging the gap between practical and theoretical (Chang & Rieple, 2013). In this context, external stakeholders are an important source of expertise. Heinonen & Poikkijoki (2006) elaborated their own entrepreneurial teaching approach to be applied in the classroom to develop an entrepreneurial behaviour in students. It is shown in Figure 1.

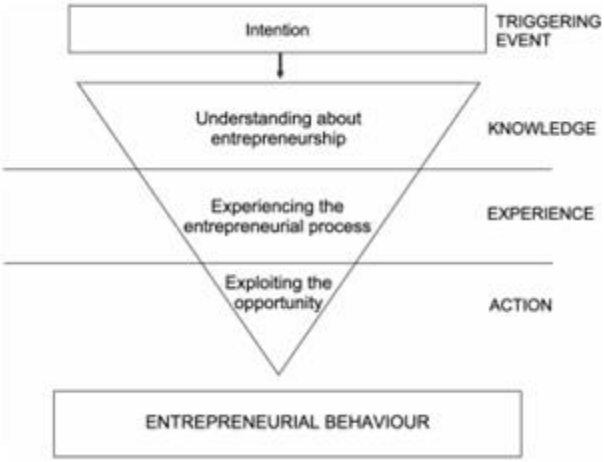

FIGURE 5 - ENTREPRENEURIAL TEACHING APPROACH (HEINONEN & POIKKIJOKI, 2006)

Concerning the third element, as stated at European level, "entrepreneurial teaching should be highly valued in an institution, within the *curricula* of the different faculties, with reward mechanisms in place, qualified educators and a wealth of interactions with the outside world, in particular with businesses and entrepreneurs. In this respect, the development and delivery of entrepreneurship are significantly affected by the internal organisational structure of the institution. Irrespective of the individual objectives of a university or college, having more effective internal organisation structures is to be recommended" (European Commission, 2012a; p. 65).

Finally, Universities can contribute to entrepreneurial knowledge creation, by sharing the results of entrepreneurship research. These could be integrated into the entrepreneurial education offer. In this way, HEIs can provide specialist research expertise and links to national and international networks of knowledge.

Thus, the entrepreneurial culture can therefore be developed through "training programs on the identification of market opportunities, the implementation of entrepreneurial solutions or the promotion of new start-ups" (Santos & Caseiro, 2015; p. 542), directing teaching towards creative, innovative and attractive learning processes.

Entrepreneurship teaching can help to develop all the skills needed for effective smart specialization strategies, as it can develop human resources with strategic mindsets, can help in demand absorption capacity through the creation of new businesses, spin-offs, or can put in place qualified human capital to help businesses incorporate knowledge and research (Santos & Caseiro, 2015).

4.4.4. Preparing and Supporting Entrepreneurs

"HEIs can help students, graduates and staff consider starting a business as a career option. At the outset it is important to help individuals reflect on the commercial, social, environmental

or lifestyle objectives related to their entrepreneurial aspirations and intentions. For those who decide to proceed to start a business, or other type of venture, targeted assistance can then be offered in generating, evaluating and acting upon the idea, building the skills necessary for successful entrepreneurship, and importantly finding relevant team members and getting access to appropriate finance and effective networks. In offering such support, an HEI should ideally act as part of a wider business support ecosystem rather than operating in isolation" (see: HEInnovate.eu).

Universities play a pivotal role in contributing to the regional entrepreneurial discovery process by bringing global awareness and partnerships across regional borders into the frame through evidence-based identification of competitive advantages around which regional strategies and resources can be concentrated (Kempton *et al.* 2013). Moreover, universities interact with other sectors and can provide knowledge partners and catalysts (Wakkee *et al.*, 2019).

According to the original principals, an HEI should act as a key partner of the entrepreneurial ecosystem in a way that potentially motivates university people (students, professors) to start enterprises or serve the local social and economic stakeholders with knowledge services. Several activities can raise motivation: raise awareness of entrepreneurship, support an idea or seeking partners, offer trainings, mentoring, help in external financing, provide consultancy etc.

Higher education institutions are responsible for their external relations, which is a key issue in raising awareness of entrepreneurship. If HEIs prepare to be the source of next-generation innovations, it will likely be attractive in joint businesses development processes in the region. The advanced university-business collaborations mean a win-win situation for both sides through the valorisation and promotion of entrepreneurship (Davey *et al.*, 2011).

Universities can contribute to the capacity building on the demand side through new business formation, student enterprises, graduate placements as well as encouraging staff to actively engage with local businesses (Kempton *et al.* 2013). This could be done by including courses on business creation as it improves students' skills, and attitudes towards becoming entrepreneurs (Gieure *et al.*, 2019). These courses provide students with practical knowledge as they learn from real-world scenarios and with theoretical knowledge on business creation. Additionally, incorporating business-oriented teaching techniques that provide business creation training can positively foster entrepreneurial intentions not only for students but also for teachers. García-González & Ramírez-Montoya (2019) suggests an innovative training model—that requires co-creation processes between different actors from different disciplines—for the development of social entrepreneurship competences.

According to this, living labs represent a useful model for co-creation. They are defined as ecosystems in which stakeholders from public-private-people partnerships of firms, public agencies, universities, institutes, and users all collaborating for creation, prototyping, validating, and testing of new technologies, services, products, and systems in real-life contexts (Leminen *et al.*, 2012).

These are experiential places where participants have the opportunity to design and experiment with products and services (Dvarioniene *et al.*, 2015). They allow working in real-life contexts by creating sustainable value and training the users for open and distributed innovation (Bergvall-Kåreborn *et al.*, 2009). Unlike other models, living labs also involve heterogeneous stakeholders such as academics, developers, industry representatives, citizens and users, as well as various types of public and private organizations in networks of living labs (Ballon & Schuurman, 2015); among these actors, the presence of all sectoral, regional and national actors is required (Mazzucato, 2018).

However, creating a network with business partners can be costly. According to the OECD (2012) report, it is crucial for a university to invest in its entrepreneurial activities through a sustainable financial strategy. Universities are entrepreneurial when they are not afraid to maximise their potential, diversify funding sources and reduce their dependency on state/public funding. Universities should bring in additional external funding from or through services in kind such as sharing space and facilities (OECD, 2012). This means that university-business collaborations can manifest in both teaching (training) and service-sharing activities.

4.4.5. Digital Transformation and Capability

Following the HEInnovate's definition and statements in this area, HEIs's digital capability has to do with the ability to integrate, optimise and transform digital technologies to support innovation and entrepreneurship. The deployment of these technologies is key enablers for innovative HEIs, as, through their application, among and within institutions, they foster a digital culture (see: HEInnovate.eu).

Open science and innovation practices are widespread across the HEI, especially through their Technology Transfer Offices (TTOs), which can lead to the creation or to be part of Digital Innovation Hubs (DIH). Entrepreneurial universities may act as incubators by promoting an interactive dynamic model process, based on linear models working in tandem and enhancing each other: on one side, especially through their TTOs, they operate starting from research and moving to utilization, moving relevant knowledge and technology out of the university; on the other side, the university's liaison office moves from problems in industry and society, seeking solutions in science. Therefore, they can house both firms generated from academic research and firms brought into the university's orbit by entrepreneurs seeking a closer connection to the academic scene to enhance their firm (Etzkowitz, 2013).

DIHs can be defined as groups of different actors or policy initiatives that support digitalisation and the development of the surrounding innovation ecosystem in concrete territorial contexts (Goetheer & Butter, 2017). More concretely, the aim is to enhance companies' competitiveness in the region by improving their business/production processes as well as their products/services through the application of digital technology (European

Commission, 2016). DIHs can provide several services (Rissola & Sörvik, 2018), in which HEIs can play a major part:

- awareness-raising: to promote the use of new technologies;
- diagnosis: analysis of the companies' specific needs and possible digital solutions to improve their competitiveness;
- design of transformation plans: as a result of the previous diagnosis;
- realisation: experimentation, testing, piloting;
- collaborative research projects: e.g., R&I; implementation of technological solutions;
- matchmaking: favouring the encounter between supply and demand (e.g. universities and research institutes as providers; companies with similar needs);
- training and skills development;
- promotion and marketing;
- internationalisation;
- financing;
- economic studies and analytical insights (for private/public actors);
- transversal initiatives to favour digitisation.

Miörner *et al.* (2019) found that most DIHs already have collaborations with other ecosystem players like authorities and universities, but still fail to perform as multi-sided brokers to draw all expected synergies. Instead, it seems that the cooperation between universities and research and technology centres (RTOs, or competence centres, CCs) is more elaborated and exploited, with access to advanced facilities for the industry. Improving this collaboration among actors through DIHs could enhance the exchange of knowledge and of their set of technology services (DEI Working Group, 2017). Then, the role of DIHs would expand to become a platform of dynamic digital presence supporting all the activities of regional actors.

Moreover, the process towards digital transformation could be even more effective if the authorities (local governments) would involve universities (as key stakeholders) into the development of digital infrastructure and the implementation and use of ICT in a wider range of services: that is a primary element in RIS3 (European Union, 2012).

Digital transformation also relates to the teaching, learning and assessment practices' aspects. To make it effective, digital infrastructure is necessary and has to be aligned to the institution's vision, mission and strategy and continuously managed and improved. Therefore, the HEI involved in this process should have a dynamic digital presence supporting all its activities (see: HEInnovate.eu).

Nowadays, we assist in a digital transition in many economic sectors which also affects the labour market. A major role in this shift is played by education. As affirmed in the OECD report (2019) about the changing nature of work in the digital era, education should focus both on young education and on life-long learning, involving adult education. The first should serve to equip young people with the knowledge, skills and attitudes needed for the new emerging opportunities in life and work while adult learning is crucial in helping those already in the labour force acquire the skills needed in digitally-enabled workplaces. The concept of "digital skills", then, goes beyond the technical knowhow or STEM (science, technology, engineering and mathematics) and includes transversal skills (e.g. problem-solving, critical and creative thinking, social skills, and a strong ability to continue learning).

In the Digital Competence Framework for Citizens (DigComp 2.1) (Carretero *et al.*, 2017) promoted by the European Commission and the JRC, a set of 5 dimensions describes the digital competences, with 8 proficiency levels for self-evaluation.

TABLE 5 - THE DIGITAL COMPETENCE FRAMEWORK FOR CITIZENS (DIGCOMP 2.1) (CARRETERO ET AL., 2017; HTTPS://EC.EUROPA.EU/JRC/EN/DIGCOMP/DIGITAL-COMPETENCE-FRAMEWORK. LAST ACCESSED: 31.10.2020)

Competence area	**Description**	**Sub-dimensions**
1. Information and data literacy	To articulate information needs, to locate and retrieve digital data, information and content. To judge the relevance of the source and its content. To store, manage, and organise digital data, information and content.	1.1 Browsing, searching, filtering data, information and digital content 1.2 Evaluating data, information and digital content 1.3 Managing data, information and digital content
2. Communication and collaboration	To interact, communicate and collaborate through digital technologies while being aware of cultural and generational diversity. To participate in society through public and private digital services and participatory citizenship. To manage one's digital identity and reputation.	2.1 Interacting through digital technologies 2.2 Sharing through digital technologies 2.3 Engaging in citizenship through digital technologies 2.4 Collaborating through digital technologies 2.5 Netiquette 2.6 Managing digital identity
3. Digital content creation	To create and edit digital content to improve and integrate information and content into an existing body of knowledge while understanding how copyright and licences	3.1 Developing digital content 3.2 Integrating and re-elaborating digital

	are to be applied. To know how to give understandable instructions for a computer system.	content 3.3 Copyright and licences 3.4 Programming
4. Safety	To protect devices, content, personal data and privacy in digital environments. To protect physical and psychological health, and to be aware of digital technologies for social well-being and social inclusion. To be aware of the environmental impact of digital technologies and their use.	4.1 Protecting devices 4.2 Protecting personal data and privacy 4.3 Protecting health and well-being 4.4 Protecting the environment
5. Problem solving	To identify needs and problems, and to resolve conceptual problems and problem situations in digital environments. To use digital tools to innovate processes and products. To keep up to date with the digital evolution.	5.1 Solving technical problems 5.2 Identifying needs and technological responses 5.3 Creatively using digital technologies 5.4 Identifying digital competence gaps

As a consequence of this transition, also the learning process is changing, with a progressive adoption of mobile technologies and digital tools integrated into the learning experience (e.g., web-based video; computerised environments; spatial science technology; slow-motion: narrated stop-motion animation; generic modelling language; digital video; augmented reality; design-based research; gamification; learning manager; simulation; computer-based teaching; library webinars, etc.) to stimulate students' entrepreneurial capacity (Sousa *et al.*, 2019). Digital learning methodologies consist of new methods of teaching using technology with the purpose to improve the quality of education and involve students in the educational process. These methodologies can be both applied in face-to-face learning experiences and also integrated into digital learning contexts. In an entrepreneurial HEI's environment, some learning approaches can be project based-learning; problem-based learning; digital stories; online learning environments; digital moments; technology-integrated teaching methods; digital storytelling; educational games; active learning (Sousa *et al.*, 2019).

4.4.6. Knowledge Exchange and Collaboration

"Knowledge exchange is an important catalyst for organisational innovation, the advancement of teaching and research, and local development. It is a continuous process which includes the third mission of an HEI, defined as "the stimulation and direct application and exploitation of knowledge for the benefit of the social, cultural and economic development of society. The

motivation for increased collaboration and knowledge exchange is to create value for the HEI and society" (see: HEInnovate.eu).

HEIs have manifold responsibilities in the collaboration with the actors of the quadruple helix. In fact, they can influence the territory in which they reside, through the decision of economic initiatives, policy development, knowledge transfer (especially at a local level as "active neighbourhood involvement"), teaching and basic research (Breznitz & Feldman, 2010). HEIs produce outputs, in terms of human capital (graduates) and knowledge (publications), that in the large majority of the cases positively influence local firms (Bonaccorsi *et al.*, 2019). Furthermore, regionally "engaged" universities also make collaborative (contact) research and consulting (Sánchez-Barrioluengo & Benneworth, 2019).

This new role of universities as a channel of intellectual capital (knowledge creation and dissemination) make them capable of playing an increasingly entrepreneurial role, involving networking and collaboration, as well as sustainability and social engagement (Frondizi *et al.*, 2019).

The quadruple helix approach, which has many connections to HEIs role in RIS3, requires a strong business sphere to incorporate innovation and knowledge coming out from universities (Pugh, 2017). Through practising meaningful co-production in research, the business sector, in fact, helps local (or regional) universities to become more responsive, accountable and effective in the economic sense (Kolehmainen *et al.*, 2016). Universities have substantial and varied experience in working with industry and business partners both in technological development, new skills development through innovation hubs and other new modes (such as, for example, collaborative doctoral programmes).

However, universities' role also goes beyond economic issues: they are involved in the technology transfer process, and they can share knowledge effectively (Marques *et al.*, 2019). For example, local knowledge creation and dissemination can engage arts and social sciences as well as an expert in the fields of technical and natural sciences (Kempton *et al.*, 2013). Ideally, HEIs involvement in regional innovation systems results in an optimal HEI-region fit (Jaeger & Kopper, 2014). In this sense, the literature moves convincingly to extend the potential of the knowledge and quadruple helix cooperation opportunities to almost all disciplinary fields.

The great potential of integrated research reflecting on wider community challenges and activities makes the engaged universities as catalysts of local development, knowledge transfers and spill-over (Sánchez-Barrioluengo & Benneworth, 2019). There is also an evolving role in re-engaging citizens in local democratic politics of collective problem solving (Kolehmainen *et al.*, 2016). Reveiu and Dardala (2013) revealed in their work that the influence of universities on the development of innovative regional clusters is crucial. The strong relationship between cluster-type agglomerations and the research results from related scientific fields should also play a more important role in complementing the traditional roles of universities (education and research). However, other actors, such as institutes of vocational education and training (VET), should also tackle the needs of the labour market

and nurture social ties with other parts of the public sector, business and the community to maximise the use of available resources (Hazelkorn & Edwards, 2019). The social side of such innovations can create knowledge, legitimacy and symbolic benefits for public institutions as well (Abbott *et al.*, 2015).

Considering the wider range of stakeholders, some authors believe that multi-level innovation ecosystems and multi-stakeholder partnerships can bring HEIs and businesses closer to regional development. For example, Carayannis & Campbell (2009) emphasise an innovation ecosystem that encourages the co-evolution of different knowledge and innovation modes as well as balances non-linear innovation modes in the context of multi-level innovation systems of universities, commercial firms and academic firms. Also, place-based and multi-stakeholder partnerships, which are dealing with real-world issues, can contribute to sustainability (Rinaldi *et al.*, 2018). In this process, science parks and incubators are hybrid organizations that combine several institutional spheres and can be considered ecosystems of innovation. They act, in fact, as the "glue" that connects the actors of the quadruple helix and as a catalyst between the different actors (Hasche *et al.*, 2019). Business centres usually do tender funding while incubators provide start-up services. Still, the latter don't normally go beyond basic business services, and that is a problem for enterprises which already have advanced innovation potential or skills. HEIs can be a solution to such challenges, since they can be the knowledge bases of regional innovation system: they promote R&D activities, establish industrial cooperation and share innovation knowledge in any ways we mentioned in earlier parts of this study (Szépvölgyi *et al.*, 2013). Besides, universities can play a role through further social engagement (idea workshops, prototyping, experience labs, etc.) (Spiesberger *et al.*, 2018).

According to Kolehmainen and colleagues' (2016) theoretical conclusion on the topic, quadruple helix actors must all share their visions, shape the future together, and start joint, collective and collaborative activities to create a framework for knowledge-based regional development.

Box 2. Best practice - EU promotion of Knowledge and Innovation Communities (KICs)

It is worth a mention that the EU itself—through the European Institute of Innovation and Technology—wants to expand the knowledge triangle (research, education and innovation) using the so-called Knowledge and Innovation Communities (KICs). KICs gather long-term (7 years) partnerships of European education, research and business entities and involve public authorities in three themes: sustainable energy, future information and communication society, climate change mitigation and adaptation. Their main mission is to foster innovation and entrepreneurship explicitly in the full innovation cycle in a flexible way. They realise this in a business-oriented approach: they create business plans, measure success with key performance indicators, etc. The final goal with KICs is to strengthen strategic synergies and contribute to smart specialization strategies by linking innovation clusters that may be able to compete on the global level (complementary strengths, economies of scale, etc.) (Allinson *et al.*, 2012).

4.4.7. The Internationalised Institution

In the context of HEInnovate, internationalisation is defined as the process of integrating an international or global dimension into the design and delivery of education, research, and knowledge exchange. It is considered as a vehicle for change and improvement as it introduces alternative ways of thinking, questions traditional teaching methods, and opens up governance and management to external stakeholders. To be entrepreneurial, an HEIs has to go international and innovative.

To recognise an entrepreneurial HEI from an internationalisation perspective, internationalisation has to be an integral part of the HEI's entrepreneurial agenda; the HEI supports the international mobility of its staff and students, seeks and attracts international and entrepreneurial staff; international perspectives are reflected in the HEI's approach to teaching, and international dimension is reflected in the HEI's approach to research (see: HEInnovate.eu).

As affirmed by Klofsten *et al.* (2019; p. 2) "adopting an internationalisation orientation, entrepreneurial universities are more proactive in terms of attracting and retaining talent with entrepreneurial mindsets and behaviours; capturing balanced and diversified funds for ensuring long-term investment in entrepreneurial and innovative activities; and building strategic partnerships with key agents with a strong entrepreneurial innovation presence and recognition across the globe."

Similarly, Minola *et al.* (2016) investigated the direct effect of internationalisation on HEIs' entrepreneurship. Starting from the premises that:

- students enrolled in an internationalized university can become open-minded and globally-oriented human capital with a developed entrepreneurial mindset able to respond both to local needs of development; they can also work abroad in culturally diverse environments, become flexible and adapt to a changing global society and labour market;

- international institutional cooperation for research activity allows the integration of programmes and the exchange of both students and academic staff; supports the creation of synergies, the capitalisation of collective efforts, investments, resources, skills and knowledge and finally put students' in contact with heterogeneous partners and resources by improving their technical and cultural knowledge and entrepreneurship;

- commercialisation of research and creation of knowledge-based firms and internationalized academic spin-off activities are promoted through international university technology transfer networks; they improve students' perception of entrepreneurial self-efficacy and contributes to validate entrepreneurial ideas and provide models for students' careers;

This study demonstrates that entrepreneurship and internationalisation are complementary and university can benefit from this combination both from a managerial perspective and from the entrepreneurial education and research one, as it allows to better access to international

research fundings and educational exchange programmes (e.g., Horizon 2020; European Research Council initiatives, Erasmus for Young Entrepreneurs etc.), to international students' networking (e.g., Junior Achievement association) and faculty exchange; to local and global strategic partnerships for investments for the international visibility and recognition of the innovative services and logistics of the campuses (Minola *et al.*, 2016).

HEIs' internationalisation can take place within "knowledge and innovation communities", which are based on the cooperation among actors from several sectors, especially from industry and from other research organisations, committed in dynamic pan-European partnerships. They aim to promote positive environments for creative processes of innovations and entrepreneurship in order to find solutions to major societal challenges in areas with high innovation potential, through training and education programmes, research applied to the market, innovation projects and business incubators and accelerators[14].

International partnerships are pivotal in EU research funding programmes, as they can support collaborative research projects in the context of RIS3 regional priority areas. As an example, Horizon2020[15] promotes public-private partnerships (with industry), also through Joint Technology Initiatives and partnerships among public actors, also through the participation in joint programmes between the Member States, with potential benefits in terms of links to national programmes; leverage effect; industry involvement; cross-border collaboration. Similarly, the Marie Skłodowska-Curie[16] research fellowship programme supports cooperation between industry and academia and innovative training to enhance employability and career development.

There are more opportunities, as the calls for projects Erasmus+ Strategic Partnerships[17]. This action finances transnational projects designed to develop and share innovative practices and promote cooperation, peer learning, and exchanges of experiences in the fields of education, training, and youth among public, private actors and NGOs, in several areas, among which Higher Education. Among the opportunities given by this action, that have to do with entrepreneurship and innovation at the international level, are:

- strengthening cooperation and networking between organisations;
- promoting the development, testing, and implementation of innovative practices;
- promoting the recognition and validation of knowledge, skills, and competences;
- promoting entrepreneurship and active citizenship among young people.

[14] EIT: https://eit.europa.eu/our-communities/eit-innovation-communities (last retrieved: 04.11.2020).

[15] Horizon 2020: https://ec.europa.eu/programmes/horizon2020/sites/horizon2020/files/281113_Horizon%202020%20standard%20presentation.pdf (last retrieved: 04.11.2020).

[16] MSCA: https://ec.europa.eu/research/mariecurieactions/ (last retrieved: 04.11.2020).

[17] Erasmus+ Strategic Partnerships: https://ec.europa.eu/programmes/erasmus-plus/opportunities/strategic-partnerships-field-education-training-and-youth_en (last retrieved: 03.11.2020).

The participation on smart specialisation platforms, within the thematic areas of energy efficiency, industrial modernisation and agri-food, also provides opportunities for HEIs to be involved in partnerships between EU regions that have identified these fields as their smart specialisation priorities. They work together in this interactive and participatory environment to implement their RIS3 and to realise joint bottom-up initiatives involving the industry, the academia, research organisations and the civil society to projects that promote alignment between the local, regional, national and European level and guarantee a more competitive and sustainable growth in the thematic areas identified (see: https://s3platform.jrc.ec.europa.eu/thematic-platforms).

HEIs can play a significant role in the formation of the R&I ecosystem thanks to their network of international contacts. They can act as a connecting channel at interregional, national and global level. The resulting benefits may also be indirect or not immediately obvious, but exist: HEIs, thanks to their international visibility, can attract talented young researchers, thus reducing the loss of talent in the region; moreover, thanks to international mobility they can increase the qualifications of existing human capital. Also, at the financial level, HEIs with strong international connections are able to bring significant resources to the territory, thanks to their participation in European and international projects, thus contributing to regional innovation (European Commission, 2012b). To conclude, "the interplay between the regional, national and global role of HEIs should be recognised as a positive element both at the design phase of RIS3, the 'entrepreneurial discovery process', and in its implementation" (Fotakis *et al.*, 2014; p. 30).

Box 3. Best practice - The Vanguard Initiative

The Vanguard Initiative – New growth through smart specialisation is a network of European Regions that, with a bottom-up approach, supports entrepreneurial innovation and industrial renewal, especially among SMEs, in smart specialisation priority areas, by applying a 4-step methodology (Learn-Connect-Demonstrate-Commercialise) for the implementation of innovative pilot projects. Thus, this initiative starts from the political commitment made by regions to use their smart specialisation strategy to boost new growth through bottom-up entrepreneurial innovation and industrial renewal in European priority areas. Interregional partnerships can create innovation ecosystems able to develop solutions for important societal challenges, while realizing the EU's ambitions for greater international competitiveness.

Vanguard regions can build synergies in smart specialisation strategies to boost world-class clusters and cluster networks, in particular through pilots and large-scale demonstrators. These investments will strengthen Europe's competitive capacity to lead in new industries in the future and develop lead markets that offer solutions to our common challenges (see: https://www.s3vanguardinitiative.eu/).

4.4.8. Measuring Impact

"Entrepreneurial/innovative higher education institutions need to understand the impact of the changes they bring about in their institution. The concept of an entrepreneurial/innovative HEI combines institutional self-perception, external reflection and an evidence-based approach. However, impact measurement in HEIs remains underdeveloped. The current measurements typically focus on the quantity of spin-offs, the volume and quality of intellectual property generation and research income generation, rather than graduate entrepreneurship, teaching and learning outcomes, retaining talent, the contribution to local economic development or the impact of the broader entrepreneurial agenda." (see: HEInnovate.eu)

There have been many attempts to measure the impact of HEIs in terms of innovation for local development.

In this sense, the OECD, in a book titled *Measuring Innovation: A New Perspective* (2010; p. 16) proposes key actions at macro level that can easily be translated to institutional level tasks, which can also be applied to measure HEIs innovation impact (Table 5).

TABLE 6 - KEY ACTIONS TO MEASURE INNOVATION (OECD, 2010; P. 16)

How to measure innovation	Specific key actions
Improve the measurement of broader innovation and its link to macroeconomic performance	- Measure and value intangible assets; - Revisit the measurement framework for innovation to identify and prioritise areas for survey design and re-design; - Align survey and administrative data with economic aggregates.
Invest in a high-quality and comprehensive data infrastructure to measure the determinants and impacts of innovation	- Improve business registers; - Exploit the statistical potential of administrative records; - Improve the data infrastructure at the sub-national level; - Establish a data infrastructure which combines data linkages with good researcher access to the data, while protecting business and individual confidentiality.
Recognise the role of innovation in the public sector and promote its measurement	- Develop a measurement framework for innovation in the public sector for the delivery of public services, health and education; - Devise indicators that capture the nature, direction and intensity of public support for innovation, at national and sub-national levels.
Promote the design of new statistical methods and interdisciplinary approaches to data collection	- Develop interdisciplinary approaches to data collection and new units of data collection; - Improve the measurement of innovative activity in complex business structures, organisations and networks; - Promote the measurement of the skills required in innovative workplaces;

	- Promote the joint measurement of emerging and enabling technologies.
Promote the measurement of innovation for social goals and of social impacts of innovation	- Develop measures of innovation that address social needs; - Devise measurement tools that bridge the economic and social impacts of innovation activities.

More recently, Bonaccorsi *et al*., (2019) affirm that HEIs produce positive externalities within their local contexts, besides the economic and local development and growth, also in terms of social and cultural impact. More in general, the main contribution of HEIs, according to the author, can be summarised as follows:

- educating and training high-level human capital. The presence of employed graduates in local firms creates a positive impact on the performance and rate of growth of countries, regions, and cities. They can manage complex tasks and work autonomously and increase the productivity of a company; they provide new knowledge to firms and thus contribute to the creation of value; by maintaining informal relationships with their university, they can provide access to external knowledge. Moreover, the proximity of an HEI has positive effects on the productivity and local development of a specific area;

- through research activities which produce knowledge spill-over effects and contribute to the economic development of an area. It has a localised dimension; namely, the proximity of a university influences a bi-directional causal relationship between the fact that research generates opportunities for innovation and growth and creates qualified human capital and that, therefore, on the other side, countries and regions are keen to support a higher level of public investment in R&D;

- through academic entrepreneurship, start-up creation and student entrepreneurship;

- attracting foreign investments, as the presence of HEIs in a region might influence location decisions of companies, also multinational, interested in R&D;

- procuring an added value, as universities can be a source of purchasing scientific instrumentation, software, equipment and the related specialized knowledge-intensive services that can be applied outside the institution and may have an impact on the local economy;

- creating social and cultural externalities. “Universities create a social and cultural climate in which valuable non-university activities find a favourable environment. The presence of a population of young and educated people brings with itself favourable conditions for cultural activities, as well as for entertainment and leisure” (p. 15).

- economic impact related to university expenditure. The direct positive impact of universities can be short-term (e.g., direct expenditures of students and faculty; expenditure of students and faculty who move into the area from other regions; expenditures by the institution; funds

for research, salaries, and equipment, infrastructure, supplies) and long-term direct and indirect effects (e.g., enhancement of workers' skills; the relationship between research and local industry; positive effects on business location, as the attraction of foreign investment); business creation. A multiplier effect has also to be considered.

Specifically, for what concerns HEIs and RIS3, a framework to analyse the contribution of HEIs to RIS3 has been developed (Edwards *et al.*, 2017), as in Table 6, even though, specific indicators should be developed.

TABLE 7 - FRAMEWORK FOR ANALYSING HEIS CONTRIBUTION TO RIS3 (BASED ON EDWARDS ET AL., 2017 AND EDWARDS & MARINELLI (EDS.), 2018 FURTHER ELABORATED BY THE AUTHORS)

RIS3 elements	HEIs contribution to RIS3
Entrepreneurial Discovery (EDP) and strategy high-level governance	Applied and interdisciplinary research and entrepreneurial contribution; Absorbing knowledge from outside the region and applying it to the local context; Orientation towards solving the problems of businesses and society; Involvement as managers in high level strategy governance structures; Systemic links to the RIS3 and capacity of interaction with regional authorities and the entrepreneurial community; Can support experimentation with new governance models.
Support to the development of a limited selection of smart specialisation priorities through education	Adaptation of curricula and research portfolios to emerging priorities; Horizontal skills among graduates, with accent on innovation skills; Organising activities to upskill the existing workforce, including development of adult learning programmes; Combining academic education with vocational and technical training; Education for the development of quadruple helix partnerships.
Involvement in the definition of a vision and smart specialisation priorities	Support in identifying regional priorities; Importance of the social sciences to detect and articulate societal challenges and interpret stakeholder positions in light of broader contextual factors that can ultimately support a more precise identification of RIS3 priorities;

	Contribution to the definition of shared vision for RIS3.
Involvement in RIS3 monitoring	Contribution to the design of the monitoring system; Involvement in monitoring activity through collection and analysis of data (analytical skills); Supporting the activity through development of skills and knowledge of experts involved in monitoring.
Broader understanding of innovation and research	Respond to regional challenges; Beyond the third mission; Civic University model and Quadruple Helix: research and teaching also to address societal challenges.

Moreover, the JRC in 2018 published a policy report containing an assessment framework for universities to measure their regional innovation impact (Jonkers *et al*., 2018). In the annex of the study there are examples of potential indicators for input, result and impact measurement opportunities. The fields identified for the measurement, which always consider the involvement of local, regional, national and/or foreign partners, are the following:

- education and human capital development;
- research, technological development, knowledge transfers and commercialisation
- entrepreneurship and support to enterprise development
- regional orientation, strategic development and knowledge infrastructure

As an example, the following table (Table 7) reports the "education and human capital development" results and impact indicators (Jonkers *et al*., 2018).

TABLE 8 - "EDUCATION AND HUMAN CAPITAL DEVELOPMENT" RESULTS AND IMPACT INDICATORS (JONKERS ET AL., 2018)

Education and human capital development (with a regional orientation)	
Inputs	'Results' indicators and 'Impact' indicators
Grants and scholarships for students from the local/regional private sector - Credit-bearing courses established through a direct request or with the involvement from non-academic local/regional organisations; - Tailor-made academic programs in partnership with businesses - Participation non-academic agents in	**Entrepreneurship education: number of students enrolled in entrepreneurship courses as % of total students and/or the number of students attending an internship** - Number of faculty members taking a temporary position in a non-academic organisation; - Number of employees from non-academic organisations taking temporary teaching and/or research positions at university - Labour outcomes and postgraduate labour surveys that measure satisfaction with knowledge gained at university - Student internships in the local region: out of the students

curricula design - Joint PhD Programmes and industry sponsorship of postgraduate education - Entrepreneurship teaching and learning; skills development - Inter-sectorial mobility of teaching staff - Labour outcomes and student satisfaction post-graduation - Regional student retention - Life-long learning and non-academic education - Graduate tracking of salaried employment	who did an internship, the percentage where the internship was with a company or organisation located in the region - BA theses with local/regional organisations: degree theses of bachelor graduates done in cooperation with organisations (industry, public, non-profit organisations) in the region - MA theses with local/regional organisations: degree theses of master graduates done in cooperation with organisations (industry, public, non-profit organisations) in the region - % academics teaching in courses required by local/regional firms; or income received from non-credit bearing teaching and associated activities for local/regional clients - Graduate employment: percentage of graduates working in the region after graduation - Wages of university graduates (3-5 years after graduation)

Indicators from the Regional Innovation Scoreboard, could also be applied to the HEIs' innovation impacts measurement (https://interactivetool.eu/RIS/index.html), also in a perspective of comparison with other realities and continuous monitoring for performing the necessary corrections. The indicators are the following:

1. scientific co-publications;
2. R&D expenditure public sector;
3. sales of new-to-market and new-to-firm innovations;
4. SMEs innovating in-house;
5. marketing or organisational innovators;
6. lifelong learning;
7. product or process innovators;
8. most-cited publications;
9. non-R&D innovation expenditures;
10. public-private co-publications;
11. employment medium and high-tech manufacturing & knowledge-intensive services;
12. innovation index;
13. population with tertiary education;
14. trademark applications;
15. R&D expenditure business sector;
16. EPO patent applications;

17. innovative SMEs collaborating with others;

18. design applications.

Finally, as Rosen (2020) affirms, a new ranking method could also be developed and be focused on the HEIs' contribution to the sustainability of communities, encouraging the necessary actions in this sector. The ranking could be useful to have an overview of the urgent challenges of the territory with respect to sustainable development and help HEIs to collect data and monitor their performance. Being already very active and committed to sustainable development, these rankings can be useful for HEIs to improve and evolve themselves. "By linking the SDGs and universities through a ranking could increase the level of contributions to and impact on the SDGs by universities, and make this happen more rapidly" (Rosen, 2020; p.2).

5. Discussion

This study aimed at investigating the contributions from the literature related to the potential role of entrepreneurial HEIs to RIS3 design and implementation, by analysing it through each one of the 8 dimensions of the HEInnovate self-assessment tool.

The results show that HEIs may contribute to regional innovation policies, by acting outside their "ivory tower" (Fonseca & Salomaa, 2020) to transfer regional economic, technological and institutional capacity to a broader society (Audretsch, 2014; Brown, 2016). This can be done as HEIs are able to play anticipatory, active and strategic roles linked to their research activity and by acting as facilitators among regional partners (Salomaa, 2018). As a result, they become channels of intellectual capital (knowledge creation and dissemination), capable of playing an increasingly entrepreneurial role, involving networking and collaboration, as well as sustainability and social engagement (Frondizi *et al.*, 2019). In concrete, with the purpose to solve business and societal problems, HEIs can work to train human capital for the modern economy and attract talents; collaborate with business to run research based on market needs; support innovation and technology transfer, seeking to maximise financial returns in the region and can engage with local businesses and communities to enhance their capacity to be innovative and competitive (Beer *et al.*, 2020; Edwards & Marinelli, 2018).

HEIs can also play a key role in different RIS3 development steps, with accent on defining a vision and smart specialisation priorities, development of a monitoring system and undertaking a role in different layers of the multi-level governance system, supporting cooperation between quadruple helix actors (Edwards & Marinelli, 2018).

To do so, HEIs need a support structure that has human, financial and physical dimensions, which relies on the involvement of internal and external stakeholders and on the alignment of different funding resources (Rubens *et al.*, 2017; Wakkee *et al.*, 2019). The importance, for an entrepreneurial HEI to contribute to RIS3, is especially in its ability to create strategic partnerships (Rubens *et al.*, 2017). These partnerships may start from a concrete interaction

between different disciplines and the coordination between different departments (administrative staff, scholars and students) and be implemented through the contact and exchange with the broader local community (public authorities, industry and civil society) (Rubens *et al.*, 2017; Towers *et al.*, 2020). Moreover, global awareness and partnerships across regional borders as well as the interaction with other sectors for the provision of knowledge partners and catalysts (Wakkee *et al.*, 2019) is relevant. This approach may contribute to the entrepreneurial discovery process at local level, to identify competitive advantages and set regional strategies and resources (Kempton *et al.*, 2013).

The combination of international orientation and local engagement should be improved and progressively implemented, also at a HEIs' governance level. In terms of education, this approach could support the development of specific skills to train human capital responding to regional needs aligned to RIS3 priorities. VET may tackle the needs of the labour market and nurture social ties in the public sector, business and the community to combine this system of supply and demand (Hazelkorn & Edwards, 2019). Moreover, there is also the need to enhance the presence of RIS3 within the universities' governance systems and in training and strategically orientate funding and synergies both related to research and local development (Arregui-Pabollet *et al.*, 2018).

In times of digital transformation, HEIs' liaison offices play a pivotal role in the process of HEIs' engagement for RIS3 and entrepreneurship: they move from the identification of problems in industry and society to search solutions in science. HEIs produce trained human capital (graduates) and knowledge (scientific publications) and run collaborative (contact) research and consulting (Sánchez-Barrioluengo & Benneworth, 2019). This may positively influence local firms (Bonaccorsi *et al.*, 2019), which may be directly generated from R&D or could look for relationships with HEIs to find scientific solutions to enhance their businesses (Etzkowitz, 2013). This practice of meaningful co-production in research can be opened to all types of stakeholders from the Quadruple Helix: engaged universities are ideally more responsive, accountable and effective in the economic sense but also in the technologic transfer and in knowledge sharing. Moreover, they take care of community challenges and activities, becoming catalysts of local development, knowledge transfers and spill-over and play a role in re-engaging citizens in a process of local democracy (Kolehmainen *et al.*, 2016; Marques *et al.*, 2019; Sánchez-Barrioluengo & Benneworth, 2019). This may have benefits for public institutions, as well (Abbott *et al.*, 2015).

The results from the literature show that, in order for HEIs to be entrepreneurial and civically engaged and contribute to RIS3, internal and external relationships have to be built, nurtured and continuously implemented and structured. Internal relationships involve members of the organisational and managerial board, administrative, teaching and research staff but also students. The HEIs' engagement with the outside world creates a number of external relationships that take place at different levels: local and regional, national and international (Table 7).

TABLE 9 - NATURE AND TERRITORIAL LEVEL OF THE RELATIONSHIPS IDEALLY BUILT BY ENTREPRENEURIAL HEIS FOR CONTRIBUTING TO RIS3 AND ITS LINKS TO HEINNOVATE'S DIMENSIONS (AUTHOR'S OWN COMPILATION)

Nature of the relationships	Links to HEInnovate's dimensions
INTERNAL RELATIONSHIPS	
Need for relationships and power balance between the central level and the different departments (academic community and administration) for the effectiveness and efficiency of the institution (Clark, 1998). Creation of a rewarding system/incentives to engage the members from different departments of the institution in entrepreneurship and innovation activities (creation of a financial system).	- Leadership and Governance - Organisational Capacity
Collaboration among different departments, contamination between different research topics and teaching methods may facilitate interdisciplinarity and sense of belonging. This is pivotal for the generation of new creative ideas and thinking and exchange of knowledge (Rubens *et al*. 2017; Towers *et al*., 2020). Students and teachers involved in entrepreneurship classes and projects may collaborate to provide concrete solutions to external stakeholders from the industry, in the context of experiential learning activities (Kolb & Kolb, 2005; Heinonen & Poikkijoki, 2006). HEIs should analyse and share the results of their collaboration with internal stakeholders.	- Organisational Capacity - Entrepreneurial Teaching and Learning - Measuring impact
Relationships among different faculties and departments (e.g. living labs) (Leminen *et al.*, 2012).	- Preparing and Supporting Entrepreneurs
Internal relationships between departments, students and academic staff from the same institution engaged in international projects or exchanges (Minola *et al.*, 2016).	- The Internationalised Institution - Leadership and governance
EXTERNAL RELATIONSHIPS ON LOCAL/REGIONAL LEVEL	
Involvement of students and teachers in training combining theory with practice and collaborating with real cases of local businesses (Kolb & Kolb, 2005) to develop a more critical approach to reality (Heinonen & Poikkijoki, 2006).	- Entrepreneurial Teaching and Learning - Preparing and Supporting Entrepreneurs

HEIs should be partners in the entrepreneurial ecosystem, stimulating internal staff to open-up to the business world and acting as a support for and transfer knowledge to local companies (Davey *et al.*, 2011). Living labs represent a tool that requires the presence of all local sectoral actors and that serves for creation, prototyping, validating, and testing of new technologies, services, products, and systems in real-life contexts (Leminen *et al.*, 2012). HEIs should analyse and share the results of their collaboration with local and regional stakeholders.	- Preparing and Supporting Entrepreneurs - Measuring impact - Knowledge exchange and collaboration
The cooperation between universities and research and technology centres could enhance the exchange of knowledge and of their set of technology services (DEI Working Group, 2017). HEIs can also be partners in Digital Innovation Hubs, offering services that support the digitalisation of economy and society.	- Digital transformation
Involvement and collaboration can also take place through innovation ecosystems (e.g.: clusters and VETs) (Carayannis & Campbell, 2009). These ecosystems aim to bring HEIs and enterprises closer together for local and regional development, addressing labour market needs, fostering social links and maximizing the use of available resources (Hazelkorn & Edwards, 2019).	- Knowledge exchange and collaboration
EXTERNAL RELATIONSHIPS ON NATIONAL/INTERNATIONAL LEVEL	
Combining international orientation and local commitment especially in terms of education. HEIs through their international networks can connect regions to external sources of knowledge (Edwards *et al*., 2017). The links they have at the national level instead refer to the purely financial aspects, as the activities within universities are mainly funded and regulated by national provisions (Arregui-Pabollet *et al*., 2018).	- The Internationalised Institution - Leadership and governance - Organisational capacity - Training and teaching entrepreneurship
Involvement of the leadership and governance level especially in building international institutional partnerships (internal/external relationships). International relationships can take place for example in the Knowledge and Innovation Communities (KiCs), which require collaboration between actors from different sectors, involving both the academic and research world and the business world.	- The Internationalised Institution - Leadership and governance - Preparing and Supporting Entrepreneurs - Digital transformation

Moreover, participation on smart specialisation platforms and as partners in European and International RDI projects also foster the development of such relationships.	
Referring to international/national models for measuring and identifying impact indicators, outcomes, results and context indicators.	- Measuring impact
SPECIFIC RIS3 ROLE (Edwards *et al.*, 2017; Edwards & Marinelli, 2018)	
HEIs have an important role in RIS3 higher level governance structures, i.e. RIS3 management.	- Leadership and Governance
In EDPs they bring both a research and entrepreneurial contribution. Through interaction with other stakeholders HEIs can contribute to solving business and society needs and for this can also connect to extra-regional knowledge sources. Can bring innovation into the mode of interaction within the quadruple helix.	- Knowledge exchange and collaboration - The Internationalised institution
HEIs can contribute to the definition of a shared vision for the RIS3 strategy and to a more precise identification and definition of smart specialisation priority areas, being able to interpret context and challenges.	- Knowledge exchange and collaboration
HEIs can contribute to the monitoring and evaluation of RIS3 through gathering and analysing data analysis, as well as by training human capital to work as data analysts.	(can be linked to) Measuring impact
HEIs can train human capital for RIS3 priority areas, but also contribute to upskill the existing workforce. Development of vocational and technical or adult learning programmes can also support RIS3 priority area development. Development of horizontal, such as innovation skills is also in line with RIS3 approach, as well as education for the development of quadruple helix partnerships.	- Training and teaching entrepreneurship - Preparing and supporting entrepreneurs

6. Conclusion

In conclusion, entrepreneurial HEIs, in the context of RIS3, from the strategy design to its implementation, can play a pivotal role: they produce and disseminate knowledge for the regional innovation systems by promoting R&D activities and results, training human capital, responding to regional needs for innovation and establishing multi-stakeholder cooperation (Szépvölgyi *et al.*, 2013, Spiesberger *et al.*, 2018; Edwards *et al*., 2017; Edwards & Marinelli, 2018; Beer *et al*. 2020). For a more efficient involvement, suitable for the local/regional context and with significant contribution to RIS3, suitable internal and external relationships need to be established. Internal relationships relate to the human resources involved in the research activity, in education, as well as administrative and support services. Inter-disciplinarity needs to be implemented at different levels: among research and working groups of scholars and teachers from different departments; at a leadership and governance level (e.g. for organisational and financial support) and with the collaboration of the administrative staff and of the teachers' support service. Students and their relationships with teachers in entrepreneurship education also play a pivotal role for the capacity to integrate the learning activity, often experiential, with their commitment with local stakeholders. At this point, external relationships emerge, at several levels: the entrepreneurial HEI interacts with the local/regional stakeholders and takes into consideration the local/regional context and needs both regarding research and teaching activity, with the support of learning experiences outside of the classroom and in direct contact with the local stakeholders; it receives regional, national and international funds to promote these kind of activities, but also should directly invest in them.

For the purpose of the RE-ACT project, this literature review constitutes an important theoretical basis for the next research steps, and along with the results of further inquiries will be included in a research report which will serve especially for the implementation of the work packages (WP) 2 and 3.

WP2 will contribute to enhance the self and shared perception about HEIs current positioning and awareness about the latent potential for HEIs to play a pivotal role in RIS3s. This will be supported, pending on research results, through a new/or a more developed/detailed self-reflection online tool and will be completed with shared perceptions, created through collaborative processes among actors from the quadruple helix. WP3 comprises activities aimed at boosting collaborative processes between the actors of the quadruple helix at regional level, working together in the design of the RIS3.

This literature review analysed the potential contribution that HEIs can bring to regional growth and development through an involvement in RIS3 in light of the dimensions of the HEInnovate tool. Results highlight what HEIs should focus on to improve their commitment for regional development, in terms of relationships, policies and activities.

Therefore, considering the aims of the WP2 and 3, the insights here collected, compared with the conclusions from the Delphi technique and the results from the interviews could be useful for the implementation of HEInnovate and for the design of the new/more developed/detailed online self-reflection tool "HEInnovate for RIS3".

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Annex 3: Report of the Delphi survey

Delphi technique is a *consensus-building process* when a panel of selected experts is involved in a series of questionnaires. In this case, there were four main research questions focused on the possible use of HEInnovate in creating a product with the working name **"HEInnovate for RIS"**:

Main research questions of Delphi study:

1. *Exploring* the role of HEIs in the regional innovation system and in the design and implementation of RIS3;
2. *Identifying* who, within university, should be responsible for cooperating in the regional innovation system and implementing RIS3;
3. *Analysing* the potential added value that HEInnovate self-assessment tool can bring for RIS3;
4. *Defining* the possible outline and content of an upgraded version of HEInnovate, supporting higher education institutions (HEIs) to participate more effectively in regional/national smart specialisation processes.

The panel of experts:
The three-round Delphi study was carried out from May to October 2020 and included 19 experts from five countries involved in the RE-ACT project:

- ✓ 10 experts from universities (who may not have sufficient experience with RIS)
- ✓ 12 experts on regional innovation policy (with less knowledge of the current internal set-up and culture of universities).

Two experts from universities were also experts on HEInnovate, and only one of the experts declared expertise on both HEIs and RIS3.

In preparation of the second and third rounds, it was necessary to analyse the respondents' previous opinions and answers in detail and use them to objectively, sensitively, and validly identify common views and prepare the new questions accordingly.

Time period of the Delphi rounds:

Round 1, from the end of May to the end of July,
R*ound 2*, from the end of July to mid-October,
Round 3, from mid-October to the beginning of November.

Research methodology in brief:

A. **The first round:** open-ended questions were used, experts were encouraged to express their views in a narrative form.

B. **The first round**: only closed questions or questions of the degree of agreement with the statements were utilised.

C. **The third round:** final dichotomous questions on agreement with the statements based on the previous two rounds were distributed to experts.

Methods of qualitative research, the thematic analysis was utilised to identify the most articulated opinions for the second round.

The following are the questionnaires that were used in the three rounds of the Delphi process.

RE-ACT survey for experts (Round 1)

Section 1 of 4

Thank you for participating in this survey exercise. Please consult the support document provided per e-mail if you wish to revisit information about the survey and main concepts used. The questions presented next are designed to seek your personal opinion. Please reply to each one. Do not feel limited in the length or style of your answers. Your participation will be confidential and you will remain anonymous throughout this process.

Section 2 of 4

About you

Please indicate in which country you are based or which country is more relevant as basis for your work:

- Hungary
- Italy
- Portugal
- Romania
- Slovakia
- Other

If you replied "other", please specify:……

My area(s) of expertise for the purpose of this survey (you can select more than one):

- Academy/ HEIs (Higher Education Institutions)
- RIS3 (Research and Innovation Strategies for Smart Specialisation)
- HEInnovate
- Other

If you replied "other", please specify:

……

Section 3 of 4

I. The role of HEIs in RIS3

I.1. How do you think a university can benefit from the involvement in the regional innovation system and the design and implementation of RIS3? How should HEIs be involved in the regional economy and RIS3 in particular? Please also address who at the university should be responsible for cooperating in the regional innovation system and implementing RIS3.

……

I.2. How should a university act to be better able to operate in a regional innovation system, in regional strategic planning and specifically in RIS3?

……

I.3. Are there any other aspects linked to the role of universities in RIS3 design and implementation that would be important from your point of view?

……

Section 4 of 4

II. HEInnovate

II.1. Do you consider that HEInnovate is a useful tool to encourage HEIs' participation in regional strategies and addresses adequately the potential of collaboration between HEIs and regional stakeholders?

……

II.2. If possible, please also briefly describe if and how you use HEInnovate (e.g. use the training materials, participate in events, implement self-assessment in your organisation).

……

II.3. What would you change or add in HEInnovate to help HEIs better operate in a regional innovation system? This could include, e.g. add new resources and tools, adjust the scope of the current 8 dimensions or add new dimensions, add or adjust statements, etc. Please include here any other suggestions regarding HEInnovate.

……

RE-ACT survey for experts (Round 2)

Section 1 of 8

Thank you for participating in Round 2 of our Delphi study. After analyzing the results of Round 1, the answers obtained were summarised and formulated into a series of more specific questions that we now kindly ask you to respond to. Please consult the support document provided per e-mail if you wish to revisit information about the survey and main concepts used. The questions presented next are designed to seek your personal opinion. Please reply to each one. Your participation will be confidential and you will remain anonymous throughout this process.

remain anonymous throughout this process.

Section 2 of 8

About you: Please indicate in which country you are based or which country is more relevant as basis for your work:

- Hungary
- Italy
- Portugal
- Romania
- Slovakia
- Other

If you replied "other", please specify ……

My area(s) of expertise for the purpose of this survey (you can select more than one):

- Academy/ HEIs (Higher Education Institutions)
- RIS3 (Research and Innovation Strategies for Smart Specialisation)
- HEInnovate
- Other

If you replied "other", please specify ……

Section 3 of 8

Please indicate how much you agree with the statements below:

The benefits for HEIs resulting from the involvement in the regional innovation system and in the design and implementation of RIS3 are:

1=Strongly disagree 2=Mostly/generally disagree 3=Neither agree nor disagree 4=Mostly/generally agree 5=Strongly agree

Statement	agreement
HEIs use RIS3 not only as a tool to strengthen the third mission activities of HEIs (besides the core functions of teaching and research), but also as a way of influencing the definition of public policies.	
HEIs are better able to understand the research, innovation and education needs of local companies and learn more about social challenges. This allows HEIs to orient research towards the needs of businesses and society and present the services of the university to regional actors.	
HEIs can build new vibrant partnerships and implement new activities defined in RIS3 because RIS3 helps to get up-to-date information on products and services needed on the market.	
HEIs build a long-term strategic partnership with regional stakeholders, which is essential to achieve greater international visibility and subsequent success in international rankings.	

HEIs can contribute with methodological support for the RIS3 design (by providing information and data for the analysis) and they can also bring knowledge regarding new technologies and RDI trends. Additionally, they can be involved in the definition of priorities and actions, as well as in project development.	

The role and involvement of HEIs in the regional economy, regional innovation system and RIS3 should be…

Strongly disagree Mostly/generally disagree Neither agree nor disagree Mostly/generally agree Strongly agree

Statement	agreement
A. Active role in formulation and implementation: HEIs should actively participate in formulating and implementing the RIS3 strategy.	
B. Active role with a strong entrepreneurial focus: HEIs should play a key role in entrepreneurial discovery processes that lie at the core of RIS3, i.e. active role in the design and implementation of RIS3 starting from the entrepreneurial discovery and development of S3 priorities, and continuing to projects and implementation of smart specialisation	
C. Monitoring, coordination and governance role: HEIs should coordinate and monitor the regional challenges agreed in the RIS3 objectives, or even have a facilitation and leadership role. HEIs should be involved in the governance structures created for bottom-up regional/national policy making.	
D. Liaison/facilitator role for inclusive growth: HEIs should be the liaison between companies, NGO's and public authorities. HEIs should be facilitators among local stakeholders by promoting research and innovation for a more efficient, sustainable and competitive local economy that take into account local resources and ensures economic, social and territorial cohesion.	
E. Pro-active dialogue role: HEIs should be pro-active in the dialogue and collaboration with economic actors and other key stakeholders in order to contribute to the economic strategic planning and implementation of RIS3, as well as to strenghten their role in the innovation ecosystem. From the beginning, HEIs should cross-link with all the actors involved in the design and implementation of RIS3 in order to create a collaborative environment, trust and efficient communication and succeed in the elaboration of innovation strategies for regional development. HEIs should be active in regional clusters and interest groups, etc.	
F. Promotion of cross-sector RDI cooperation and provision of innovation infrastructures: HEIs' role as intermediaries between R&D and the market is crucial (e.g. offering TT and innovation services through technology transfer offices or even through a dedicated organisation). HEIs should play the role of educator, developer or innovator, providing innovation infrastructure and	

services and promote cross-sectoral RDI cooperation.	

Section 4 of 8

"The role and involvement of HEIs in the regional economy, regional innovation system and RIS3 should be…" - Please rank the same statements as in the previous section by order of importance in your opinion.

Please use the scale: 1=Less important; 6=More important. Please use all the levels of the scale, i.e. don't repeat the same ranking number in two or more sentences

Statement	importance
A. Active role in formulation and implementation: HEIs should actively participate in formulating and implementing the RIS3 strategy.	
B. Active role with a strong entrepreneurial focus: HEIs should play a key role in entrepreneurial discovery processes that lie at the core of RIS3, i.e. active role in the design and implementation of RIS3 starting from the entrepreneurial discovery and development of S3 priorities, and continuing to projects and implementation of smart specialisation.	
C. Monitoring, coordination and governance role: HEIs should coordinate and monitor the regional challenges agreed in the RIS3 objectives, or even have a facilitation and leadership role. HEIs should be involved in the governance structures created for bottom-up regional/national policy making.	
D. Liaison/facilitator role for inclusive growth: HEIs should be the liaison between companies, NGO's and public authorities. HEIs should be facilitators among local stakeholders by promoting research and innovation for a more efficient, sustainable and competitive local economy that take into account local resources and ensures economic, social and territorial cohesion.	
E. Pro-active dialogue role: HEIs should be pro-active in the dialogue and collaboration with economic actors and other key stakeholders in order to contribute to the economic strategic planning and implementation of RIS3, as well as to strengthen their role in the innovation ecosystem. From the beginning, HEIs should cross-link with all the actors involved in the design and implementation of RIS3 in order to create a collaborative environment, trust, and efficient communication and succeed in the elaboration of innovation strategies for regional development. HEIs should be active in regional clusters and interest groups, etc.	
F. Promotion of cross-sector RDI cooperation and provision of innovation infrastructures: HEIs' role as intermediaries between R&D and the market is crucial (e.g. offering TT and innovation services through technology transfer offices or even through a dedicated organisation). HEIs should play the role of educator, developer, or innovator, providing innovation infrastructure and services and promote cross-sectoral RDI cooperation.	

Please add any comments related to the questions above if you think it is needed.

Section 5 of 8

Please indicate how much you agree with the statements below

To be better able to operate in a regional innovation system, in regional strategic planning and specifically in RIS3 HEIs should…

1=Strongly disagree 2=Mostly/generally disagree 3=Neither agree nor disagree 4=Mostly/generally agree 5=Strongly agree

Statement	agreement
…prepare students especially for solving economic, social and technological challenges in the future mainly by enforcing interdisciplinary approaches.	
…develop different services linked to RDI and business support, like TT and innovation services, start-up support, acceleration, etc.	
…provide highly skilled human capital, as well as ideas and solutions to future economic, social and technological challenges.	
...be open, collaborative, proactive and in a constant interaction with other actors from the innovation ecosystem.	
...first clearly state their goals, identify their strenghts and weaknesses, identify the most relevant areas of research and education and third mission activities and make synergy in the research areas of different teams.	
...work in an integrated manner with the other universities and high schools of the Region also involving students as part of the network.	
...have a long run perspective in the planning and fine tuning of priorities and actions, act based on a long term vision in the process and have a long term commitment.	
…improve internal communication.	

Among the sentences above, please select two (2) that you consider more relevant.

- ○ …prepare students especially for solving economic, social and technological challenges in the future mainly by enforcing interdisciplinary approaches.
- ○ …develop different services linked to RDI and business support, like TT and innovation services, start-up support, acceleration, etc.
- ○ …provide highly skilled human capital, as well as ideas and solutions to future economic, social and technological challenges.
- ○ ...be open, collaborative, proactive and in a constant interaction with other actors from the innovation ecosystem.

- ...first clearly state their goals, identify their strenghts and weaknesses, identify the most relevant areas of research and education and third mission activities and make synergy in the research areas of different teams.
- ...work in an integrated manner with the other universities and high schools of the Region also involving students as part of the network.
- ...have a long run perspective in the planning and fine tuning of priorities and actions, act based on a long term vision in the process and have a long term commitment.
- …improve internal communication.

Section 6 of 8

Please indicate how much you agree with the statements below

At the university, responsibility for cooperating in the regional innovation system and implementing RIS3 should be from…

1=Strongly disagree 2=Mostly/generally disagree 3=Neither agree nor disagree 4=Mostly/generally agree 5=Strongly agree

Statement	agreement
The rector/vice-rector/top management.	
Technology Transfer Offices or a transfer agency.	
A "one-stop-shop" concept dedicated unit and commitee within the university.	

As a tool to encourage HEIs' participation in regional strategies, HEInnovate…

1=Strongly disagree 2=Mostly/generally disagree 3=Neither agree nor disagree 4=Mostly/generally agree 5=Strongly agree

Statement	agreement
...is useful to support the participation of HEIs in the creation and implementation of regional strategies, but only if HEIs are engaged from the very beginning of the process.	
...helps the cooperation and moderation between HEIs and regional stakeholders, enterprises, corporates and startups.	
...is a tool to be improved because it is probably not able to awake the interest of regional stakeholders and motivate HEIs' participation in regional strategies.	
…helps the process of evaluation of HEIs' strengths and weaknesses across multiple dimensions that, in turn, helps identifying areas for improvement	
…depends on various aspects, including the way HEIs are using the tool, the commitment of staff, integration of dimensions into internal documents and procedures, etc.	

...offers a basis, but for a successful participation other aspects need to be considered, like development of soft skills, for example.	

Section 7 of 8

Please state how much you use HEInnovate for the purposes indicated

I use HEInnovate… 1=No use 2=Rarely 3=Sometimes 4=A lot

Statement	agreement
...as a more general self-assessment tool in my Faculty/University.	
...to self-evaluate the collaboration (and promote exchange) with other regional actors.	
...for active participation in events.	
…to organise our own events, seminars, meetings, etc.	
...to consult and apply training materials for self-assesment.	
...for the formulation of strategic documents and in designing internal procedures.	
I don't use HEInnovate because… (explain why if applicable).	
I use HEInnovate for other purposes and/or have other comments (please detail).	

Section 8 of 8

Please indicate how much you agree with the statements below.

If I could change something in HEInnovate I would…

1=Strongly disagree 2=Mostly/generally disagree 3=Neither agree nor disagree 4=Mostly/generally agree 5=Strongly agree

Statement	agreement
...add the use of popular smart tools to be adapted at regional level (e.g.: new education forms, A.I., S2B marketing...).	
...add new instruments to foster the dialogue among regional stakeholders and to have a feedback from all of them.	
...add more indicators for HEIs' evaluation (but not necessarily add more dimensions/sub-dimensions).	

...add more dimensions/sub-dimensions (e.g. international dimension of innovation; HEIs' embeddedness in RIS3; HEIs' characterization in terms of strategic orientation and strenghts; new competences needed...).	
...add more instructions how to use the results of HEI and how to proceed in the future based on the results.	
...bring more focus on entrepreneurial teaching.	
HEInnovate tool is fine as it is.	
I don't know the tool well enough to give suggestions	

Please add any comments related to the questions above if you think it is needed.

……

RE-ACT survey for experts (Round 3)

Section 1 of 8

Thank you for participating in Round 2 of our Delphi study. After analyzing the results of Round 1, the answers obtained were summarised and formulated into a series of more specific questions that we now kindly ask you to respond to. Please consult the support document provided per e-mail if you wish to revisit information about the survey and main concepts used. The questions presented next are designed to seek your personal opinion. Please reply to each one. Your participation will be confidential and you will remain anonymous throughout this process.

remain anonymous throughout this process.

Section 2 of 8

About you

Please indicate in which country you are based or which country is more relevant as basis for your work:

- Hungary
- Italy
- Portugal
- Romania
- Slovakia

- Other

If you replied "other", please specify ……

Section 3 of 8

Please state your opinion on the statements below

Note to respondent: In the last round of questions, 66% or more of respondents agreed with the statements below.

For HEIs, relevant benefits resulting from the involvement in the regional innovation system and in the design and implementation of RIS3 are:

Statement	agree	disagree
HEIs are better able to understand the research, innovation and education needs of local companies and learn more about social challenges. This allows HEIs to orient research towards the needs of businesses and society and present the services of the university to regional actors.		
HEIs build a long-term strategic partnership with regional stakeholders, which is essential to achieve greater international visibility and subsequent success in international rankings.		
HEIs can build new vibrant partnerships and implement new activities defined in RIS3 because RIS3 helps to get up-to-date information on products and services needed on the market.		
HEIs can contribute with methodological support for the RIS3 design (by providing information and data for the analysis) and they can also bring knowledge regarding new technologies and RDI trends. Additionally, they can be involved in the definition of priorities and actions, as well as in project development.		

A less relevant benefit for HEIs resulting from the involvement in the regional innovation system and in the design and implementation of RIS3 is that...

Statement	agree	disagree
HEIs use RIS3 not only as a tool to strengthen the third mission activities of HEIs (besides the core functions of teaching and research), but also as a way of influencing the definition of public policies.		

Section 4 of 8

Please state your opinion on the statements below

Note to respondent: In the last round of questions, 66% or more of respondents agreed with the statements below

The most important role and involvement of HEIs in the regional economy, regional innovation system and RIS3 should be…

Statement	agree	disagree
...actively participate in formulating and implementing the RIS3 strategy.		
...key role in entrepreneurial discovery processes and interaction/cooperation with business environment, i.e. active role in the design and implementation of RIS3 starting from the entrepreneurial discovery and development of S3 priorities, and continuing with projects to support implementation of smart specialisation.		

An also important role (but less important than the ones above) of HEIs in the regional economy, regional innovation system and RIS3 should be...

Statement	agree	disagree
...engage in pro-active dialogue and collaboration with economic actors and other key stakeholders to contribute to the strategic planning and implementation of RIS3, as well as to strenghten HEIs role in the innovation ecosystem.		
...promote cross-sector RDI cooperation and provision of innovation infrastructures		

Less important roles for HEIs in the regional economy, regional innovation system and RIS3 should be…

Statement	agree	disagree
...Monitoring, coordination and governance role		
...Liaison/facilitator role for inclusive growth		

Section 5 of 8

To be better able to operate in a regional innovation system, in regional strategic planning and specifically in RIS3, HEIs should give priority to the following:

Statement	agree	disagree
…provide highly skilled human capital, as well as ideas and solutions to future economic, social and technological challenges.		
…develop services linked to RDI and business support, like TT and innovation services, start-up support, acceleration, etc.		

…prepare students especially for solving economic, social and technological challenges in the future mainly by enforcing interdisciplinary approaches.		

To be better able to operate in a regional innovation system, in regional strategic planning and specifically in RIS3, it is less of a priority for HEIs to…

Statement	agree	disagree
...first clearly state their goals, identify their strenghts and weaknesses, identify the most relevant areas of research and education and third mission activities and make synergy in the research areas of different teams.		
...work in an integrated manner with the other universities and high schools of the Region also involving students as part of the network.		
...be open, collaborative, proactive and in a constant interaction with other actors from the innovation ecosystem.		
...have a long run perspective in the planning and fine tuning of priorities and actions, act based on a long term vision in the process and have a long term commitment.		
…improve internal communication.		

Section 6 of 8

Please indicate how much you agree with the statements below

Regarding the role of HEInnovate for HEIs' participation in regional strategies, to me it is clear that...

Statement	agree	disagree
...HEInnovate helps the process of evaluation of HEIs' strengths and weaknesses across multiple dimensions that, in turn, helps identifying areas for improvement.		
...HEInnovate is useful to support the participation of HEIs in the creation and implementation of regional strategies, but only if HEIs are engaged from the very beginning of the process.		
...HEInnovate offers a basis to encourage HEIs' participation in regional strategies, but for a successful participation other aspects need to be considered, including: development of soft skills, commitment of staff and integration of dimensions into internal documents and procedures, etc.		

For me it is not clear that HEInnovate…

Statement	agree	disagree
...helps the cooperation and moderation between HEIs and regional stakeholders, enterprises, corporates and startups.		
...should be improved in order to awake the interest of regional stakeholders and motivate HEIs' participation in regional strategies.		

Section 7 of 8

Please state how much you use HEInnovate for the purposes indicated (if you don't use HEInnovate at all, please tick the first option).

I use HEInnovate mostly for the following purposes:

Statement	I don't use HEInnovate	agree	disagree
Active participation in events			
Formulation of strategic documents and design of internal procedures.			
As a more general self-assessment tool in my Faculty / University.			

Although I use HEInnovate for other purposes, I don't use it to:

Statement	I don't use HEInnovate	agree	disagree
Organise our own events, seminars, meetings, etc.			
Consult and apply training materials for self-assesment.			
Self-evaluate the collaboration (and promote exchange) with other regional actors.			

Section 8 of 8

Please indicate how much you agree with the statements below.

If I could change something in HEInnovate I would most probably...

Statement	agree	disagree	Don't know/don't use

			HEInnovate
...add new instruments to foster the dialogue among regional stakeholders and to have a feedback from all of them.			
...bring more focus on entrepreneurial teaching.			
...add the use of popular smart tools to be adapted at regional level (e.g.: new education forms, A.I., S2B marketing...).			
...add more instructions on how to use the results of HEI and how to proceed in the future based on the results.			

In HEInnovate I would not...

Statement	agree	disagree	Don't know/don't use HEInnovate
...add more indicators for HEIs' evaluation			
...add more dimensions/sub-dimensions			

Please add any comments related to any of the questions if you think it is needed. ……

Annex 4: Report of the interviews

Porto Business School (Portugal)

1. **How do you consider the progress/results of (national/regional) S3/RIS3? What are the most important challenges to improve performance and impact?**

In Portugal, smart specialization strategies are place-based strategies with a multilevel approach (one national strategy and seven regional ones). Smart specialization process began with academia working alongside the European Commission to create this new strategic planning methodology. The main goal was fund allocation of R&D, innovation, competitiveness, and qualification, therefore RIS3 was an ex-ante requisite to assign funds. The two greatest progresses compared to previous processes are (1) the definition of priorities in a (2) collaborative way. In fact, the design of the strategy is performed through a collaborative model, involving not only HEIs but other institutions. These partnerships have been a novelty and they enable the harnessing of synergies. This model still has weaknesses and points for improvement, but it has clearly been an improvement from the close model that was previously applied.

Regarding the definition of priorities, which was the second progress regarding this system, in Portugal there are 8 priorities. These priorities are translated into domains that represent Portuguese competitive advantages, that are afterwards adapted to the 7 regions. These regions are not politic ones, the division is based on similar characteristics related to the competitive advantages, which was also a novelty and a progress.

Other result of this collaborative process was the transformation of academic knowledge into "real life" knowledge, meaning that the scientific knowledge is now translated into products, services or strategies to fulfil people and society needs. This is a two-way advantage because it means that the knowledge produced is more in line to society needs, enhancing the reputation of Higher Education Institutions (and the knowledge produced). On the other hand, society (companies and citizens) actually employs this new knowledge and technologies, being able to solve its problems.

2. **How could HEIs ideally contribute to the development and implementation of RIS3. , i.e.: What kind of services should HEIs provide? Which resources, competencies should HEIs mobilise and what should they do for a more efficient involvement suitable to each of the main steps of RIS3 design and implementation?**

Smart specialization strategies are based on knowledge, reason why they cannot be dissociated by academia. It is expected that HEIs have a relevant role both in the design of RIS3 (entrepreneurial discovery process that leads to the definition of priorities) and in its implementation. Nevertheless, the role of HEIs should be both on the national and regional strategies.

The design of RIS3 contemplates 3 dimensions: resources and assets of the region (scientific, technological, educational), regional business base and international trends. Therefore, HEIs have an upstream role, as they define the region's resources in terms of education, training, knowledge, scientific areas, technological areas, infrastructure, among others. A good

example that can be mentioned is the indicator “number of graduates per training area”, which is extremely important for the definition of the region's competitive advantages.

When it comes to the implementation phase, HEIs participate as beneficiaries of the Regional Operational Program, both in programs targeted at these institutions, at scientific knowledge and interface infrastructures, and in programs targeted at companies in which HEIs participate.

Regarding monitoring and revision of the strategy, all universities and polytechnic institutes belong, on the one hand, to the Regional Innovation Council and, on the other hand, participate in regional smart specialization platforms, thus having a relevant role.

Nevertheless, the role of HEIs could be enhanced in all phases of RIS3:

- Design of the strategy: definition of priorities; analysis of the context; analysis of the labour market
- Implementation: design of a structural plan for collaboration
- Monitoring and revision: establishment of an evaluation model and KPIs

2. What kind of other services offered by HEIs are/could be important for the stakeholders in the national/regional innovation ecosystem and for the ecosystem as a whole in line with the objectives of RIS3?

The role of HEIs in RIS3 should be mainly based on their research activities and their link to the business world (through startups for example).

In the current stage of revision, HEIs have a role at 2 levels:

- as an organization participating in the governance model, with an aggregated and focused view on teaching and R&D, supporting the characterization of the resources and assets of the region in terms of training areas, essential for the definition of priority domains
- as an international organization, helping to internationalize RIS3 itself

Regarding other RIS3 steps, the role of HEIs should be focused on identifying specialisation priorities, implementation of projects based on those priorities, smoothing the connection to external sources, participation on the entrepreneurial discovery process and contribution to the process monitoring and evaluation.

In fact, there are several services that HEIs could offer to enrich the collaboration with other actors, namely consultancy services (mainly focus on market analysis and need identification), methodology/ framework construction and sharing of infrastructure.

3. In your opinion, which contribution can HEIs give in terms of knowledge and expertise within a Quadruple Helix type co-operation (between key actors of the national/regional innovation ecosystem), characteristic to RIS3?

The governance strategy follows a Quadruple Helix collaboration with representatives from the public sector, institutions representing businesses (competitiveness clusters and business associations) and HEIs in the governance bodies.

Furthermore, companies also participate in public consultation processes.

It is important to refer that RIS3 gained importance as it became transversal and central to the entire community. In fact, the multiplication of efforts has been replaced by their convergence.

Nevertheless, HEIs could support the improvement of these relations through new ideas and methodologies to better include all the helices on smart specialization processes. A structural plan should be designed based on open governance models in order for regional problems to be solved by all actors.

Two great examples of collaboration between HEIs and the business world are the interface centres and the collaborative laboratories.

Interface centres are basically partnerships aiming at enhancing and developing a business sector. These interface centres could and should have a role in shaping policies and setting priorities for smart specialization.

The collaborative laboratories are autonomous entities focused on a particular theme/area (even more focused than the interface centres), which are set up with the objective of introducing new products in the market to solve an identified need.

These two structures should be included into the discussion of public policies and smart specialization strategies. This has already happened (the case of hydrogen, for example, in which a political discussion led to the creation of a collaborative laboratory), but it should be generalised.

It should also be noted that faculty should have practical experience or, at least, be in contact with the labour market. Otherwise they may not be able to understand the needs of the market and will not provide the best training to their students. Actually, adapting the curriculum to the real-life needs is crucial. This adaptation must be gradual, but it cannot be done separately from companies. The problem lies in HEIs' resistance to change: when there is a new trend, HEIs always react a *posteriori*, instead of promoting that change.

4. What do you think HEIs should focus on to become an attractive partner for RIS3 stakeholders in the RIS3 related planning and implementation activities or in facilitating Quadruple Helix cooperation/interaction in general?

HEIs are involved at different steps of the RIS3 process, but the main focus should be on their core activities, namely teaching, strengthening their R&D capacity, and improve technology transfer processes.

Teaching activities should be focused on regional needs and aligned with local priorities. Research and development capacities should be enhanced throughout the connection to the

R&D ecosystem, through research centres, collaborative laboratories, and other infrastructures identified by FCT (Science and Technology Foundation).

Technology transfer processes should also be a priority because the ultimate goal of RIS3 is to transform scientific knowledge into economic value.

Furthermore, it is important to have a team within HEIs that coordinate RIS3 processes (clear internal structure and responsibilities for those who are going to be active in RIS3 related tasks). Companies and public authorities must be aware of the process, the mechanisms and who to turn to about RIS3 (one stop shop). HEIs must have immediate responses, because when a company or a public entity involves the academy in solving a problem, they expect prompt responsiveness. Besides, HEIs must "speak the business language" and reduce bureaucracy to improve these collaborations.

In addition, Higher Education Institutions should take a more leading position, instead of following the recommendations of other institutions. They should perform foresight activities, forecasting what will be the skills of the future, in order to provide a proactive, rather than a reactive, response. In fact, a weakness of HEIs has been to look more at the past than at the future, which should be changed.

Lastly, HEIs should themselves be specialized in thematic areas, through competence centres, making the problem-solution connection more effective.

5. How do HEIs respond to human capital needs of the region/country in smart specialisation areas? What are the most burning human capital/competency needs of the region/country in smart specialisation fields? What kind of cooperation arrangements can lead to responsive HE training supply/services?

HEIs should not be responsive (have a reaction) but proactive (have an action), i.e. having proactive offers when it comes to new curricula and adjustment to the new market needs. They should identify the priorities of the region alongside other quadruple helix stakeholders and, on one side, build training programs to answer these identified needs, and, on the other side, improve their research capacity to find the solutions to those needs. There is still a gap between what is done in research and development centres and departments, and what is translated to industry. In some sectors, the improvements due to scientific and technologic findings are obvious, such as textile and footwear. However, there are some sectors that are being neglected. Therefore, Higher Educations Institutions should analyse the human capital needs of the regions and encourage students to build capacity on some priority areas. This should, obviously, be aligned and coherent with the students' choice in terms of courses and careers.

6. How do HEIs respond to the RDI needs of the region/country in smart specialisation areas?

This year, Portugal has been upgraded in the ranking of the European Commission's annual publication in terms of innovation. The country is now considered "strongly innovative", having been moved from the third to the second group, reaching our best-ever position. The

strength of Portuguese innovation is substantiated through the number of collaborative projects, namely with SMEs that represent the majority of Portuguese businesses, and through the establishment of startups with scientific and technological base (through ideas that arise in the academic world). Therefore, it can be concluded that research and development within HEIs is being transferred to companies and society in general.

Besides, there is a set of initiatives and incentives for the transfer of scientific knowledge from the academia to the business world, such as awards, which facilitates the processes of recognition and transfer of capacities between the various actors.

However, research does not have to be constantly aligned with companies. Fundamental research has an essential role in innovation and creation of knowledge and has no connection to companies. There must, then, be a mix – staff that contacts / collaborates with companies and other external entities, and staff that has no external relations. Nevertheless, for the success of this mix, it is necessary to build a robust rewards system, as one group cannot be overlooked in relation to the other.

7. Do you think that, at national/regional level, are there any existing networking opportunities between HEIs and other RIS3 stakeholders in order to capitalize on/exploit and bring together their actions and projects?

RIS3 governance meetings are a good opportunity for different stakeholders to join forces and share knowledge and ideas, but the real networking opportunities occur through the implementation of joint projects, i.e., in the application of the funds in co-promoted projects.

HEIs need to become more open, more focused on society, especially now, since a crisis is approaching, which will bring opportunities and threats. Provided HEIs are able to foresight and seize opportunities, new networking opportunities will arise, and a very strong innovation ecosystem will be established.

Moreover, as companies and public authorities recognize HEIs as the providers of technical and human skills they need to be innovative and keep their strategic position, these networking opportunities will continuously exist.

Nonetheless, and it was stated before, there is a need for a structural plan and a clear system in order to increase the efficiency of these collaborations. It is important that HEIs promote their services besides teaching and researching, namely consultancy services. They should position themselves as valuable partners for projects. They should create tools and methodologies to be widely used by the private and public sectors. Often, these instruments are developed through the academia sphere, but they are not properly disseminated, therefore they are not transferred from HEIs to the business world.

8. How do universities contribute to linking the region/country to international sources of knowledge, especially through participation in formal and informal European and global R&I networks?

HEIs' participation on European projects and their connection to international knowledge networks, such as the European Intelligent Specialization Platform and the Vanguard Initiative, are value-added assets to the smart specializations processes, mainly on the implementation side.

However, HEIs also have a role on other phases of RIS3, such as design, monitoring, governance and review, so HEIs international component and their connection to international sources of knowledge should be applicable on other phases of the RIS3 processes.

In this context, HEIs should take a more aggressive position. The truth is that Portugal is a small country, so our knowledge centres and companies are limited. Participating in international knowledge networks enables, though, the value recognition and dimension acquisition needed for our entities to expand. All innovation agents and quadruple helix actors must actively participate in these networks, rather than just HEIs.

International networks and external analysis enable our structures and actors to become more aware of global trends, which will allow Portuguese higher education institutions to assume a proactive role and to be at the forefront of innovation. Moreover, international trends should also influence the selection of smart specialization areas.

9. What are the key funding opportunities and incentives that universities would need to support the enhancement of regional competitiveness and contribute to the smart specialisation objectives through R&D and innovation?

The implementations of RIS3 is based on the application of funds, so the strategy becomes itself an analysis tool.

Portugal has a robust funding system divided into Thematic Operational Programs, Regional Operational Programs, Rural Development Programs, Programme for the European Maritime Affairs and Fisheries Fund, Operational Technical Assistance Program, Operational Programmes for European Territorial Cooperation, and Other Programs. All of them are based either on competitive advantages or on specific needs of the country/ region.

Hence, HEIs support the enhancement of regional competitiveness and contribute to the smart specialization objectives when they are involved in funded projects promoted by these programs – implementation side of the RIS3. Through their research activities, though, HEIs could support the identification of opportunities to be harnessed.

Regarding funded programs, there is no need for tenders specifically targeted to education institutions, but it is important for them to be allowed beneficiaries.

10. Taking into consideration the experiences from the current (2014-2020) programming period what do you expect for the next one (2021-2027)? How can the involvement of HEIs be improved in RIS3 revision and implementation for/during 2021-2027? How should HEIs prepare themselves to be more efficiently involved?

The collaborative governance model, applied on the strategy design phase, was supposed to be kept beyond this phase, but this has not happened. In fact, it was expected that all quadruple helix partners would support the implementation of the strategy and help on the continuous identification of investment priorities that would lead to the launch of thematic tenders. However, this connection between RIS3, the financing instruments and operational programs, in a participatory approach, has failed. For this reason, it is now a pivotal to encourage the participation of regional actors in the revision of actual RIS3 and in the implementation of the next one. Moreover, the innovation effects were not transferred to the economy (Portuguese companies are mainly low-tech), which should be enhanced through a better collaborative environment.

It is also important to mention that the "specialization" part of the strategy was dispersed, with the 7 regions working on almost the same priorities, instead of defining specific regional topics to be addressed. Besides, there has been an overlapping of work within the different regions. Thus, priorities should be better defined to boost the economy.

Additionally, there has been a lack of execution capacity, mainly on social economy perspective. Therefore, it is crucial to create capacity building programs targeted to social economy actors of the regional ecosystem.

It is also important to keep and expand the regional network, so an award/recognition system should be built to keep all stakeholders aligned, engaged and motivated.

From HEIs' perspective, a foresight strategy should be followed in order to forecast the future of work, providing a proactive educational offer, rather than a reactive one. In truth, a weakness of HEIs has been analysing the past more than exploring the future.

Lastly, other important issue to be improved during the next period is the internationalisation of the strategy, enhancing the connection to international networks and foreign stakeholders.

Corvinus University of Budapest (Hungary)

Q.0.

The actors do not feel the goals as their own, there is no coordinated cooperation. Due to the EDP method, county profiles were not focused enough, the priority list was too wide. The biggest challenge was to find the right focus for the S3 and to focus on real tasks. As in the previous period, there is no regional strategy planning now, there is a national S3 with national priorities.

The presence of international companies is strong at the national, regional and local levels. There is much to do in the field of cooperation between science-government-economic-social actors, the development of digital competencies and the improvement of competitiveness.

The system under construction and its requirements are loose, but R&D domestic nd EU level funding is more-and-more likely to be linked to S3.

Q.1.

Universities have positioned themselves so that the regional strategy covers those competencies that the university already knows. It is difficult for universities to learn about corporate needs and find answers to them. The actors also assert individual needs, typically companies like to manage.

The goal is to achieve smart specialization. Within this, it is most important for the higher education institution to be able to issue specialists suitable for the region or sector, as well as to participate in the LLL skills development related to smart specialization.

Independent of S3, RDI policy has set an important goal for higher education institutions to become regional RDI centres, therefore the strengthening and transformation of all three mission activities is important: services, utilization of RDI results, more open training, infrastructure sharing. These are important challenges even without S3. The point of S3 is for Q. Helix's actors and higher education institutions to find each other.

The answers can be approximated from two directions: the types of services offered by the higher education institution or the steps of RIS3.

Higher education institutions need to become more flexible, responding more quickly to labour market requests. The changing model of some higher education institutions is expected to support this and will provide them more elbow room and a faster opportunity to react.

In the field of research and development, local universities should carry out applied research collaborations with economic organizations. They need to mobilize their planning and research capacities and resources and participate in local planning processes.

Well-selected economic and civic actors can make university activities more innovative and relevant. In Hungary, it is more important what the university can get from the business sector than what it can give. The university can't really reach out to business partners, rather it could give more to the public sector.

From the point of view of higher education, it would be necessary for researchers and lecturers of HEIs to participate in corporate projects, for professionals to participate in RDI, joint curriculum development of higher education, this could lead to new teaching and learning forms, stronger higher education institutional research potential and more market products.

Q.2.

The government will build on higher education institutions in the next period, with universities becoming the centres of the local RDI ecosystem. Institutions are very different, companies in different parts of the country need completely different services. There are currently 8 regional Innovation Platforms in operation in the country, and more are planned to be established: the coordinating organization (NKFI Office) will act as a bridge between the

Government, the local economy, the corporate sector, and - according to Q. Hélix - all actors in the local economy (NGOs, local governments, advocacy organizations, etc.).

Higher education institutions can raise awareness of information acquisition: they know what their own region needs. At the same time, the organizational structure of higher education institutions differs. We see different solutions for the third mission activities, there is no central recommendation, only a framework. The responsibility of higher education institutions in identifying areas of specialization can be important. There must be clear responsibilities in each institution: who is involved in communicating with external partners, who is involved in communicating with the Government, who is acting as a bridge within the institution.

What is listed as necessary: 1. Retraining in the field of digital competence development. 2. Increasing the available research resources (recruiting full-time researchers, making the research career more attractive - taking care of the researcher supply - directing talented, master's degree students towards dual doctoral workshops 3. Rapid response to local needs, cooperation. 4. Continuous networking 5. Exploring international good practice. All this is crossed by the Green Deal, the goal of a climate-neutral Europe.

Q.3.

The third mission (S3) activity of higher education institutions in Hungary is at an early stage. The pre-existing competencies in the activities of universities are dominant, this does not result in viable solutions. System-level collaboration is rare, information flow is inadequate.

The economic development of a country or a region highly depends on the performance of higher education institutions, so there is an increasing emphasis on knowledge sharing in higher education. It is important to develop the digital and managerial skills of entrepreneurs. Applied research based on local needs, formal and informal collaborations, international networking opportunities, and the exploration of international good practices can be used to advance.

There is also a need to strengthen cooperation platforms. There is a significant demand for quality labour force from the for-profit sector, which makes them much more active towards higher education institutions than in the previous period.

Financial and professional support for cross-sectoral platforms is typical, recently they have been supported by NKFI and the government. The Centres for Higher Education and Industry Cooperation (FIEKs), which have continued with the establishment of the Centres of Excellence, are centrally supported developments from which the state expects universities to become stronger actors. A dedicated program for the internal strengthening of higher education institutions is the University Innovation Ecosystem Program. At the same time, the government does not have to be “omnipotent,” it cannot assign central resources to all development goals.

RIS3 stakeholders can make better use of the knowledge and expertise of higher education institutions if they can see what higher education institutions have to offer, as well as the main strengths and bottlenecks of higher education institutions.

Higher education institutions can contribute to this in many ways. It is important to know what common steps and methods can help to assess the knowledge needs of RIS3 goals and to determine what they need to do. It is also important to know which processes and interface organizations can play an important role in facilitating stakeholder engagement.

Q.4.

The university should be independent, flexible, responsive, faster with easier administration.

According to the respondents, all the previously assumed expectations are relevant:

- Fast (reliable and timely) response to the questions and suggestions of the stakeholders
- Reduction of administration
- More knowledge about structures, processes, topics and stakeholders related to RIS3
- Providing one-stop access to the services of the given higher education institution
- Clear internal structure and responsibilities for those who will be active in RIS3-related tasks
- Database and CRM for RIS3 stakeholders
- Regular review of the needs of RIS3 stakeholders
- proactive offers
- Strengthen formal and informal relations with RIS3 stakeholders
- Expand the offered services and make them more visible
- Stronger capacities in demand-driven services
- More practical than theoretical knowledge
- Stronger presence in the regional environment and institutions
- Appropriate incentives

It is important to strengthen the dialogue. According to respondents, higher education institutions, larger companies are more reliable, SMEs are less so.

Q.5.

It seems that the needs of companies alone will not lead to the launch of new trainings. They build on precedent rather than needs. It is difficult to create new training due to accreditation difficulties, the slow response of institutions is also a problem (by the time the training is established, the need may disappear) and opposing parties are blocking initiatives that harm their interests. Higher education institutions are not consciously built.

Expertise can be found in many places. However, the trainings demonstrate quality of a scientific sense, their role in innovation and their stimulating effect on RDI activities lags behind the possibilities.

Not enough PhD students and inadequate research supply is a problem not only of the for-profit sector, but also the problem of universities. Quality supply is also a problem for public administration. A few years ago, the lack of quality labour was a problem only in the for-profit sector, now everywhere. It is a positive trend that companies have started to look for higher education institutions, cooperation with institutions is more active. A negative trend is that employees in the higher education sector are also wanted in the private sector.

In response to labour shortages, the goal is to develop a common denominator. It is in the common interest of government, companies and higher education institutions to find a compromise solution. This can be achieved by promoting the principle of subsidiarity: within the framework of specialization strategic cooperation actors should seek solutions that result in a win-win situation for all actors. The cooperative doctoral program is a good example of this approach.

One potential role for higher education institutions is to support the human capital needs of RIS3 stakeholders. a.) Is there preferred cooperation in the region between higher education institutions and other regional stakeholders (especially businesses) to attract, develop and retain talent? b.) Can higher education institutions be better involved in continuing education and lifelong learning (including adult education, technical and vocational training, entrepreneurship education, etc.) c.) What are the most in-demand professions / competencies? d.) What are the main bottlenecks? and where are opportunities for development in human capital development?

Local higher education institutions usually look for a solution when they receive a request for a specific adult education. Most often their answer is presented in the form of a shorter specialist training. Bottleneck: rigidity, lack of lifelong learning ability. Opportunity for human capital development: motivation; flexibility; preparing for the emergence of cross-border professions.

For example, the University of Miskolc has achieved a high number, but there is also a need for a company that hires skilled workforce. Companies have to be asked what kind of professionals they will need, there is a need for continuous development, consultation, feedback.

The allocation of application resources will be linked to the smart specialization strategy. It is important to shape collaborations in such a way that the goals set by smart specialization coincide and are achieved in a common set. Market players have a big role to play, they formulate their needs. Let universities be proactive, but industry also needs to know what the challenge is. Cooperation + effective competition.

One of the most important areas of supporting the RIS3 process is research and access to new knowledge and technologies.

What are the conditions for effective consent? a. What are the expectations of higher education institutions in this regard? (Expectations of both quality assurance stakeholders and those responsible for RIS3 are important) b. Is there a preferred collaboration between higher education institutions and other types of stakeholders to create / develop / maintain a critical mass of RDI assets (both human capital and equipment) in the areas of smart specialization? c. What are your main strengths and where do you see opportunity for improvement to increase R&D cooperation (between R&D actors, companies and public authorities)? d. What about the joint definition of research objectives and key research issues? e. What about joint monitoring of the research process? f. With a common interpretation of the results? g. Is there

data on what is in higher education institutions i. what RDI results were achieved ii. is there an RDI partner database iii. is there a knowledge base (HR and other discovered experience)?

Some universities have made institutional developments for smart specialization. Where universities do not have an industrial base, it is more difficult to move forward.

EU and domestic innovation tenders also support this process.

Q.7.

It is a question of how much universities can make use of the opportunities that exist both domestically and internationally. While there is undoubtedly a need for resources in the process, a change of perspective is also needed.

There are 8 regional innovation platforms in Hungary. They can become regional networks. This question is about regional networking opportunities that can be monitored by those responsible for coordinating RIS3.

The Association of European Universities (EUA) abroad, at the domestic level the Hungarian Rectors' Conference is a forum for responsible leaders of universities.

Within the framework of the EUA, it is possible to share best practices, participate in international projects and events, and institutions can learn from each other. At the regional level, clusters can also be considered, where RIS3 actors can meet, or participate in chamber or municipal events where the goal is to find actors and exploit professional synergies. Now it is beginning to become clear, if there is no support then this networking process will die. EU funding is expected to be available under the H2020 successor program, and more and more institutions need to be prepared. Other smaller programs are also worth noting: CEEPUS scholarships - research cooperation, international mobility, strategic partnerships - Erasmus.

Q.8.

Most collaborations are based on personal contact, so getting partners and keeping partners. It is much more effective and efficient to apply with existing partnerships. Both domestic and international tenders play a significant role.

The internationalization of universities results the expansion of international relations. This can also be a great advantage for the region. Usually, these collaborations are most easily established between a university and domestic subsidiaries of foreign companies.

Having a funding framework (H2020 or INTERREG) has a positive effect on change. However, after the application expires, these collaborations often cease if the main motivation was fundraising. Without mutual commitment, common professional goals and interests the sustainability of these relationships -in most cases- is questionable.

Q.9.

Since 2015, the Higher Education and Industry Collaboration Centers (FIEKs) have been operating in half a dozen institutions where the resources needed for these collaborations are

available to produce a specific market service or product. They move along specific themes and support the creation of knowledge that contributes to S3 RDI goals. The question is how sustainable they can be in the long run and how effective they will be. Science Parks: Infrastructure → The regional embeddedness of companies increases through science parks. National Laboratories: provide an opportunity for concentration and networking of researchers on the topic. The thematically focused research they conduct supports smart specialization well.

The university innovation ecosystem program is important for the visibility of universities. Under the project, universities will map their knowledge assets, encourage the development and incubation of entrepreneurial skills, assess corporate needs and help partners find each other. H2020, thematic excellence program, OTKA - many domestic and international programs encourage the development of HEI's innovation purposes.

FIEKs, Science Parks and Competence Centres provide a framework for collaborations.

For local universities, the tender options related to the objectives of smart specialization, the fulfilment of corporate orders based on local collaborations, the development of corporate research service provider profile can be incentives. In general, they need to be aware of their scientific capabilities, explore their existing strengths and breakout opportunities. Along these lines, they must determine the development directions, with which they can contribute to the innovation potential and competitiveness of the given regions.

Q.10.

It's important to understand that the goal needs to be aligned with what we want, not what we know. Stronger concentration, stronger prioritization, stability. It is important to have feedback for policies, not just monitoring in the traditional sense, but feedback for the whole policy cycle. The organizational conditions for this must be created, because the higher education institution can be involved in this way. In the monitoring system, we build on the Territorial Innovation Platforms and the Territorial Innovation Platforms are organized around the universities.

How should a higher education institution prepare? Preparation is facilitated by Territorial Innovation Platforms, which represent the local, regional branch of policy. There is no separate S3. There is a policy that has a specific methodological perspective for S3. There is no need of a separate organizational system for S3. A higher education institution is needed with good FIEKs, cooperating with the competence centre, and having a system in line with the principles of the university innovation ecosystem application.

Within Europe, Hungary achieves a more innovative position by providing opportunities for talented and creative young people and continuing the modernization processes of the economy in the key implementation areas:

• Strengthening RDI capacities and introduction of advanced technologies,

• Digitization for citizens, companies and government,

• Developing the skills needed for S3, supporting industrial transformation and strengthening entrepreneurship

• Enhancing the growth and competitiveness of SMEs.

This process has already begun with the Territorial Innovation Platform initiatives launched by NKFIH in 2019. More and more related information is coming to the attention of policy makers. The innovation directorates of higher education institutions and their knowledge transfer offices play a key role. We must look for the opportunity to participate in as many local and regional cooperation as possible.

Universities need to work to make their activities more relevant to their external partners. For universities in order to play a more important role in the development and implementation of RIS3, S3 strategies, participation in state-funded projects is a useful field of practice.

Technical University of Košice (Slovak Republic)

0. How do you consider the progress/results of (national/regional) S3/RIS3? What are the most important challenges to improve performance and impact?

S3 (programming period (2014-2020):

Context: Slovakia has implemented the national RIS3 2014-2020 as a key economic strategy, which was designed as sectoral it did not contain any regional elements, although it is named regional. The committees that formed the strategy are not made public, hence, the implementation process has mainly been non-transparent. The conditionality was merely understood as the selection of the sectors that are eligible to utilise some of the European funds. Eventually, the evaluation report also contains, in principle, the list of the entities with the amounts received through compliance with RIS3 priorities. Some regional authorities decided to prepare optional RIS3, but their RIS3 were not registered in the JRC, did not have sufficient influence, were not assigned to resources and remained only documents with sometimes stimulating ideas.

Respondents claimed, unfortunately, the national RIS3 failed to meet its targets. The main challenge is to break the ongoing sectoralism, improve implementation mechanisms and coordination. The results of the S3 could have been better:

- Efficiency and transparency: The respective EU Operational Programs did not work efficiently. The Ministries of Education and Economy did not cooperate sufficiently, leading to inefficient and non-transparent delivery of EU funds.
- Communication and collaboration: The responsible institutions have not enforced open communication and collaboration with self-governing regions, cities and universities. In Slovakia, national S3 worked separately from RIS3 created later at the regional level. Responsible institutions for the national S3 registered that the regions also initiated and created their own RIS, but the formal connection has never been created. Thus, only a few synergies were created within national/regional innovation ecosystems.
- Sectoralism and centralisation: Partners involved in S3 initiatives operated within one of the five domains/sectors and sectoralism and centralism has continued in the Slovak economic policy. Respondents mentioned that decentralisation in terms of higher competencies of individual regions for creating the activities to support the innovation

creation is needed. Therefore, most respondents prefer to focus on RIS against NIS; as RIS are closer to the regional innovation community and the regional needs. RIS can better utilise the innovation potential of regions thanks to the proximity of regional partners within regional innovation system.

- Involvement of regional authorities: the access to finance and decision-making related to innovation development of the regions should have been changed. The self-governing regions cannot fulfil the competence of regional (innovation) policy without having rights to implement EU sources. They lack financial resources for covering the regional development needs.
- The lack of understanding of Smart specialisation concept: the concept of Smart specialisation has been oversimplified and misunderstood to a large extent. Mechanisms that would stimulate informal/formal communication have never been created sufficiently. Triple helix partners thus face misunderstandings, conflicts in strategic goals, but also the stereotypical mindset. Communicating together is a big problem.

Košice region:

Regarding RIS3 (programming period 2014-2020) there were some positive aspects:

- active involvement of people from the academic and industry area in its creation,
- the university Science Park TECHNICOM and MEDIPARK were built and functional, which can play an important mediating role in the nest RIS3 period,
- a few innovations activities, workshops, debates, conferences took place in Košice Region (KSR), there are better knowledge and awareness of regional needs
- several stakeholders have become connected through projects, workshops and debates.

Regarding RIS3 (programming period 2014-2020) there were some negative aspects:

- RIS3 strategy was too general, very descriptive, missing specific objectives, actions and responsibilities that should have been implemented. It focused on a one-way redistribution of sources to individual institutions; the aspect of partner networking was missing.
- The relationship between the national strategy and the regional RIS has not yet been resolved. This is a serious coordination issue to be addressed in the coming programming period.
- It is also absolutely necessary to set clear and transparent funding for innovation strategies and projects.
- No information platform was created that would have precisely described the outputs reached under the RIS3. There was a lack of greater transparency.

1. How could HEIs ideally contribute to the development and implementation of RIS3, i.e.: What kind of services should HEIs provide? Which resources, competencies should HEIs mobilise and what should they do for a more efficient involvement suitable to each of the main steps of RIS3 design and implementation?

For better implementation of RIS HEIs should:

A. Participate in the initial stakeholders' meetings and entrepreneurial discovery process – HEIs should be open to cooperating with stakeholders in the initial phase of RIS creation, to communicate and coordinate their needs, their strategic goals for near future (next programming period), their solutions for challenges at the regional and national level,

their ideas that would bring economic and social benefits to the regions, their success in foreign projects and in cooperation with different companies. HEIs intensive discussion and effective communication should lead to a consensus and selection of key priority areas defined in RIS.

B. Provide the collection of relevant information and analysis – HEIs can help with the collecting and evaluating best practices in defining key priority areas fitting for the region. HEIs could come up with a detailed proposal on what technology, human capital inputs they can provide to make the RIS outputs feasible for the next period. HEIs should collect information on what they would like to do in those areas of specialisation, how they can help fulfil RIS main/partial objectives. They should be able to provide data, analysis and do the mapping of their current outputs in the relevant topics. As mentioned by one interviewee, "universities are essential in every step of RIS, but they are irreplaceable in the selection of priorities of vertical specialisation and the design of a mix of policies and action plan".

C. Be flexible responding to identified priority fields in education and training – HEIs should provide more innovative education relevant for the 21st century. It is necessary to change the overall paradigm of the way of teaching. Unfortunately, we can see that companies must reskill graduates to fulfil their needs. The knowledge and skills of graduates are often different than required in the labour market. The connection between HEIs and firms must be tighter. HEIs should prepare study programs in cooperation with companies to better adapt their education to the needs of larger companies and the regional labour markets. Two interviewees also mentioned that besides hard skills, soft skills should be taught more as well. Graduates often do not know how to work in teams - they are rather individualists.
Note: The discrepancy on the labor market is largely due to the fact that there are no professionally oriented universities in Slovakia (fachhoschule, polytechnics) that would educate more in cooperation with the needs of employers. There is a general lack of discussion, while larger companies would like to run universities so that they can educate graduates according to their current needs.

D. Be flexible responding on identified priority fields through research activities – three interviewees stated that research at universities is often too academic, far removed from the problems of companies. Identification of priorities in cooperation with industry and other stakeholders is therefore expected. The R&D projects of HEIs could be thus more dedicated to RIS topics to bring practical implementations and solutions for industry. HEIs will focus not only on the application of narrow, specialised research carried out by micro teams, but they can create large R&D teams and build R&D clusters / networks within the university under the specific priority topic.

E. Strengthen micromanagement capacity and promote entrepreneurship and innovation culture at HEIs - having sufficient sources and capacities (financial, human etc.) is essential for HEIs for successful collaboration within QH. HEIs, therefore, need to strengthen their internal ability to have respectful manager/leader/ capable of communicating with public administration and industry in order to create a culture of cooperation, commitment and responsibility. HEIs middle management is a crucial one, mainly Vice-deans, heads of departments, leaders of the research teams.

F. Sharing infrastructure – opening research infrastructure for business demanders can be a significant HEIs contribution to the development and implementation of RIS objectives. It is also essential to create modus operandi for cooperation with industry.

2. What kind of other services offered by HEIs are/could be important for the stakeholders in the national/regional innovation ecosystem and for the ecosystem as a whole in line with the objectives of RIS3?

There are several critical views on the topic of HEIs services.
A distinction needs to be made, given a large number of universities with questionable quality. Besides, opportunities and potential are regional and sector-specific. Although technical universities have great potential in collaborating with industry and identifying (technological) priorities.

The universities themselves should be interested; it is in their interest to obtain resources from commercial projects. Cooperation types of projects are also attractive to students. History shows that the government is failing to promote cooperation, so universities should take responsibility for their own development and not wait for another public support program.

Most interviewees agreed that HEIs strength is their expertise within the specific topics/areas and technological equipment as well. The HEIs are effective in activities that require a more sophisticated methodology. For example, providing primary research of the regional needs, setting up the development and monitoring indicators, use of correct statistical methods use of proper sample design and stratification of respondents in surveys. HEIs can also help with the evaluation of potential contribution and impact of ideas on higher regional competitiveness, as well as to the regional growth models. However, several obstacles exist - mentality, other priorities, reluctance

Education and training in co-creation, design thinking, user-centered design techniques those areas. HEIs can train those techniques not only students but also stakeholders in quadruple helix. In the initial phase, when innovative ideas for solving new problems are generated, those techniques are crucial and need to be mastered. However, training of future skills and techniques depends on HEI quality and willingness to become more entrepreneurial.

Two respondents mentioned the establishment of a high-quality, profound portal about knowledge solutions arising at the HEIs environment or being transferred into the region via international projects. Such a portal could also serve as a HEIs active promotion, increasing HEIs visibility and attractiveness.

Other services relate to the implementation phase of RIS. One respondent emphasised that just to create RIS is not enough, but Task Force platforms, hubs must exist, where innovative teams could work on the development, testing and practical implementation of solutions for the region. HEIs could provide or create such infrastructure in cooperation with regional actors. (e.g. creation of space working, digital labs, hubs etc.)

Besides the main services (A-F) mentioned in the first question, one interviewee included marketing and communication services in the portfolio offer of HEIs services. The reason is that RIS partners underestimate marketing communication, leading to a low level of information and understanding.

3. In your opinion, which contribution can HEIs give in terms of knowledge and expertise within a Quadruple Helix type cooperation (between key actors of the national/regional innovation ecosystem), characteristic to RIS3?

HEIs can offer expertise, research infrastructure, training experts, prepare related study programs, etc. However, HEIs should also actively enter the economic and social environment of the region via interventions into the value chain development, in cooperation with other stakeholders in QH.

A. Interventions aiming at start-up ecosystem - HEIs could collect information about innovative entrepreneurs, carry out innovative technology audits and support creative entrepreneurship via different activities (e.g. hackathon, idea coffee, start-up competition). HEIs should be involved in various high-tech base initiatives that can stimulate a particular type of entrepreneurship.
B. Interventions via Common Innovation Platform - HEIs could be one of the relevant QH partners in the systematically functioning institutional platform, where relevant actors would meet regularly and would discuss up to date project proposals/ideas with solutions for the challenges of 21century. HEIs should bring ideas for the long-term competitive advantage of the region. HEIs can show what might be the way for growth and sustainable trajectory. The critical factor is to have a common platform that is regular, systematic. QH actors do different activities, but there is no umbrella, which would monitor the whole system. The regional government should take the lead, but without the contribution of other QH partners, active cooperation and participation in the platform cannot work.
C. Interventions in the selection process – HEIs can help with the preparation of criteria for selecting the right priority areas which ensure higher prosperity of the region, creation of new jobs, generation of additional revenue and export. It is imperative to choose 2-3 key priority areas at the regional level, having the capacity and technological roots for creating a critical mass of R&D, logistics, distributions, relations, human capital etc. However, the consequent changes have to be reflected in the value chain, society and industry. An essential task is to prepare road mapping in this step, over-all and priority area-specific as well (robotisation, digitalisation, decarbonisation etc.). And that brings is a real chance for boosting the economy.
D. Interventions in acceleration – once the key priority areas are set up, HEIs can make interventions to develop them. HEIs can train and prepare people, can create relevant study programs, experimentations spaces, apply for project calls at the EU and national level, create research teams and consortium etc. However, this step depends on HEIs flexibility, adaptivity and leadership, a captain who would take the selected priority under his/her wings.
E. Interventions for interdisciplinary cooperation - once the key priority areas are defined, they should be robustly supported by creating vertical links of institutions and mechanisms. An effective vertical and horizontal collaboration must also happen at the HEIs, that is crucial for every innovative regional initiative. HEIs can create mechanisms, gradually cultivate such partnerships between several HEIs, to create synergies. For example, suppose the key priority will be a low carbon economy and low energy intensity in the future; Then, we need several organisations to collaborate together (project organisations, organisations that make heat pumps, photovoltaics, recuperators, respective faculties at HEIs, producers, etc.).

4. What do you think HEIs should focus on to become an attractive partner for RIS3 stakeholders in the RIS3 related planning and implementation activities or in facilitating Quadruple Helix cooperation/interaction in general?

Respondents mentioned that HEIs should mainly:

- Create proactive offers - HEIs should be able to show different solutions and innovation possibilities that HEIs might offer within the specific ecosystem challenges. To ensure this, HEIs should have people/leaders capable of communicating and promoting HEIs offer, and consequently to attract and convince other people.
- Strengthen the capacity to implement services based on external demand – in the initial phase of idea generation, the use of new appropriate techniques focus on clients' needs is necessary, especially if innovation is in the service industry. HEIs should strengthen their capacities in areas such as co-creation, design thinking, user-centred design.
- Introduce appropriate incentives to engage in cooperation with external partners – targeted financial incentives would motivate academic employees to contribute more to regional competitiveness. But this implies changes in the national policies to develop incentive mechanism at the HEIs level. In Slovakia, the main source of HEIs funding institutions is constituted of public subsidies that are mainly based on the number of students and scientific outputs. Therefore, there is less motivation to work with the industry and become essentially more entrepreneurial.
- Strengthen both formal and informal ties with RIS3 stakeholders – mechanisms that would stimulate informal communication have never been constituted so far. HEIs can be proactive in initiating and organising such informal meetings (e.g. common lunch meetings) to provide a positive signal that QH partners are important to them.
- Promptly responsive to the requests of the stakeholders – the external environment is dynamic and unpredictable, continuously changing; HEIs should be more resilient and capable of responding to rapid changes. Companies expect solutions from the HEIs immediately.
- Create single point for HEIs services – such an office would act as a contact and channel for external customers to find a relevant partner at the HEI .

Note: The role and image of universities is greatly deteriorated due to the constantly publicised bad practices and cases that the media likes to present to the public (they are only theoretical, they teach students old and unnecessary knowledge, they have weak positions in academic rankings, the structure of graduates does not correspond to the needs of companies, etc.). There is clearly a high need for higher social acceptance and appreciation of HEIs work. Of course, this task is mainly in the hands of the universities themselves, in cooperation with the government.

5. How do HEIs respond to human capital needs of the region/country in smart specialisation areas? What are the most burning human capital/competency needs of the region/country in smart specialisation fields? What kind of cooperation arrangements can lead to responsive HEIs training supply/services?

HEIs should focus on global technological and civilisation trends, and accordingly adapt and build skills. The key skills mentioned by interviewees are digital and IT skills, data management skills, creative skills, social skills, communication skills, the team works skills.

Other qualities mentioned are open-mindedness, emotional intelligence and the ability to self-improve. The idea is to incite internal motivations of students and to ignite them for learning and innovation. HEIs should also adopt more innovative forms of teaching and training, and to learn from the prestigious universities around the world.

Human capital needs might be well-designed by RIS key priority areas. HEIs could prepare new or recover existing study programs in cooperation with companies to better adapt their education to the needs of innovative companies and RIS objectives. Interviewees mentioned the fields of decarbonisation, zero waste management, circular economy, active ageing, sharing economy, eco-housing, etc. Those fields provide significant opportunities, and there is room for HEIs to develop skills in those fields.

As for the HEIs involvement in adult education, it could have been more efficient. It must be stressed that at first, region's and lifelong learning needs are not assessed. The weakness of HEIs is that too academic orientation in the lifelong learning education sometimes/often prevail.

Two interviewees mentioned that strategy aiming at attracting and retaining the most talented people within the region are critical; Also, study programs preventing brain drain and supporting brain gain could be effectively managed in the cooperation with the regional government. For example, a scholarship or grant scheme can be provided for those skilled students, who have the potential to create innovative solutions. HEIs should detect and support those students and provide space for developing innovative solutions. The regional government could help with financing and testing, and keep the solutions mainly in the regional/national economy.

Today, joint university-industry projects funded from public sources are considered to be the ideal approach, with each partner finally using the allocated resources separately. The question is whether this is the right approach. The aim should be to promote knowledge transfer between the parties.

6. How do HEIs respond to the RDI needs of the region/country in smart specialisation areas?

HEIs partially realise R&D that is in line with RIS objectives, but there is a room for better focusing on region's needs. HEIs could:

- establish a particular (joint) research unit at HEIs, devoted to RIS topics (agenda) and could be co-financed by the region, city, state and HEIs. It is therefore essential that HEIs would actively participate in RIS creation and defining priority areas. Nowadays, there is a lack of understanding of Smart specialisation concept due to the limited communication between stakeholders. Creation of the Common Innovation platform at the regional level would improve communication and cooperation.
- formulate their strategic goals and create developing plans with the reflection on the RIS needs.
- create a mechanism to identify the most quality outputs that can be used in daily life as not every HEIs outputs (final theses, articles, project outputs) meets the expectations of the economy. Publicly available portfolio of such outcomes would certainly also help. Universities should convince businesses that they have something to offer.

- participate with industry in support schemes. The participation should not be formal and for the sake of obtaining extra funding but rather improve real innovation potential of the region.
- participate in several RDI projects with Penta-helix actors.

Critical note: What do RIS3 partners and QH members expect from universities? In general, nothing or students. Subsequently, knowledge in the implementation of projects. In reality, companies do not need Slovak universities, but work together to get involved in support schemes, gain resources and have an impact. The majority of managers do not have a high opinion on the quality of our universities and the practical usability of teams and knowledge. I'm sorry, but I've met this many times. Universities should convince businesses that they have something to offer.

7. Do you think that, at national/regional level, are there any existing networking opportunities between HEIs and other RIS3 stakeholders in order to capitalise on/exploit and bring together their actions and projects?

Networking opportunities have always been there. Several forums and partnerships were created via project activities. However, such forums and partnerships were mostly limited to the project's outputs. What is missing here is the exclusive initiative of the region, city and HEIs, who would put own energy, human capital, money into some social partnership initiatives, e.g. the conference that would take place once a year. The conference would serve for evaluation of what has been achieved and what has been done in the region. There must be a commitment and willingness to invest human resources and organisational efforts into those activities.

Another networking opportunity is a formal internal managing meeting at the HEI, with representatives of regional government (e.g. mayor, deputy mayor etc.). For HEIs it can be an opportunity to show ideas, challenges and innovation possibilities that they might offer within the specific regional ecosystem.

Innovation vouchers are an important mechanism, especially in less innovative and institutionally dense regions, that quickly and efficiently connects R&D potential of HEIs and relevant SMEs. Such cooperation and networking should be based on the participatory principle. This ensures the mutual interconnection of all involved stakeholders and the generating of new networks.

8. How do universities contribute to linking the region/country to international sources of knowledge, especially through participation in formal and informal European and global R&I networks?

Linking is done mainly through:

- participation in international research projects (Horizon 2020, Interreg programs etc.). Within the framework of joint international projects, there is the mutual exchange of experts, knowledge is imported mainly to HEIs, however dissemination of knowledge to the region is only limited. Therefore, HEIs could further thematically develop and disseminate and utilise project partnership outcomes for the needs of RIS. The creation of triple helix partnerships and HEI partnerships is also strongly supported by the EU.

- participation in mobility projects (Erasmus) and education consortiums – inter-regional linkages can also be formed via Erasmus mobility.

HEIs should be in the position of an expert and primary coordinator of those activities. HEIs should be more pro-active and initiate their original research topics in the international environment. Nowadays, international activities are mainly academic, as they are related to the criteria that are set up for funding universities from the state budget and the link to RIS objectives is often missing. Thus, this topic could be debated with key actors in the region and utilised in favour of RIS.

Note: There is a persistent misunderstanding between the three pillars of the triple helix, and so different ways of thinking. For example, universities rely mainly on codified knowledge that exists concentrated in academic journals. However, companies are not interested in this knowledge and consider it a theory that does not work in practice. It is surprising how separated these worlds are from each other and burdened with prejudices and destructive perceptions.

9. What are the key funding opportunities and incentives that universities would need to support the enhancement of regional competitiveness and contribute to the smart specialisation objectives through R&D and innovation?

The creation of Common regional (financial) tool/mechanism is an idea to fund and support initiatives, RDI activities related to the key RIS priority areas. As mentioned above, the creation of Common Innovation Platform arranged by the regional government would be desirable. Each member would pay a membership fee. Such an integrating mechanism could motivate HEIs as well. Not only they would feel to be directly involved in the creation, but they could be better aware of regional needs and gain different views from industry, region, and cities.

As for incentives, one option how to advance the HEIs involvement in RIS activities by setting the third role (entrepreneurialism) among HEIs quality assessments. HEIs funding from the Ministry could be revised so as to include also triple helix criteria; That might stimulate HEIs active involvement in RIS implementation.

10. Taking into consideration the experiences from the current (2014-2020) programming period what do you expect for the next one (2021-2027)? How can the involvement of HEIs be improved in RIS3 revision and implementation for/during 2021-2027? How should HEIs prepare themselves to be more efficiently involved?

For effective RIS3 implementation HEIs should in future:

- act as an "entrepreneurial university"- be able to reflect the needs of market and non-market actors in the focus of their R&D activities, but also in the setting of education.
- define their strategic goals appropriate for the 21st century, following the example of reputable universities.
- have a comprehensive overview of their R&D capacities and capabilities and be willing to offer those capacities (actively) for the needs of RIS objectives.
- willing to support higher goals (sometimes) at the expense of its own goals.

- be adaptable as adaptivity is essential. What worked yesterday, will not work tomorrow; so HEIs need to react alertly to early signals from the external environment and from QH partners.
- should have a leader, a captain who would be a recognisable holder of HEIs regional engagement. A leader must also gain trust from the industry, city, region and at the same time should be capable of attracting other academicis too.

Expectations for the next period (2021-2027) from national level:

- a simplification of drawing from the ESI Funds,
- effectiveness of the EU's rules for financial allocation,
- setting HEIs quality assessments within the framework of their contribution to RIS (funding HEIs should be also based on their contribution to RIS implementation)

Expectations for the next period (2021-2027) from regional level:

- a greater degree of a participatory approach to public policy-making (higher HEIs involvement),
- financial support from regional grant schemes for RIS activities

Babes-Bolyai University (Romania)

0. How do you consider the progress/results of (national/regional) S3/RIS3? What are the most important challenges to improve performance and impact?

The RDAs generally mention not only problems faced during the 2014-2020 programming period, but also current and general challenges. In all cases they reflect on issues concerning both the policy making organization and regional stakeholders, two of them making explicit reference to universities.

As a general problem most persons interviewed mention the lack of understanding of stakeholders linked to the smart specialisation concept that can be still considered as a novelty as well as interlinked concepts, such as innovation, innovation management, bankable projects, etc. However, one RDA mentions that compared to other stakeholders universities and academia have a better understanding compared to other stakeholders. This low level of understanding in some cases is interlinked with low level of involvement in strategy design and communication problems between the policy making organization and key actors.

Linked to the implementation of RIS3s for 2014-2020 one RDA mentions difficulty of stakeholders to develop RIS3 project ideas for obtaining financing, coupled with a week innovation system. Another interviewee underlines that in general the instruments deployed to support RIS3 implementation were not adequate to market needs. Two respondents underline that RDAs faced problems with strategy monitoring and evaluation. Establishing a proper monitoring system for the 2021-2027 RIS3 is also a challenge, mentioned by one RDA in connection with the lack of coordination between strategy design on national and regional levels. Lack of harmonization in general is mentioned by three interviewees. Other current problems refer to the movement of EDPs and other stakeholder involvement (bottom-up) processes in the online space.

Specific problems of HEIs hindering strategy implementation, as mentioned by one RDA, are:

failure in bringing R&D results to the market, in constructing viable partnerships, communication and cooperation with firms.

1. How could HEIs ideally contribute to the development and implementation of RIS3, i.e.: What kind of services should HEIs provide? Which resources, competencies should HEIs mobilise and what should they do for a more efficient involvement suitable to each of the main steps of RIS3 design and implementation?

In general HEIs, as all other stakeholders were involved in the main steps of strategy design, offering feedback on the analysis, participating at EDPs and in different strategy governance structures, giving feedback on smart specialisation priorities and niches. One RDA established an Academic Committee as part of governance structures, involving HEIs even more. Three

organizations report a more effective involvement of universities, compared to other key actors, mentioning that academia brought a valuable contribution in shaping the final version of the strategy, especially the definition of smart specialization priority areas and niches and in general had a very efficient involvement in EDPs compared to other stakeholder categories. One interviewee ads, that with the Horizon 2020 projects implemented, HEIs contributed a lot in consolidating the regional innovation system. Other two RDAs (from West and North-West Regions, with quite big universities) underline that HEI involvement was more re-active than proactive and not considerable or below expectations.

All interviewees agree that HEI involvement should be improved in the future, particularly linked to:

A) Assuring a more efficient involvement according to HEIs role in the innovation system, by taking internal actions and making changes within the organization to become poles, centres of knowledge generation in smart specialization areas specifically and for communities in general.

To this end HEIs should:

- have the necessary number of human resources that have the knowledge and competencies in order to facilitate R&I cooperation between the HEI and businesses, that can be alternatively organized in a special department. Dedicated personnel should support university-business cooperation by: gathering and communicating market needs towards researchers, gathering and communicating information regarding the R&I potential of universities towards businesses, facilitating internal communication within the university. To support this: a) a centralized inventory of R&D infrastructure, results and competencies should be prepared and filtered based on market needs, b) researchers should be made aware about business needs and should be supported to make a shift from R&D to R&I, c) universities should be (able) opening their infrastructure to businesses.
- make themselves more visible and facilitate communication and cooperation with businesses by organizing events, such as workshops or even EDPs.

Generally universities should become more entrepreneurial, and, as two interviewees mention should also develop a vision and a strategy for cooperating with businesses, not just to support innovation, but also linked to education/human resource development in entrepreneurship and innovation. Development of trainings, engagement in LLL programs to develop employees from companies in line with the latest technological advancements would also be necessary on the market. To make HEI contribution more effective, one region also mentions the need for cooperation between at least the universities that have similar or complementary profiles.

To achieve this it would be very important that universities become more dynamic, take the

necessary steps internally and make changes in both mentalities (institutional and individual) and procedures. This includes offering proper incentives to researchers that engage in R&I. There are however bottlenecks in this sense: a) general lack of competent and dedicated human resources, b) the R&D equipment that was acquired from EU funding and can be used only up to 20% for RDI projects requested by the market, c) universities have constant funding sources for education from the state budget based on the number of students enrolled and do not have to search for other financing sources. However, as one interviewee notes, HEIs, especially smaller ones, might be forced to reinvent themselves and be more engaged in RDI. As the number of students is constantly dropping, they will not have enough financial sources to sustain themselves.

B) Supporting the responsible organization in policy design, review and implementation through a pro-active involvement (2 regions):

− supporting strategy monitoring by giving input (supplying data),

− elaborating analysis, gathering and offering data on/regarding smart specialisation priority areas, supporting the policy responsible organization with information from the ground, and (even) justifying the amendment of priorities or introduction of new priorities.

2. What kind of other services offered by HEIs are/could be important for the stakeholders in the national/regional innovation ecosystem and for the ecosystem as a whole in line with the objectives of RIS3?

Altogether universities should become the main catalysts of innovation in their respective regions and sources of knowledge generation and transformation for communities. In this sense they should continue by further developing initiatives that have been started in some regions like supplying technology transfer services, developing Digital Innovation Hubs. Competence centers would also be welcome, as one of the respondents added.

Additionally, all interviewees agree, that they need to put accent on opening up their R&D infrastructure and offering their know-how especially for SMEs, taking up contractual research and proof of concept activities and offering testing services, since according to latest studies these would be much needed. Complementary services, such as consultancy, marketing, innovation training, integrated platforms for mutual learning would be appreciated, as well, as few RDA representatives add.

As mentioned at point 1, the main bottlenecks of the development of such services are: lack of centralization and presentation of potential offer filtered based on business needs and systemic problems (i.e. reluctance of HEIs in using infrastructure acquired with EU funding for this purpose, even if, pending the fulfilment of certain conditions this can be used up to 20%).

However, as one interviewee mentions, the primary role of educating highly qualified human resources should not be forgotten. Well prepared graduates and support for the continuous development of employees are the backbone of economy and also a prerequisite of innovation. In this sense HEIs, besides higher education, should also develop trainings, post-graduate courses and participate in LLL.

3. In your opinion, which contribution can HEIs give in terms of knowledge and expertise within a Quadruple Helix type co-operation (between key actors of the national/regional innovation ecosystem), characteristic to RIS3?

First and foremost HEIs should develop and present an offer especially towards businesses and become more pro-active in initiating cooperation with firms, thus: they should centralize

their offer, adapt it to market needs and present it to companies online on platforms and offline during dedicated match-making events. For this, as it is presented under point 1, there should be dedicated human resources, vision and strategies should be developed, internal procedures updated. Reaction to requests should also be faster since the market "can't wait", as expressed by North-East RDA. Internal cooperation needs to be enhanced and shift made from R&D towards R&I. Adaptation of content and curricula to business needs would also be important, as well as offering innovation and technology transfer related education especially to master students, PhDs and post-docs. Supplying the market with highly qualified human resources would be a first step on behalf of universities and could develop trust towards HEIs on the market. As underlined by one of the experts interviewed, in some cases lack of trust on behalf of companies is hindering cooperation. Lack of interest towards innovation and cooperation with HEIs on behalf of companies is also a bottleneck. Additionally, there is a lack of appropriate financing sources.

As one respondent notes, HEIs would be welcome to offer also services to the local public administration, especially elaborating studies linked to social and economic development (sustainable development strategies). In this case, as well, they should be more pro-active in presenting their offer. The key to facilitating this type of cooperation are also the human resources.

Similarly, another respondent mentions that HEIs could support the local public administration by assisting them in the deployment of innovative measures for community development or even innovation procurement.

4. What do you think HEIs should focus on to become an attractive partner for RIS3 stakeholders in the RIS3 related planning and implementation activities or in facilitating Quadruple Helix cooperation/interaction in general?

First and foremost, HEIs should be able to communicate about their offer and promote their offer. While they do this for their higher education programs, they fail to do this when it comes to R&D results and services. The prerequisite would be a change in mind-sets and behaviour though, since right now education is their priority. This change should start with university leaders. Then there should be adequate and dedicated human resources that should deal with all aspects of cooperation between HEIs and other key actors. Internal changes in terms of procedures should follow and instruments for facilitating cooperation developed. These can cover development of data-bases with research results, organization of networking events, analysis of market needs, development of cooperation platforms and of open innovation platforms facilitating demand-driven co-creation, etc.

Focus could also be on: joining forces with companies to keep graduates in the region and fight brain drain, undertaking the role of organizing EDPs.

The historic role of universities needs to be revived. They should become again development poles on regional level and opinion leaders, coagulating key actors and connecting regions to trends. (NE RDA)

5. How do HEIs respond to human capital needs of the region/country in smart specialisation areas? What are the most burning human capital/competency needs of the region/country in smart specialisation fields? What kind of cooperation arrangements can lead to responsive HE training supply/services?

In general all respondents agree that education offer should be in line with needs of the market. Based on constant mapping of market needs universities should:

- put accent on developing specialisations that are requested on the market and not continuing to

deliver graduates that cannot find a workplace in their field of expertise,

however one respondent mentions that in their region specialisations offered by HEIs are in line with the regional economic profile,

- change curricula in order to incorporate latest knowledge and technological advancements,

- develop and apply new teaching methods,

- raise the general quality of education,

- build competencies and practical skills of students by developing additional courses and trainings, as well as cooperate with businesses in order to assure more efficient student practice programmes,

- orient students towards writing their thesis and dissertations in fields that are linked to real problems communities and businesses are facing,

- develop other types of trainings, courses for employees in general and promote LLL, in cooperation with businesses.

There are respondents that mention individual cases when a curriculum has been adapted due to pressure coming from the market, or trainings that were developed in response to market needs. However, such cases are singular and responsiveness on behalf of universities is very slow. As one respondent notes, also procedures of getting the necessary accreditation for changed curricula or new specializations is lengthy and bureaucratic and universities are not able to anticipate all future needs and technological changes. Thus an immediate help would consist especially in trainings, additional/optional courses both for students (to acquire skills and competencies) and other stakeholders (to participate in continuous development and education).

"HEIs should make a shift from investing in buildings and equipment towards investing in people." (Centre RDA)

6. How do HEIs respond to the RDI needs of the region/country in smart specialisation areas?

Out of the five respondents only two mention generally, that there are universities implementing R&D projects with companies, especially big ones, or initiating and developing projects that would support the regional innovation ecosystem. Both of these interviewees agree that these are individual initiatives, driven by enthusiastic individuals from HEIs or boundary spanners, and, as the other three respondents, put accent on the steps universities should make in order to better respond to RDI needs.

All agree that HEIs should be better involved in RDI and cooperate more with businesses, especially SMEs. They would have a lot to offer in terms of knowledge and RD equipment. To this end, four respondents argue that internal changes would be necessary. HEIs should become more open towards cooperation, institutional mentalities and individual mind-sets should be changed, internal rules and procedures should be adapted, trainings in technology transfer should be delivered to researchers and/or a dedicated department should be established (linking universities with the business environment), incentives should be offered to researchers (at the moment they are evaluated based on their scientific activity, especially number of articles published). Additionally RDI offer should be presented and communication between researchers and businesses should be facilitated, if necessary by dedicated personnel. The fifth respondent puts accent on the fact that HEIs should be more involved in the activity and development of clusters and should put accent on the development and implementation of the project ideas.

7. Do you think that, at national/regional level, are there any existing networking opportunities between HEIs and other RIS3 stakeholders in order to capitalize on/exploit and bring together their actions and projects?

Three respondents report that besides the events organized and initiated by the RDA there are no such events on regional level, or, in case they are they do not have any impact. They underline that universities should organize such events. Other two respondents mention that universities organize such events on regional level in order to present research results to businesses, one adding that clusters also organize quadruple helix networking events, similar to EDPs. These respondents also mention projects, initiatives implemented in partnership as bases of future cooperation (for ex. innovation vouchers). In such cases building partnership is an eligibility criteria that needs to be met, however, on the long run could contribute to the development of networks.

In general RDAs underline that, besides EDPs that are organized in connection to RIS3 they, as policy responsible organizations, also undertake other opportunities to bring HEIs closer to other stakeholders and facilitate cooperation. Such events and initiatives are in the framework of Enterprise Europe Network project, but also as part of Horizon 2020 or Interreg Europe projects. Some RDAs also look at best practices that worked well in other regions and try to implement them to facilitate links within the innovation system.

(Note: the difference between the three regions reporting no such events and the other two is that the first ones have bigger HEIs that are also more recognized internationally, while the other two smaller universities.)

8. How do universities contribute to linking the region/country to international sources of knowledge, especially through participation in formal and informal European and global R&I networks?

All respondents underline that participation in Horizon 2020 projects is a good way of creating networks and linking universities to external sources of knowledge.

Some individual respondents add that:

- by setting up joint RDI laboratories with big, multinational companies, universities are linked to RDI activities performed with the involvement of the same companies elsewhere,
- participation in Erasmus mobility projects is also a good way of creating extra-regional linkages, also reporting that there are individual cooperation for example between a regional university and a TTO from Germany,
- participation in ESFRI (European Research Infrastructures) and ERRIN (European Regions Research and Innovation) networks is also beneficial in this sense.

Four respondents underline that there is room for improvement. One mentions that HEIs would need support and assistance in joining, entering networks and partnerships comprised of organizations that are forerunners in RDI. This could start by financially supporting the involvement of HEIs (but also other stakeholders) in different phases of Horizon projects where implementing partners usually involve third parties (testing, validation). Another respondent mentions that matchmaking events between European universities would also be beneficial in supporting networking and cooperation.

The respondents from the regions with bigger university centres put accent on the fact that HEIs are currently followers and re-active when it comes to European projects, i.e. up taking opportunities, but not initiating projects and building consortia around their ideas. This would

be expected especially from highly ranked and internationally recognized universities.

Thus, they should be more focused on initiating own projects, based on the needs of the social and economic environment from the regional level. In this way project results would be beneficial for the region and could be multiplied, becoming more sustainable. Since currently these results are more connected to needs met elsewhere, they are not relevant on regional level.

HEIs should become bridges or gateways for channelling external knowledge to the region and disseminating it towards stakeholders. (RDA North West)

9. What are the key funding opportunities and incentives that universities would need to support the enhancement of regional competitiveness and contribute to the smart specialisation objectives through R&D and innovation?

Two respondents mention that HEIs seek European funding especially for infrastructural development (buildings and RDI equipment). All other interwievees report that HEIs are interested in any type of funding for RDI, including R&D activities, technology transfer service development.

One respondent adds that currently HEIs mention the need for funding to develop digital infrastructure and skills.

As a bottleneck all respondents mention the big co-financing rates that are applied to RDI projects, due to the application of state aid rules for industrial research and experimental development. These high co-financing (50%) rates prevented universities in the current period from developing their ideas and actually apply for funding. However, as two regions ad, in case of big universities this is not linked to the lack of money, but more a matter of setting priorities and commitment/engagement towards RDI.

Besides the type of projects HEIs mention, respondents add, that universities should be more preoccupied in absorbing funds for attracting experts from abroad for knowledge transfer in areas where they have knowledge and infrastructure in place or learning/sharing experience from/with more developed regions.

Two regions highlight the fact that absorption of EU Funds on behalf of universities will be pending the adaptation of HEIs to the new framework characterizing the 2021-2027 period. There will be no more funds for basic research and, for receiving grants, universities will need to develop R&I projects in partnership with companies. So they will need to develop new types of projects and should be ready to enter partnerships with companies.

One region mentions that the biggest problem of HEIs is the general underfunding for research activities. Financing sources are depending on calls for proposals launched. Thus national sources of financing should be assured on the long term for research activities and EU funding should come on top of that for innovation projects.

10. Taking into consideration the experiences from the current (2014-2020) programming period what do you expect for the next one (2021-2027)? How can the involvement of HEIs be improved in RIS3 revision and implementation for/during 2021-2027? How should HEIs prepare themselves to be more efficiently involved?

To support RIS3 implementation more effectively HEIs should:

- be more involved in cooperation with businesses as highlighted by all respondents, *i.e.* being open at institutional level to cooperate, being interested in creating partnership with businesses, being able to develop bankable projects (that are needed by the market and are

cost efficient) and attract also private sources of financing, analyze market needs, develop technology transfer services/establish TTOs and elaborate and present their offer based on market needs. For achieving this internal changes are necessary, vision and strategy in this sense need to be developed, internal procedures updated, mentalities changed and dedicated personnel hired. Researchers should be offered incentives for their involvement in R&I projects.

- be able to develop project ideas and partnerships with businesses and attract financing for their projects, otherwise they will not be able to absorb European Funding (as mentioned by two respondents),

- be more involved in RIS3 design and implementation (as mentioned by two respondents), elaborating studies and analysis, participating more actively in EDPs, offering input for strategy monitoring,

- change their educational offer according to market needs (mentioned by one respondent), change and update curricula, and besides higher education, should develop an additional education offer in cooperation with businesses, like trainings, post-university courses, etc.

University of Macerata (Italy)

0. How do you consider the progress/results of (national/regional) S3/RIS3? What are the most important challenges to improve performance and impact?

Respondents all agreed about the positive impact of S3 in their Regions. Nevertheless, one of them stated that even though the progress was positive it has also been slow, considering the first programming period as a starting point. Another respondent highlighted that at the beginning there was a higher involvement from the actors of the quadruple helix, but then, there was not the same continuity over time.

In terms of results, especially related to R&D collaboration between HEIs and businesses, it emerged that in some regions (e.g.: Marche) it has been successful, with an increased number of interventions of this kind. In other regional contexts, this collaboration is not that continuous. As an example, there are cases in which companies do not invest a lot in R&D: data show that the percentage of R&D investments is higher in the public sector. Nevertheless, it seems evident that companies working S3 have a higher added value than others. Moreover, sometimes the collaboration between HEIs and companies only relates to one-shot innovative projects, with a lack of continuity.

From an administrative perspective, one of the respondents highlighted that S3 did not represent a simplification, especially in terms of activities involving regional human resources involved in the activities and heavier workload.

Concerning the challenges, all respondents agreed on the fact that relationships among all the actors involved in RIS3, and especially between HEIs and businesses, should be improved. In this sense, one respondent highlighted the importance of systematizing these relationships to give continuity to projects and activities; another one focused on the integration and connection of S3 initiatives involving both HEIs and businesses, to other actions, such as European projects and further activities at regional level; another respondent stressed the

importance to give space and provide funding opportunities not only to structured companies but also to new start-ups and, therefore, work horizontally, by collaborating with HEIs.

1. How could HEIs ideally contribute to the development and implementation of RIS3, i.e.: What kind of services should HEIs provide? Which resources, competencies should HEIs mobilise and what should they do for a more efficient involvement suitable to each of the main steps of RIS3 design and implementation?

All respondents agree that for HEIs in order to contribute to the development and implementation of RIS3, research and R&D are pivotal. Some respondents made some examples of positive initiatives and measures taken at regional level that confirm the importance of this aspect. In the case of Apulia, the interviewee stressed the need for capitalising positive experiences. There, through the collaboration of different research organisations and by bringing together their competences, the result was the creation of a network that started working to a structural reinforcement at regional level, focused on responding to company's needs. Based on ERDF funds, in this direction, equipment was bought and services useful to the territorial system have been provided. Similarly, two respondents acknowledged that HEIs could play a role in raising the attitude to multidisciplinarity and contamination, to bring together complementary skills and professionalisms, to combine technology and business knowledge. Moreover, another respondent focused the attention on the importance of entrepreneurship teaching to stimulate HEIs' students, even from different study fields, to gain business skills and knowledge.

According to another respondent, an important aspect on which HEIs should do, in a RIS3 perspective, is investing on the cultural and social sectors in terms of research and projects as "nowadays people need to live a complete cultural experience and from a social point of view, also due to this specific period (ref. to COVID-19), it is important to intervene to help and support people with difficulties" (RIS3 Referent Abruzzo Region). Moreover, from a social perspective, HEIs should collaborate with companies in terms of R&D and innovation, to respond to the specific needs of elderly, which are a growing part of the society (e.g.: technologies for healthy living). The same respondent highlighted that HEIs should consider expanding their educational offer according to the emerging sectors in the Region (e.g. wine tourism and agri-food studies, concerning Abruzzo Region).

Similarly, in terms of services, one respondent stated that HEIs could provide summer schools or advanced and up-to-date alternative courses on topics related to innovation and S3, both at bachelor's and master's degree level. Another interviewee, regarding resources that could be mobilised by HEIs to contribute to RIS3, mentioned the importance of researchers trained as facilitators able to link universities/research organisations and companies: the first ones may offer competences, technological resources and innovation, the second ones could benefit of this contribution, having them a latent demand for these aspects and, sometimes, even the need to find out which their specific needs are.

2. What kind of other services offered by HEIs are/could be important for the stakeholders in the national/regional innovation ecosystem and for the ecosystem as a whole in line with the objectives of RIS3?

In answering this question, respondents were aligned. All of them considered HEIs pivotal in shaping a new vision, new scenarios, by combining innovation and knowledge and transferring them into concrete projects. To do so, it is necessary to break the barriers and

interact with businesses and to bring companies together, at local and international level. HEIs can act as innovation brokers, as in the case of the High Tech Farming platform (https://s3platform.jrc.ec.europa.eu/high-tech-farming), for precision agriculture, where professors commit themselves in promoting activities and running projects. During the interview, a respondent highlighted that HEIs can play a role also in terms of social innovation.

One of the interviewees stressed the importance of multidisciplinarity and entrepreneurship at student's level as a further aspect of the HEIs contribution. This is conceived as bringing together students from different study fields and making them work together. "An engineer would be, for sure, very skilled in finding an innovative solution for a product or a service, but, competencies related to the team working, to how to prepare a business plan, to marketing and budgeting would be needed and these come from the economic sphere. Contamination of knowledge can lead to new ideas." (RIS3 Referent Apulia Region)

3. In your opinion, which contribution can HEIs give in terms of knowledge and expertise within a Quadruple Helix type co-operation (between key actors of the national/regional innovation ecosystem), characteristic to RIS3?

According to respondents, collaboration among the quadruple helix actors, from HEIs' side, can be improved in several ways:

- HEIs should provide and share knowledge and information useful to the other actors of the quadruple helix, especially companies. More recently, a shift to an increasingly green economy and the spread of ICT arose new companies' needs: they need to learn how to translate innovation and technology into business.
  In this perspective, Tuscany Region joined the Nefertiti project (https://nefertiti-h2020.eu/about-project/), which is about the creation of living labs to share knowledge for innovation in agriculture among several stakeholders and to spread it at international level. Moreover, in Tuscany, the Region has implemented a community of practice on precision agriculture, to share knowledge among farmers.
- HEIs should listen to the territories and the companies, HEIs could collect their innovation needs. Specialistic competences and knowledge come from the HEIs, but the know-how and the field experience also belong to the companies: for this reason, listening is essential;
- HEIs departments' internal multidisciplinarity: different departments should better communicate on common topics and connect: e.g. economics, management and agriculture departments;
- HEIs should communicate with other stakeholders about what the University offers. More participatory activities could be organised to make stakeholders aware of what a university can offer compared to another. In Apulia, the Regional Agency for Technology and Innovation (ARTI) created an open catalogue about the university services for companies, in collaboration with Confindustria trade association, based on "Reti di Laboratori", a regional initiative (https://www.arti.puglia.it/reti-di-laboratori/). The university services were described in order to be aligned with the company's needs for innovation. This was done because the Region made a huge investment at the university level (millions of euros) on the knowledge infrastructure and to be transparent with the citizens and companies about the use of these funds;
- HEIs can connect a place to the rest of the world, through international research collaborations. They act as hot-spots: by listening to their territory to gain insights on

specific local needs, through their international networks they collect the best experiences and potential solutions and they spread them in the territory, following the "think global, act local" philosophy.

Other two aspects emerged from the answers to this question: existing interpersonal relationships (researcher-entrepreneur) are important for successful collaborative projects.

Moreover, HEIs could provide knowledge and expertise by also training human capital to innovation in specific sectors, also related to culture and societal aspects and in emerging niches important to the Region, in order to respond to real needs for competencies and professionalism. Regional authorities assure political continuity and invest in innovation to absorb the trained human capital in the Region.

4. What do you think HEIs should focus on to become an attractive partner for RIS3 stakeholders in the RIS3 related planning and implementation activities or in facilitating Quadruple Helix cooperation/interaction in general?

Two main aspects arise from the answers to this question:

HEIs should learn how to build strong bonds with territories. To do so they could start from disseminating their knowledge, the results of their studies and talk to the stakeholders about them. They have to understand how to communicate innovation to local stakeholders. One respondent suggested that the use of social media can be an excellent tool for this aim.

Companies need to understand that success results from collaborating with a plurality of stakeholders and that there is a gain in investing in R&D. “I believe that communication can play an important role to change the mentality, especially in this period of industrial transition, green processes, digitalization of production processes.” (RIS3 Referent Marche Region)

Another element emerged: more investments should be made on industrial PhDs (https://s3platform.jrc.ec.europa.eu/hess). Regions, in S3, choose specialisation areas and also emerging niche sectors on which to invest in a future perspective, identify emerging competencies in certain fields and decide to address specific funds and measures in those directions. An industrial PhD would be coherent with this approach as it can be made in the context of specific specialisation areas of the territory could also be positively exploited to foresight future successful niches.

5. How do HEIs respond to human capital needs of the region/country in smart specialisation areas? What are the most burning human capital/competency needs of the region/country in smart specialisation fields? What kind of cooperation arrangements can lead to responsive HE training supply/services?

Interviewees contributed to this answer in different ways.

Concerning how HEIs respond to human capital needs of the region in S3, one respondent suggested that there is the need for a specific training in S3 and capacity building. Another respondent stated that a critical point is the lack of capacity of absorption in the Region of graduates and PhDs, with a high risk of brain drain. On the other hand, HEIs should also give students tools for inventing a future for themselves beyond Academia as “they should start

thinking about giving their contribution also in other contexts, be self-entrepreneurs or offer their competencies to companies or within a public institution" (RIS3 Referent Apulia Region).

One interviewee highlighted that innovative PhDs and Eureka (Industrial PhDs) represent a response to the need for human capital at regional level: they are a tool to generate knowledge for companies and ways to absorb human capital in the Region. S3 has certainly fostered an increase in staff and researcher's employment. The industrial PhDs are useful to improve and complete the model of the quadruple helix, in other words, they may represent collaborative arrangements for contributing to RIS3, especially if the students' research topics are in line with the regional smart specialisation areas.

Concerning the most burning human capital needs, one respondent highlighted the need for people able to translate technology in a language accessible to all, experts in tourism, agriculture, computer science and engineering, etc. Moreover, another respondent stated the importance to train students in order to respond to societal problems and to identify emerging regional niches and to work on it through technology innovation.

6. How do HEIs respond to the RDI needs of the region/country in smart specialisation areas?

According to the interviewees, the HEIs are not very careful to the needs of the territory, as not all university departments are willing to dialogue. This problem, according to one of the interviewees, depends not only on HEIs but also on the attitude of local stakeholders. However, there are more academic universities and smarter ones that are more in touch with companies and their problems and needs.

In terms of projects, their intervention and collaboration in some cases occur only for one-shot innovative projects without a system of continuous planning. In other cases, they get involved in projects only if there is the availability of funds to cover the costs. In the case of the Apulia region, instead, HEIs and region have tried to collaborate to develop projects in line with the areas of specialization S3. Therefore, collaborative research took place, so universities had to work on specific areas of specialization to fund research projects. It is, therefore, necessary to "bring together the synergies within the Region" (RIS3 Referent Tuscany Region) but also within "HEIs departments in order to put together their skills and create complementarity" (RIS3 Referent Marche Region).

In terms of expertise, according to one of the interviewees, the region would need more skills in managerial and business management and HEIs do not respond adequately to this need. They should implement training in this field of study and bring on the territory this type of skills and knowledge.

7. Do you think that, at national/regional level, are there any existing networking opportunities between HEIs and other RIS3 stakeholders in order to capitalize on/exploit and bring together their actions and projects?

Respondents all agreed that there are many networking opportunities between HEIs and other RIS3 stakeholders in order to capitalize and bring together actions and projects and each of them talked about different networks.

According to one of the interviewees, "HEIs can get close to the production system through spin-offs and start-ups". In the case of start-ups, they can represent a network as they generally deal with young people or young students who belong to the academic world.

Researchers are also useful to transfer knowledge and to communicate to companies the importance of collaboration as they apply research within the industrial system thus bringing together practical and theoretical skills. In other cases, (eg.: Abruzzo Region), on the other hand, some big companies have research departments but that, being far away from universities (especially in terms of physical space) are unable to communicate with them and create synergies in order to exploit and bring together projects.

In general, there are many interventions and measures at international, national and regional level, but they need to be systematized trying to monitor all steps starting from planning, implementation and measurement.

Thus, although networking opportunities exist, HEIs have "to be more present on the territory, which is the most complicated thing and take into account the needs of all" (RIS3 Referent Sardinia Region).

8. How do universities contribute to linking the region/country to international sources of knowledge, especially through participation in formal and informal European and global R&I networks?

According to all the interviewees, HEIs have an excellent level of internationalization and their role is precisely to connect the territory at an international level, creating "bridges between local contexts and the rest of the world" and "bringing entrepreneurs to an international level" as to implement the strategy and collect successful results.

The most common way used by HEIs to link the region to international sources of knowledge is through European projects. In some cases, the Region asks HEIs to "share information about their linkages and projects at international and European level" (RIS3 Referent Tuscany Region), but often this happens through unofficial channels because sometimes there is no direct collaboration. However, even the opposite happens: the region takes care to engage the HEIs involving them in their international networks.

However, the interviewees also highlighted problems and aspects to implement:

- HEIs have to involve more local stakeholders from the same region in international projects (eg.: Horizon 2020) in order to "collect information and experiences from their local contexts and spread them at international level" (RIS3 Referent Apulia Region).
- The participation of HEIs in international projects should not be too academic, as it is necessary to have a bottom-up approach that allows the involvement of companies and local authorities as well.
- It is necessary to create an environment and relationships of trust that allows breaking the barriers (eg.: the language) that often emerge between stakeholders. In this, it can be helpful the figure of a facilitator (probably HEIs), able to go beyond the contrast that exists between stakeholders.

In general, this aspect could be implemented.

9. What are the key funding opportunities and incentives that universities would need to support the enhancement of regional competitiveness and contribute to the smart specialisation objectives through R&D and innovation?

According to all respondents, there are many funding opportunities at regional level, especially for innovation, regional development and the agricultural sector.

However, the problems identified in the use of these resources are several:

- it is important to "combine different funding sources to bring together a variety of needs with common points" (eg.: combine the technological aspects with that one of agriculture) (RIS3 Referent Tuscany Region);
- generally for an HEI is challenging to obtain fundings because of internal university regulations that are sometimes strict and full of bureaucracy;
- sometimes there is a lack of commitment because of complexity. It could be useful for HEIs to run research projects with other departments;
- project design, to be successful, should focus on the areas identified by the Smart Specialization Strategy;
- "the problem is also the absorption capacity of universities and entrepreneurs. The time and human resources are always the same and people must be able to manage the projects they carry out" (RIS3 Referent Sardinia Region);
- to get fundings, HEIs should help those who are not able to design international/European projects.

Another source of funding highlighted was identified in the post-doc scholarships related to S3. This aspect should be systematized. Generally, these are temporary solutions that finance a researcher for a few years. This implies, at the end of these years, the possible loss of human resources. There is a "need for researchers within the companies, in the public institutions and of course, through a selection, also in the university context but all this needs to become structural in order to don't lose the impact it could have on the territory" (RIS3 Referent Apulia Region).

10. Taking into consideration the experiences from the current (2014-2020) programming period what do you expect for the next one (2021-2027)? How can the involvement of HEIs be improved in RIS3 revision and implementation for/during 2021-2027? How should HEIs prepare themselves to be more efficiently involved?

All the interviewees have provided various work ideas for the next programming period 2021-2027. three main aspects have been highlighted:

- <u>Relationships between actors of the quadruple helix</u>:
  - HEIs should be more involved and should play an active role in the territory they are located. All barriers must be broken down. The commitment must take place both with:
- the regional authorities in order to "think about visionary but concrete solutions and build a dialogue both formal and informal" (RIS3 Referent Sardinia Region).
- the productive district. Not all companies can afford to spend on R&D, so the collaboration with HEIs could be essential to maintain more and more high levels of production. In this, stakeholders must listen to HEIs and get help from them.
  - Regions should be available to assist the process of partnership creation between all the components of the quadruple helix.
- <u>Topics</u>:

- Based on the new pillars: green, digital and health, the new actions should focus on innovation and technology: these two aspects require a lot of financial resources, thus, it is important to have updated knowledge and skills.
- Internationalization: HEIs could help entrepreneurs to engage with European partnerships.

- How to work:
- At national level, the Ministry should "periodically involve each region to discuss the progress in RIS3 and to bring them together to plan, implement and monitor the strategy" (RIS3 Referent Tuscany Region).
- In terms of tools, the bottom-up approach is the best one to understand what is happening on the territory.
    - "The simplification of the procedural phases and the systematization and standardization of interventions should be improved" (RIS3 Referent Marche Region).

RE-ACT

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