

iWATERMAP

1st Draft Integrated Roadmap Report

In this report you find the first integrated roadmap of the regions participating in the iWATERMAP project. These are: Crete (GR), Murcia (ES), North (PT), ADR Nord-Est (RO), Latvia (LV), Southern Moravia (CZ) and Friesland (NL). The Roadmap of each region is a first analysis of the Critical Mass Development in the field of water technology in each region. The iWATERMAP project will look in more detail into (1) critical mass development; (2) human capital and (3) interregional collaboration. This draft report will offer an overview of these three dimensions within one report. The project will produce 3 different reports at the end of year 3 of the first phase of the project (end of May 2021).

In parallel action plans will be developed, which take into account the strengths and weaknesses of the participating regions, regional programmes and ambitions and new opportunities offered by European programmes (ERDF, COSME, Horizon Europe, Erasmus, Interreg, etc.) in the next MFF (2020-2027).

Southern Europe/ Mediterranean:

- 1) Region of Crete
- 2) Region of Murcia
- 3) Norte

<i>Region of Crete - Greece</i>	
Policy instrument	Crete Regional Operational Program 2014-2020: PRIORITY AXIS 2: Sustainable development by improving the environment and addressing the impact of climate change. TO1 (thematic priority) – Boosting Research, Technological Development and Innovation
Definition	TO1 is in line with smart specialization strategy RIS3 Crete, as is chosen to nourish the strengths of the local economy such as the existence of a strong international educational and research network with a great potential to develop and diffuse innovations and meet the needs and weaknesses such as the low level of investment by SMEs in technology and the small contribution of research centers to the local economy
<i>Region of Murcia - Spain</i>	
Policy instrument	Regional Operational Programme 2014-2020 for the Murcia Region. Measures 01-1b
Definition	Measure 1b focuses on the development of links and synergies between enterprises, research and development centres and the higher education sector. It promotes among others eco-innovation and public private partnerships.

Northern Region - Portugal	
Policy instrument	Norte 2020 (2014-2020 North Portugal Regional Operational Programme)
Definition	NORTE 2020 priority axis 1 intends for Research, Development and Technological Innovation (R&D&TI), and specifically the Priority Investment 1.2 that aims at increasing investment in R&D&TI by companies, strengthening the link between businesses and the regional science and technology system, and promoting an increase in knowledge-intensive economic activities, as well as the creation of value based on innovation. The ROP supports several aspects related to innovation delivery and puts emphasis on internationalisation (specific objectives 1.2.3 and 1.2.4).

1. Introduction

1.1 Current situation

Water resource management is a priority for the regions as it is directly linked with the main economic activities, such as agricultural production and agri-food industry, as well as tourism. Climate change threatens the traditional model of regional development and it is especially important to look at water and water innovation in order to face the incoming problems. For example, Mediterranean regions needs to learn how to deal with long drought seasons, as well as severe floods.

Crete

Water sufficiency is a major issue in the region of Crete due to a variety of reasons such as the diversification into annual precipitation levels which have been affected by climate change, the overexploitation of underground water reservoirs to fulfil the need of irrigation water and touristic sector, as well as the high levels of water losses in the aged water pump network etc.

Business initiatives for the development, introduction and exploitation of innovative water loss reduction technologies, optimal water services management, systems for tracking and recording networks and infrastructures for rational use and reuse, are expected to facilitate adaptation to climate change and reduce the risk of serious economic damage locally. For this reason, it is very important to promote innovation in these areas and the first and most important step in this direction is the strengthening of the innovation ecosystem.

It is acknowledged that the development of a specific water innovation ecosystem is limited in the Region of Crete. The regional innovation is mostly related to programs supported by academic and research institutes of Crete but there is limited focus on the water cycle. In general, in Greece there is quite limited correlation with the market needs and the training offered in academia. Businesses often complain that the language spoken is not the same. At the same time, communication between academic institutions and government, is more fluent. The region of Crete cooperates on

various levels with academic institutions and promotes related synergies. Businesses are mistrustful towards public bodies as they believe bureaucracy and fragmentation of responsibilities will cost them time and disorient them. The communication/knowledge exchange in each branch of triple helix is the following (0 – no communication, 5 – excellent communication):

Crete – GR	Administration	Academia	Business
Administration	-	4	2
Academia	4	-	3
Business	2	3	-

The existence of high-level academic and research potential ensures thorough and documented information to the Regional Administration for designing and implementing targeted regional policies¹. The Regional Research and Innovation Council (RRIC) is setting up the Strategic Innovation Agenda, describing the priority areas, the RRIC initiatives supporting research, technological development, innovation, education and cooperation between private and public sector actors. The administrative procedures required to implement policies and actions remain complex and time-consuming resulting in slowing down the establishment and operation of enterprises¹. The rate impact of policies is the following:

Region	Administration	Academia	Business
Crete	4	4	3

Through RIS3Crete Smart Specialization Strategy and the Regional Operational Program 2014-2020, Business Partnerships are being promoted among Research and Knowledge Institutions, which is consistent with the triple helix innovation model. The RIS3Crete consultation is intended to highlight specific weaknesses and opportunities and forms a guide into a more targeted regional strategy. Public opinion seems to add pressure as the expected risks due to climate change worry a large part of society.

Murcia

The Region of Murcia is suffering an important scarcity of water which is conditioning most of their industrial activities. The region aims to reduce the consumption of water by 10 % without reducing the irrigation surface, because the agricultural activity is developed in rural areas with very few industrial possibilities. It is therefore particularly important to foster innovation and the innovation chain (cooperation between administration, enterprises and research) in the water sector, helping the local companies to stay competitive and to be able to cope with the scarce resources.

All actors, research centers, enterprises and public administration, involved in the development of the water sector are known and collaborate in accordance with their lines of work to achieve a sustainable economy in the Region of Murcia, but communication/knowledge exchange is mainly to achieve success in calls for projects proposed by the regional administration and other national and

¹ SWOT analysis under the “Governance, Sustainability and Regional Innovation” project

international calls. The communication/knowledge exchange in each branch of triple helix is the following (0 – no communication, 5 – excellent communication):

Murcia – ES	Administration	Academia	Business
Administration	-	3	3
Academia	3	-	3
Business	3	3	-

An important proportion of water consumption is dedicated to the production of food. In order to meet this demand, new ways of obtaining water are currently being researched, improving water efficiency, but also good practices that are based on training are essential, and policies often support them. Currently, policies in this community boost private investment to achieve quality solutions. The Region of Murcia has a high number of SMEs and it is very difficult for them to access financing to achieve new technological development. However, the economic activity inherent in the private sector is what guarantees the maintenance of the Welfare State and the sustainability of public services. For this reason, the budget of the Autonomous Community of the Region of Murcia is aimed at expanding the items for the promotion of economic activity and job creation. The maintenance of the Welfare State must be compatible with the allocation of greater resources for investments that stimulate the private sector and promote the development of the regional economy. Spain has a participatory management of water because the hydraulic confederations (public administration) discuss how to use water and the government of the Region of Murcia considers the efficient use of its water resources as a priority. However, there are insufficient rates to recover the costs incurred in the water services and undertake new investments.

The rate impact of policies is the following:

Region	Administration	Academia	Business
Murcia - ES	5	4	3

Nowadays, the Region of Murcia is highly successful in the optimal management of its water resources. Among others, the strategic project Ris3mur Reusagua, funded by the Ministry of Employment, Universities, Business and Environment of the Region of Murcia, within the framework of the Regional Operational Programme 2014-2020, faces the challenge of producing and using regenerated and safe water in controlled crops, as well as managing the available water resources according to their quality, availability and needs. This project is in line with the triple helix innovation model to promote the economic development of the Region of Murcia.

Northern – PT Region

Northern region of Portugal has a heterogeneous distribution of water. The west part has plenty of water, with the highest levels of precipitation of the country, while the east side faces water scarcity. The region has already acquired a significant critical mass in Water and Water Technology area, both in research as well as start-ups/spin-offs. Northern – PT region has the third highest figure of STEMA – Science, Technology, Engineering, Mathematics and Agriculture fields – PhDs per 1,000 inhabitants (0.67 in 2014; national average was 0.82) and ranks second regarding R&D researchers in active population (0.64% in 2013, below the national average: 0.72%). Nevertheless, water and water technologies do not seem to play an important direct role in RIS3 strategy at this moment. The

region has a wide range of regional higher education and already has experience in setting up strategic partnerships with international organisations (e.g.: MIT Portugal Program).

Research centres, enterprises and public administration involved in the development of the Northern-PT water sector collaborate in accordance with their lines of work to achieve a sustainable economy in the region. However, communication/knowledge exchange is mainly to achieve success in calls for projects proposed by the regional administration and other national and international calls. The communication/knowledge exchange in each branch of triple helix is the following (0 – no communication, 5 – excellent communication):

Northern Region – PT	Administration	Academia	Business
Administration	-	3	3
Academia	3	-	4
Business	3	4	-

The impact of policies on each branch of triple helix is high in Northern-PT region. Regional administration is governed by national and European policies (e.g. National RIS3 strategy), and both academia and business entities are dependent of regional policy guidelines to get funds for project development/implementation. The impact rate of policies is the following:

Region	Administration	Academia	Business
Northern Region – PT	5	5	4

1.2. Problems

Generally, in all regions, the communication levels between triple helix actors are low. The fragmentation of responsibilities in the water sector is appointed as a key component of both poor communication within the triple helix actors and the lack of coordination of the competent bodies.

In the Region of Crete the industry sector, that can support innovation in water technology, is not developed. The majority of the business sector consists of small and medium-sized enterprises that do not develop synergies with the research area and neither invest nor have an interest in innovation. There is also a shortage of staff training that could connect academic and business space as there are no organized actions in this direction. Although there is enough information in public bodies about water, it is scattered and there is no easy access to it.

Many regional institutions have competencies in water and funding seems not to be focused to guarantee the placing on the market of technological solutions and their implementation in the agri-food system of the Region of Murcia, which is of high importance. A single agency should coordinate all these competences so that financing reaches the companies and regional development is more efficiently stimulated.

In the Northern – PT Region water and water technologies do not seem to play an important direct role in RIS3 strategy at this moment. Water was seen as a natural resource that is important to protect, but not a RIS3 topic itself.

1.3 Definition and objective of roadmaps

The present roadmaps will provide guidelines for the development of a mature water and water technology innovation ecosystem in each region.

Roadmaps are expected to form a solid basis for a thorough analysis of the key issues that hamper the development and implementation of innovation in the water field as well as the regional potential that remain untapped. Mapping these areas is a prerequisite for prioritizing goals and developing a realistic plan that will be enriched with feedback from stakeholders. In the Region of Crete, from the first contacts with the stakeholders, it has emerged a need to organize information on a single platform, to focus on technical staff training and new talent development, to encourage business start-ups, and bring the research focus in accordance with business needs.

The roadmaps will also assist in the creation of a technology progress plan in the Region of Murcia, by facilitating the access to funding. For example, water reuse and wastewater treatment plants as well as the modernization of irrigation systems should be tackled. This could for example be carried out through targeted calls or improved support for such initiatives or also revised selection criteria and specific priority areas, that address particularly water management issues.

In the Northern-PT region, the roadmaps aim the reduction of the gap between the knowledge production system and the economy by fostering a technological market that contributes to multiplying interactions, financial flows between companies and universities, knowledge transfer, and supporting business innovation by acquiring skills and optimizing the efficiency of R+D+I business departments.

2. Roadmaps

2.1 Critical Mass Development Model

2.1.1 Goal Definition

This roadmap aims to improve the sustainable economic growth of water and water technology sector in each region.

Five years from now, in the Region of Crete, it is expected that contacts among all branches of the triple-helix through stakeholders meeting and communication channels would have highlighted regional needs and deficiencies in water technology. This information would have influenced both the regional strategic plan and the research activity in the water sector. In conjunction with the above, the Regional Labour Market Monitoring Mechanism will be mobilized to the emerged requirements on specific qualifications. Training and reskilling seminars will be developed in this direction and academic institutions could play a major role. The business sector will be able to easily obtain the necessary information about needs and be prepared accordingly. At the same time, information and awareness programs for both the general public and students at all levels, through the resulting social pressure, will indirectly affect regional policy.

Region of Murcia aims to improve the economic growth of water and water technology sector through innovation and knowledge of R+D+i. The current research groups and training and technological centres will increase their capacity by participating in a greater number of research and demonstration projects. The companies of the Region will benefit from the advances and will be able to reach an economic advantage by the efficient use of the water resources.

Northern-PT aims to increase the capacity of research, training and technological centres to participate in a greater number of regional and international research and demonstration projects. Five years from now, it is expected that contacts among all branches of the triple-helix through stakeholders meeting and communication channels would have highlighted regional needs and deficiencies in water and water technology. This information would have influenced both the regional strategic plan and the research activity in the water sector, especially by the incorporation of circular economy practices in water and agri-food sector.

2.1.2 Approach

• Which sector will be targeted/focused on?

This roadmap is mainly focused in the articulation between the regional agricultural and agri-food industry, as well as tourism sectors with the scientific, technological and business competences to develop related products, with special focus in a correct and sustainable management of WATER (e.g. by looking for persistent and emerging pollutants, reducing water losses, business intelligence, big data acquisition and management, sensors, resource recovery, sludge valorisation, water reuse, energy efficiency and production).

As one common route for both human capital and critical mass development is through education, building a talent pipeline from school to university research is another goal to focus at the same time.

• **How each region will improve the development of Critical Mass of the innovation ecosystem within their region?**

Region of Crete will try to improve the critical mass development through stakeholder meetings and in person conversations with key players in the water sector. Additionally, Crete will invest in the establishment of fine-tuned channels of communication between the stakeholders involved in the water sector in the Region of Crete.

Region of Murcia will improve the development of its critical mass by reducing risks in the collaboration of all the involved stakeholders, favouring the knowledge of its success cases and their technological, financial and innovation needs through a proper communication channel. Stakeholders opinions should produce changes in political decisions and become involved in a political debate for the development of the Region.

Northern – PT region will improve the development of its critical mass by promoting an efficient allocation of water and water technology innovation resources to the regional water and agri-food challenges, by rebalancing the research agenda as well the priority areas of the regional RIS3. Promote new collaborative programs to support the integration of Highly Qualified Human Resources in private companies (e.g. CoLABs - new partnerships between private companies and research units). More investments in vocational education and training schools, and continue to support the doctoral programs in the universities. Finally, it is expected that more funds will be allocated to research projects in niche areas related with water and agro-industry (resource recovery, water reuse, emerging pollutants).

• **Description of steps to improve innovation policies for enhancing the critical mass development of innovation ecosystems in the water technology sector.**

The steps to improve innovation policies in water technology are:

1. Funding lines that support innovative activities closer to the market and interactive collaboration;
2. Public authorities could provide open and easy access to water related data for innovators;
3. Investigation of the regional capability for innovation based incubators;
4. Funding lines aimed at training, research and technological centres based on indicators that guarantee quality results;
5. Generation of technical reports aimed at public administrations including environmental and socio-economic impact assessment;
6. Dissemination reports for final consumers and general public in order to modify their consumption habits and inform them about the water problem in Region of Murcia. This social impact should generate new needs and legislations;
7. Promoting thematic workshops aiming to achieve the rationalization of regional RIS3, research activities and private company's needs in the Northern – PT region.
8. Create an effective communication channel between the triple helix actors;

9. Increase and improve public consultation procedures during the preparation of regional RIS3 and innovation policies in water technology.

• **Description of steps to establish an integrated network in each participating region where research and innovation efforts are commonly shared between knowledge institutions, local stakeholders and policy makers.**

The main steps to achieve an integrated network in each region are:

1. The Chamber of Commerce and Industry in the Region of Crete, as a link between business and the public sector, could enhance the dissemination of information through the networks and channels in which is involved (e.g. Enterprise Europe Network);
2. The involvement of the Center for Training and Lifelong Learning of the University of Crete, which focuses, among other things, on the production of innovation;
3. By organizing workshops and thematic meetings aimed at businesses and public organizations, where innovative ideas and research projects with specific focus will be presented (i.e. water quality, loss estimation, smart systems, etc.) as well as exchanging good practices among the participated partners;
4. Through the creation of a Single Regional Agency in the Region of Murcia that coordinates efforts to promote the participation of stakeholders in working groups (both directors and technicians must participate in the decision-making process);
5. Guarantee the participation of different groups of training, research and technology in the funding calls. Calls should have a multiactor/multiapproach focus. Example of beneficiaries: University, company and training centre, Technological centre, company and policy maker, etc;
6. Provide platforms for information exchange among stakeholders (specialized forums). In this way, a Water Agency for the Region of Murcia could be created, which would be facilitated by the Regional Ministry of Water, Agriculture, Livestock and Fisheries and that would include researchers, companies and training personnel;
7. Promotion of stakeholders' participation in working groups (policy makers, researchers and business innovators must participate in the decision-making process).

• **Description of how funding synergies will be increased and what OP ERDF can contribute to this development?**

The region of Crete increased its participation to the program HORIZON2020 from 184 participants in 2017 to 284 in 2019 and a total net EU contribution of 99,2M€. These data constitute a reliable indicator of the strong externalization of the national research and technology system, as well as a potential indicator of scientific excellence and innovation. Indicative calls foreseen starting on May 2019 are on «Self-employment of Tertiary Education Graduates», «Strengthening entrepreneurship and start-ups», «Upgrading of established SMEs to new markets and supporting tourism SMEs». However, no new RIS related calls are foreseen for this period. Funding synergies will increase through specific calls that promote the synergistic and interactive character of collaboration.

In the Region of Murcia, the training, research and technological centres and organisms have a demonstrated good experience in Horizon 2020 programme, so it is expected to have a good participation in the next Horizon Europe that will finance R&D and will serve as the basis to achieve their basic knowledge. LIFE Program that finances the demonstration of these technologies and

guarantees the dissemination of results is also well known in the Region of Murcia as well as other programs that allow the entry of knowledge from other regions/countries or enhance the business R+D+i activities to achieve proximity to the market. All these programs can achieve the entry of funds for different actions in the same project or favour the continuity of projects, guaranteeing the development of the critical mass capable of producing business plans, managing intellectual property rights and attracting investors.

On the other hand, the ERDF operational program for Sustainable Development seeks to cover the need to achieve water quality and indicates that investments must be made in environmental infrastructures that guarantee compliance with Directive 91/271 / EEC and must be a fundamental objective of the policy to promote the reuse of purified water to increase the availability of water resources. Therefore, the ERDF operational program may provide funding to achieve the implementation of innovation technologies in the treatment of wastewater and its future reuse. In summary, many programs guarantee R+D+i and ERDF funds guarantee the implementation of innovations and new technologies in the region.

Research centres and companies from Northern-PT region have demonstrated good rate of utilization of Horizon 2020 programme, as well as national and regional calls. Therefore, a good participation in the next Horizon Europe programme is expected. At this moment, there are open calls under the scope of OP ERDF to support the hiring of highly qualified human resources (ref: NORTE-59-2018-41 and NORTE-59-2018-42) by companies, especially by SMEs INTERFACE programme. In the future, it is expected that the current investment is maintained, but in addition new calls are expected which specifically address the water technology cycle in the agri-food industry, and related topics. This would lead to more cross-sectoral and multidisciplinary collaboration and highly needed research and innovation.

2.2 Human Resources

2.2.1 Goal Definition

This roadmap aims to improve the stable and sustainable economic growth of the sector of water technologies through the qualification of human capital and by promoting the brain/talent retain. This roadmap intends also to strengthen the interaction between academia, administration and companies, by supporting their technological capacity building, increasing their capacity to absorb and create knowledge, and fostering an increasing innovation culture.

All student levels should have specific courses in Water Management and Development of Sustainable Technologies to maximize the efficiency of water resources. Special emphasis shall be placed on vocational education and training, for both Region of Crete and the Northern – PT region, where in this field there is no activity related to water.

Region of Crete has also a special interest to promote lifelong learning in the water field as it is recognised as a key component in the human capital development that is missing at the moment.

Two very important mechanisms for the Region of Crete that we will try to activate in this direction are both the Regional Labor Market Monitoring Mechanism and the Center for Training and Lifelong Learning of the University of Crete.

[The Regional Labor Market Observation Mechanism of Crete is an innovative large-scale research project. Its object is to monitor the trends and to diagnose the needs of the local labor market at the level of the Region of Crete. It is a project funded by the Region of Crete from the OP CRETE 2014-2020, started in March 2016 and will be completed in March 2022.

The diagnostic and monitoring requirements will involve two levels:

- Human resources
- Enterprises/ businesses

It is implemented by the University of Crete and specifically by the University of Crete Research and Market Research Unit.

The Center for Training and Lifelong Learning (KEDI.VI.M.) of the University of Crete was established on the basis of a very recent Law (4485/2017) aiming at the organization and implementation of lifelong learning actions at the University of Crete. This Center aspires to stimulate the workplace by cultivating new skills and Producing innovation at national, regional and local level.]

2.2.2 Approach

• Description of steps to develop the human capital roadmap.

In both Region of Crete and Northern – PT region steps will include:

1. In-depth mapping of existing training actions at the local level as well as the needs of trained staff in both public and private sectors.
2. Support the creation of a platform to collect all relevant educational activities from primary and secondary education in the area of water and water technology.

3. Promote the creation of technical vocational courses, in the field of water and water technology.

Additionally, the Region of Crete will focus on:

- Development of related educational material in schools of Crete.
- Involvement of the Regional Labor Market Monitoring Mechanism to identify training needs.

and the Northern – PT region will focus on:

- Support the integration of highly qualified human resources into companies (e.g by Collaborative Lab)

In the Region of Murcia efforts shall focus on the analysis and understanding of current needs to achieve a specific qualification and retention of talent to be applied in the business sector of water. Actions must be done to guarantee the labour market for the human capital. The proposed steps are:

1. Description of the job profiles demanded in the companies. Working groups with companies will be encouraged.
2. Evaluation of technological advances and areas of knowledge, from technological surveillance to equipment manufacturing.
3. Preparation of training programs, in collaboration with training centres, universities, etc., with visits and internships in companies, in such a way that technical vocations are encouraged among the youngest.
4. Encourage the participation of researchers in training projects.

• **Description of steps to improve integration of entrepreneurship into the education profiles?**

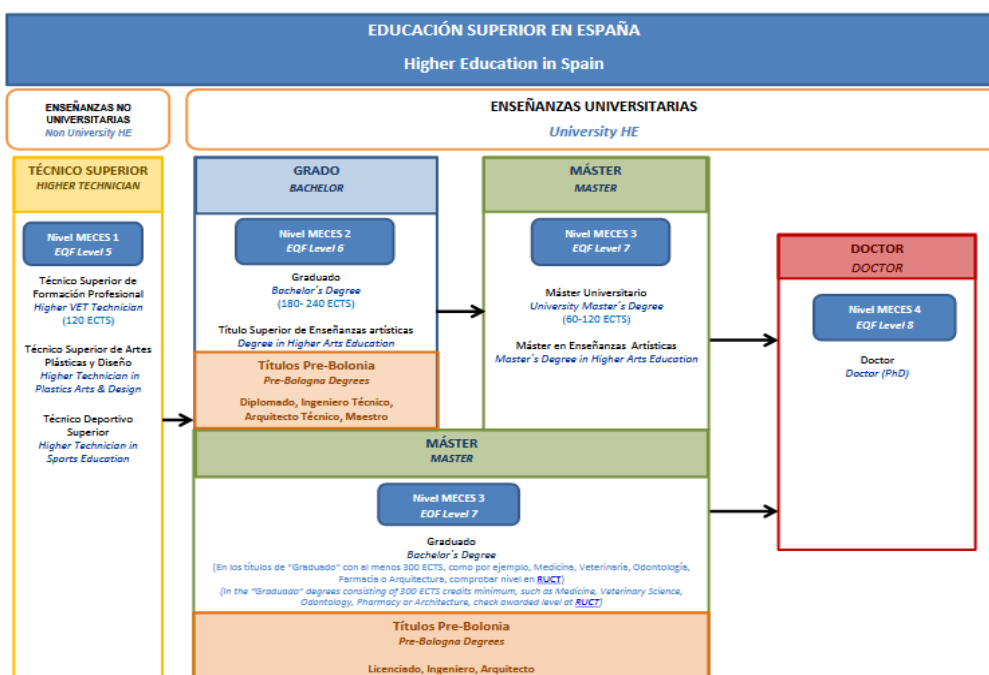
1. In compulsory education it is necessary to investigate the training opportunities in this direction with the regional education project coordinators. One option could be the configuration of specific programs aimed at educators to promote soft skills among their students.
2. Exploration of good practices from other European countries for integrating entrepreneurship across education levels.
3. Involvement of the Regional Labor Market Monitoring Mechanism for the Region of Crete in diagnosing the related needs and raising awareness among the policy makers.

4. Including teachers with technical and business experience in the training programs.
5. Update of the current teaching staff through continuous training in collaboration with research and technological centres.
6. Promoting the increase of collaboration agreements between companies and training centres, which bring professional experience to students through pre-professional practices.
7. Bringing the best available techniques to students at the intermediate and higher levels, to raise awareness of the need to modernize the water sector.
8. Science and technological interfaces (such as TecMinho, KE.DI.VI.M, e.t.c.) can act as intermediate platforms to provide technical specialized short courses designed for specific industrial needs in the water technology sector.

• **How far are the various EQF (European Qualifications Framework) levels represented in the education profiles of the region, connected with the innovation ecosystem?**

In Greece, connected with the innovation ecosystem are only the EQF 5-8 levels.

In Spain, the Spanish Qualification Framework for Higher Education (MECES) is being implemented, from level 5 to level 8, which may be connected with innovation in University level and Non-University Higher Education (EQF takes into account all levels of qualification of general education, vocational training, academic education and other types of training, but does not associate degrees.).



In the northern region EQF 6-8 levels are directly connected with the innovation ecosystem (the majority of research centres are inside the Universities). Regarding the other levels, there are several

activities (e.g. Science and Technology Week, Summer in the Campus, Career Week: Engineer, ExpoBiotec) with the objective of promoting scientific culture among the young people.

• Are there other instruments or support programmes in your region? If yes: Can these programmes be more interesting for applicants? What is the awareness about them in different branches of triple helix? What should be done to increase the awareness and encourage potential partners for application? If not: what steps should be taken to introduce such programmes in your region?

The Erasmus + program of the European Union, which favours the training of technicians through the exchange of knowledge with other regions.

For the Region of Crete, where field for intervention regarding awareness in different branches of triple helix is fairly large, there are some new instruments like:

- The Center for Training and Lifelong Learning (KEDI.VI.M.) of the University of Crete aspires to stimulate the workplace by cultivating new skills and Producing innovation at national, regional and local level.
- The H2B HUB at the Chamber of Commerce and Industry aims to be a platform for interconnecting local society with innovation and entrepreneurship, effectively helping to create an innovative business culture in Crete. Its actions include -but are not limited to- the training and education of executives, new and existing businesses, the introduction of business culture in education and supporting the transition of local businesses to the digital economy.

The Employment and Training Unit of the Region of Murcia (Sefcarm), through the Spanish Ministry of Employment and Social Security, encourages the development of training courses. These services or programs are offered to the population in general and to students of professional training and university and receive support from the public administration for the accreditation of training demanded by the market. Some of the teachers are technicians of companies and personnel of research centres and technological centres. In addition, associated professors in the public universities of Murcia develop their professional activity in external companies.

For the Northern Region the existing activities are very general and have a broad audience. Thus, if it was possible to design new activities more focused on water and water technology, this will increase the visibility of activities close to the populations, especially considering the increase of the awareness regarding the climate changes and the importance of water quality and quantity. Academia is very active in the promotion of activities linking research and young students with the goal of influencing the choice of graduation by high school students. The perception from the academia side is that administration needs to develop more technical and less bureaucratic activities.

• Which elements are concretely missing? Can these be addressed through OP ERDF?

More funding is necessary to expand strategic public-private cooperation through dedicated projects, as well as to create educational infrastructures in water issues (levels of Primary and

Secondary Education, University Education and Vocational Training), in order to expand and improve the training offer and develop the labour potential highlighting the construction of practice laboratories in the training facilities. In addition, a higher funding would allow the hiring of personnel from the agriculture, industrial and business sector to bring innovation to basic and specialized training and continuous education of current teachers.

These improvements can be achieved through the OP ERDF of Murcia and Crete 2014-2020, whose main objective is to promote the development of the Region of Murcia and the creation of employment.

For the Northern Region, the lack of some competences in the sector were identified by stakeholders more specifically at the level of WWTP operation and maintenance. Although not being a pillar of the eco-innovation systems, this aspect should be considered in the educational offer to be implemented in VET schools in the region. At this moment there are two (<http://norte2020.pt/concursos/concursos-abertos>) open calls for private and public entities to support the creation of higher technical vocational courses (TeSP) with a ISCED 5, under the scope of the priority axis 8 - Lifelong Learning and Education – Norte 2020.

2.3 Internalisation roadmap

2.3.1 Goal Definition

To improve the stable economic growth of the sector of water technologies in the Regions of Murcia - Spain, Crete - Greece and Northern Region - Portugal through connectivity with other knowledge regions abroad, strengthening networks and other forms of partnership and cooperation (new collaborative and exchange of personnel projects) aimed at consolidation of innovation and internationalisation of research centres and companies in the value chains of water technology and agri-food sector. For these regions, this would support to set right conditions water innovation, which are needed for sustainable growth through access to advanced technology, research and innovation cooperation, development of basic skills, making use of environmental sustainability and also to put on the international market technological solutions in the water sector.

2.3.2 Approach

- **In which areas is internationalisation of the innovation ecosystems required?**

The three regions participate in many projects of different EU programmes as Interregional Collaboration is already an integral part of the regional policies. Regions of Crete and Murcia have their own INFO office in Brussels where municipalities, universities and companies can be informed about European projects and communicate and meet with other European regions.

The three regions need to improve their collaboration with other European regions in international R+D+i projects for the efficient use of water. Regarding water scarcity, the worst situation is that of the Region of Murcia, so, Region of Murcia should work even more than the other two regions to promote the capture of international knowledge. Due to this historical shortage of water resources Region of Murcia also has many technological solutions which it can bring to the international market (modernization of irrigation, universalization of drip irrigation, wastewater treatments for its reuse, etc).

The creation of a regional representative in the European Community would facilitate the access to international initiatives, such as Smart Specialisation Platforms (Water Smart Territories), ERRIN, among others.

SMEs internationalisation should be strengthened with educational material and by organizing seminars by local chambers and institutions.

- **Identify barriers for student or staff exchanges. Describe steps to overcome these barriers.**

Although there seems to be no particular difficulty in student mobility, SMEs probably lack basic knowledge, skills and financial resources to support the staff exchanges of their employees, as well as the lack of time due to excessive bureaucracy and missing appropriate networking opportunities to participate in interregional partnerships.

English language is the main barrier for the exchange of students and / or staff from the Region of Murcia. It would be necessary to propose a series of steps that favor the learning of “practical” English language from basic education levels and encourage the presence of translators in the business sector. Nowadays English language is studied in all those levels but mainly written, not allowing the students to have a fluent conversation in English.

Some indicative steps to overcome these barriers are:

1. ERASMUS could enhance mobility and address specific needs of the innovation ecosystem. The dissemination of knowledge required for the participation in related calls, for both business and public bodies, could effectively occur through an organized workshop from the Chambers of Commerce and Industry, Technological Centres, Universities, etc. The creation of specific Erasmus+ programmes with the goal to support education and training with a focus on SMEs and public administrations directly linked with water and water technology could be one possibility.
2. Another way to connect SMEs to other regions is through networks where Region of Crete, Murcia or Northern – PT region are among the participants (e.g. ERRIN).
3. The Chamber of Commerce and Industry of Crete, Minho University and Technological Centre of Murcia, as well as links between business, companies and the public sector, could enhance the dissemination of information among them through the networks and channels in which they are involved (e.g. Enterprise Europe Network, Food for Life Spain Platform etc.).
4. Promotion of international events and creation of International experts’ committees related to the water sector in the three Regions.
5. At least in the Region of Murcia to increase in the teaching hours of English language in primary and secondary schools prioritizing the conversation. Promotion of the exchange of students in secondary school.

• **Is there a possibility for interregional collaboration regarding environmental challenges? e.g. research or demonstration projects. What should be done to intensify such actions? What are the main barriers for interregional collaboration?**

Region of Crete joins more than 20 consortiums for competitive European projects of major financial frameworks (H2020, Interreg MED, Interreg EU, ADRION, LIFE, Interreg Gr-Cy.). Region of Crete also participates in dynamic European Networks focusing on transregional cooperation and interregional synergies.

One of the strengths of the Region of Murcia is the scientific cooperation between the Region of Murcia and other neighbouring regions, as well as abroad. In this regard, the integration of the Region of Murcia in international organizations and networks for science, politics and governance of water in the Mediterranean basin is noteworthy.

The Northern – PT region institutions have participated in different interregional initiatives in the EU context. These initiatives gained greater relevance with the adjacent regions of Spain (Galicia and Castilla y León). The deepening of these collaborations is fundamental to improving the

competitiveness of regional economies. Life+, PRIMA and INTERREG VA Spain-Portugal cooperation programmes are examples of collaborative programmes regarding environmental challenges.

The three Regions participate in many environmental projects with European funding that include an international consortium. The Regions participate in many LIFE projects of the European Union, where the water sector is one of the addressed topics and it is possible to demonstrate the most innovative technologies. Therefore, there is a possibility of interregional collaboration. In any case, to increase this interregional cooperation, its critical mass should be supported by their regional and national public administrations involved in regional development, international funds and foreign cooperation, as well as by the commercial offices of the National Embassies in other countries.

The Chamber of Commerce and Industry of Region Unit of Heraklion in Crete participates in the Enterprise Europe Network (EEN) with 600 member organizations, that offers consultation to businesses and also has the capacity to organize B2B meetings. The countries that are asking information on the water cycle are mainly from Southern Europe. This is a clear indication of the need for cooperation emerging from similar environmental challenges.

On the other hand, the main barrier for interregional collaboration is the size of the regional companies, which are mainly SMEs. The Regions are in the middle of a generational change and it is necessary to ensure that new technicians, researchers and entrepreneurs have qualified training, with knowledge of several languages and that SMEs have access to funds for the financing of international actions.

• **Is it possible to formalize cooperation between innovation ecosystems, to support start-ups, students, researchers or research projects? What should be done to stimulate such cooperation?**

In Crete, both the Regional Research and Innovation Council (RRIC) and the training and lifelong learning centers (KE.DI.VI.M.) of local academic institutions aim, inter alia, to interconnect with the international environment.

In Murcia the Regional Development Agency INFO works hard to promote internationalisation in the industrial sector.

In Northern – PT region, both PortugalFoods and the Portuguese Water Partnership promote synergies and maximize the potential of the regional agri-food industry and water sector in the world, by promoting the construction and consolidation of alliances and partnerships between regional institutions and international institutions engaged in sustainable water use and enhancement of water resources. COTEC Portugal is another program leading a Think and Action network for advancing technology diffusion and business Innovation cooperation.

It is necessary to increase cooperation through the internationalization of companies, training centres and research centres. To this end, the collaboration of companies with international specialists or companies should be encouraged to increase the network of contacts in areas that show synergies with the three Regions. It is also necessary to find appropriate solutions for SMEs. Promoting clustering and be active in the support of qualification for internationalization, identifying and capturing opportunities through business intelligence could be a solution.

- **How OP ERDF can support interregional collaboration?**

Internationalization is one of the priorities of the OP ERDF of the Region of Murcia and for this reason it supports the incorporation of internationalization into the strategy of regional SMEs. Through collaborations and development of interregional projects, the complementarity of each Region can be a competitive advantage for the technological development in the water sector. In addition, OP ERDF can support the organization of international events dedicated to interregional collaboration and propose funding calls aimed at promoting the internationalization of companies in the Region of Murcia in competitive calls.

In Northern Portugal OP ERDF should continue with calls to assist Northern – PT region entities in the preparation of projects participation in European research programs such as Horizon 2020 and subsequent.

To date, in Crete, OP ERDF has not supported interregional collaboration and there is still no evidence on which to base an assessment on whether OP ERDF 2021-2027 will support interregional cooperation

- **Realistic assessment of creating the conditions for raising competitiveness, growth and jobs in the regions.**

Region of Murcia has launched its Circular Economy Strategy 2019-2025 with eight lines of action within which 51 specific measures are integrated, with a total investment of 510.4 million euros, which could generate directly about 2,000 'green' jobs and keep another 21,000. This Strategy has been prepared with the participation of experts and technicians from six regional ministries, as well as economic and social agents, as well as 60 representatives of universities, technological centers and research organizations, social and environmental organizations, business associations or agricultural and trade union organizations.

This strategy seeks to produce a transformation in the production systems of companies in the Region of Murcia and a change in consumption habits to use resources more efficiently, strengthening the business and industrial sector of the Region of Murcia, create "green" jobs linked to new business opportunities.

The regional importance of water is so high that the fifth line of action is devoted entirely to efficient use of water. This action line includes 5 actions totaling 205.3 million euros, that is, 40 % of the total budget. In this area, the Region of Murcia will develop programs to improve irrigation systems and reuse purified water (87 million euros); and other types of measures related to the improvement of sanitation or the operation of waste water treatment plants. Finally, within this Strategy a favourable system for the accumulation of human capital specialized in the water sector in the Region of Murcia will be raised to achieve its sustainable development while obtaining competitive advantages from the use of innovative technologies.

- **How internationalisation could contribute to critical mass development in participating regions?**

The development of common projects and networking with European and international organizations and institutions characterized by higher levels of technological intensification of their productive base could be decisive for the internationalization of the regional innovation system and for the consolidation of the priority areas of RIS3 of a NUTS II region, such as the North Portugal, considered in a "moderate innovative" level in the Regional Innovation Scoreboard 2014, in order to overcome regional weaknesses and limitations.

Internationalization within the water sector should allow an increase of scientific and technological knowledge, being able to optimize the hydric resources of the three Regions and their sustainability, as well as reaching a greater volume of business in exports due to the greater commercialization of technological products that provide sustainable solutions in other European regions.

C. Conclusions

Identified limitations and outlook

In the Region of Crete, the biggest constraint is that there is no developed business sector that is interested and can invest in innovation at regional level. Start-ups and SMEs need empowerment to join the innovation ecosystem. Internationalization could be a very important pillar of this effort. At the same time, the educational background must be enriched with more innovation and entrepreneurial focused actions. Integrating relevant information is desirable throughout the range of interventions. To ensure sustainability of interventions a water management committee may need to be established to support the coordination between all local actors.

It can be highlighted that the Region of Murcia has systemic shortages of water and must work on the development of innovative and sustainable technologies for an efficient use of its water resources, highlighting lines of work in reuse and awareness of the population. There are many institutions (public and private Research Centres and Universities, Technological Centres, Training Centres, private companies, policy makers, local and regional administrations, etc.) working in water issues but a higher level of coordination should be desirable. A unique Regional Agency on Water could coordinate all the regional activities to promote innovation and sustainability in the Region. Region of Murcia Circular Economy Strategy 2019-2025 with 40% of its budget allocated to water issues is a good tool to improve innovation in water technologies in the near future.

In the Northern – PT region the main constraint is that water was not considered as a priority area in the regional RIS3. Therefore, the proposed rebalance of the research agenda as well the priority areas of the regional RIS3, together with the promotion of vocational education and training courses will lead the Northern – PT region to a more sustainable and inclusive economic growth.

Central and Eastern Europe:

4) Nord-Est

5) Latvia

6) Southern-Moravia

<i>Latvia</i>	
Policy instrument	Operational Programme Latvia "Growth and Employment" Thematic objective No 1 "Strengthening research, technology development and innovation."
Definition	OP in general aims to achieve key national development priorities along with the EU2020 objectives. TO 1 specific objective No 1.1.1 "Enhanced capacity of scientific institutions of Latvia to conduct research and contribute to innovation, as well as attract external funding and invest in human resources and infrastructure" and No 1.2.2. "To facilitate the development of innovative and technology-intensive entrepreneurs" are developed to support the implementation of RIS3. Water sector as a thematic area is interdisciplinary and corresponds to two of five LV RIS3 specialization areas, (a) advanced materials, technologies, engineering systems and (b) knowledge-intensive bio-economics. Specific water sector-related issues to ensure sustainable water management through new technologies and innovation are supported by structural funds.
<i>North-East Region of Romania</i>	
Policy instrument	Regional Operational Programme 2014-2020 (ROP 2014-2020) Romania for North East (NE) region
Definition	ROP is managed by the Ministry of Regional Development, Public Administration and European Funds (MRDPAEF) as MA. Through Priority Axis 1 - Promoting technology transfer, ROP allocates to NE Region EUR 36.15 mil for the implementation of investments on the development of infrastructures and technological transfer (TT) services.
<i>Czech Republic</i>	
Policy instrument	Aktualizace strategií vize Strategie rozvoje Jihomoravského kraje 2020 (Actualization of Strategy Vision – Strategy of development for South Moravia (SM) region 2020)
Definition	The update of the Strategic Vision of the Development Strategy for the SM Region 2020 follows the strategic documents of the EU, the Regional Development Strategy for the Czech Republic and the Development Strategy of the SM Region 2006-2016. It creates a general framework for Regional Development Program and other regional concepts and strategic documents. It's a strategic document outlining priorities and future interventions for SM with 4 main priority axes: 1. Competitive regional economy on European/global scale

2. Adequate and high-quality public service offer
3. The development of core infrastructure and transport links
4. Long term viability of the disadvantaged parts of the region

1. Introduction

1.1 Current situation

South Moravian Region of the Czech Republic

- Historical tradition in this field since 19th century
- Tradition and level of Universities
 - VUT (Brno University of Technology)- 120 years
 - MUNI (Masaryk University) - 100 years
 - MENDELU (Mendel University in Brno) - 100 years
- Strong research capacities
- The disintegration of big companies after 1989
- Reestablishing and foreign investors
- Newly arising business sector since 1990
- The shift in the educational sphere - a decline of interest
- Very narrow RIS3 influenced by big and rich companies
- Alibismus (endeavour to avoid responsibility by making excuses, blaming circumstances etc.) of government sphere - competition on the lowest level
- The strategy of development focused on common challenges - water, drought
- Establishment of the cluster in 2008, slow change of the focus from export alliance to a cooperation inside the region
- Low level of cooperation, nearly no coordination

In South Moravian Region of the Czech Republic, the following was achieved:

- Cluster received support from OP PIK (ERDF) for development, internationalization, infrastructure and research
- Establishment of inter-regional and international collaboration with Austria, Danube region, NATUREEF, iWATERMAP
- The regional government delegated the realization of the project to the cluster.
- The cooperation in the fields of environment, education and regional development have started.
- The cooperation of Universities with companies on research projects of the cluster exists.
- Horizontal cooperation among the universities and scientific bodies (e.g. Czech Academy of Science, Czech Hydrometeorological Institute, Water Research Institute etc.) within the research and education focused on water
- Renewing of cooperation between the universities and secondary schools with a focus on water maintaining and management
- Starting of preparation of extra-curricular educational system focused on water
- The communication has been established with regional government and cluster

North-East Region of Romania

In the North-East Region of Romania, the development of the critical mass of innovation ecosystems has been achieved through cooperation between industry and education through the development of internships that students develop in private industry firms.

Between June and August 2017, the North-East Regional Development Agency (RDA) carried out, together with the representatives of the Management Authorities, an analysis of the operational programs available in Romania during the 2014-2020 programming period, in order to identify the financing sources necessary for the operationalization of the projects proposed in the North-East RIS3 pipeline, which includes 168 project ideas, of which 93 are at project stage and 36 at the stage of cover letters.

The Entrepreneurial Discovery Process (EDP) is a concept developed by the European Commission's Joint Research Center (JRC) within the European Intelligent Specialization Platform S3. This is an interactive and inclusive bottom-up process aimed at:

- identifying the directions of regional development through smart specialization (niche sectors with a significant competitive advantage and their major challenges)
- identifying innovative development solutions (sectoral, cross-sectoral, local).

The sector benefited from the implementation of several projects, both investments and software, which contributed to-:

- improvement and development of water supply systems, wastewater collection and treatment in the region.
- Reduction of the impact on the environment through the implementation of an integrated urban waste management system.

In the North-East Region of Romania, the following was achieved-:

- Initial steps in industry-academia cooperation - Cooperation between industry and academia exists.
- Bottom-up Process - Identification of organic needs through common reflection
- Entrepreneurial discovery process - EDP's were organized to discover innovative project ideas in 2016 & 2017.
- Regionally important sectors and emerging sectors reflecting regional strengths and potential - Niches partially identified.
- BSc and MSc students perform traineeship in RIS3 industries/companies - Specialized training in the region.
- The region participates as a partner in Interreg projects.
- Establishing public-private partnerships - These partnerships exist. Public authorities and private companies are already developing projects together.

Latvia

The Latvian water technology sector stretches across two RIS3 areas:

1. **Advanced materials, technologies, engineering systems and**
2. **knowledge-intensive bio-economics.**

The leading role in the water technology sector among the Academic institutions is played by University of Latvia (LU), Latvia University of Life Sciences and Technologies (LLU) and Riga Technical University (RTU).

In RTU water technologies are embedded within the Faculty of Civil Engineering, where Water research laboratory (established in 2002) is covering technology sectors as Water/Wastewater treatment processes and technologies and Bioenergy production from wastes. Water-related SMEs and other stakeholders from Industry are involved in Cleantech Latvia cluster. Most active municipal water services utilities have formed the Latvian Water and Wastewater Works Association which is a significant stakeholder in the water technology sector.

From the policy-makers, Ministry of Education and Science of the Republic of Latvia and Ministry of Environmental Protection and Regional Development (responsible for infrastructure investments in the water sector) are involved in forming various aspects of the policies that impact the water technology sector in Latvia.

During the first phase of the project, important information regarding the private sector involvement was gathered. In Latvia, more than 70 companies are involved in the water technology sector. Companies are organized into three groups:

1. **distributors of services/technologies ("Simple re-sellers") - approx. 43%,**
2. **Engineering design ("Pick up guy") - approx. 32%,**
3. **Original equipment manufacturer - approx. 26%.**

32% of companies are operating in the wastewater field, 13% in the drinking water field, 11% are exclusively working with pumps and pump systems, 6% in automatization field and 6% working with piped distribution/production.

Lead Interviews and workgroup meetings with the Academia and Industry stakeholders have provided **valuable insights towards:**

1. **the role of R&D in the companies (relatively limited) and understanding of available funds (low understanding);**
2. **the missing competencies for personnel in companies and water sector in general (operators of water and wastewater treatment plants);**
3. **the readiness of companies to be engaged in a lifelong learning process;**
4. **the potential research topics from the market and product perspectives (sewage sludge treatment and disposal);**
5. **cooperation and interaction between Academia and Industry;**

In Academia sector, vocational education and training (VET) has been identified as a critical area to improve the lifelong learning process. The school that delivers the skills needed is Mechanics and Technology College of Olaine. The school specialises in - chemistry, pharmacy, biotechnology, environment, and food sector. Sewage sludge treatment and disposal have been identified as vital research topic both, from the demand side (municipal companies responsible for the provision of the service for drinking water treatment/supply and sewerage collection and wastewater treatment) and supply (original equipment manufacturer and distributors of services/technologies).

Possible research topics and collaborations have been identified based on historical publications that were analysed interdisciplinary between Academia players by considering the funding sources as well.

Possible cooperation partners from secondary schools have been identified to accelerate knowledge exchange between Universities within the field of water technologies.

Rate communication/knowledge exchange in each branch of triple helix between the scientific community, business, and government. Use scale from 0 to 5, where 0 – no communication, 5 – excellent communication

	CZ	LV	RO
Communication/knowledge	2-3	1-2	2-3

exchange rating			
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Communication/knowledge exchange is now in the way of strong development. Participants creating triple helix has understood that communication and knowledge exchange is the strongest tool for the current situation improvement. This is supported also by the social situation influenced by the impacts of global climate changes which are widely accepted all through the Czech society. Unfortunately, the processes of communication/knowledge exchange are currently based more on personal relationships than on some systematic rules. It can be stated that in many cases, just two participants from the triplex are involved (scientists x government, government x business, scientists x business). Technically, the mainly used methods of communication/knowledge exchange are as follow: Government – creating expert committees, scientists – research projects, business – technical projects. Projects are mostly financed by the grants from the state agencies with different proportion of self coo-financing only a small number of technical projects is financed by business companies.

- Rate (the same scale as above) impact of policies on each branch of triple helix in each participating region.

Impact of policies rating on	CZ	LV	RO
Scientific community	3	2	3
Business	3	3	2
Government	4	1	1

The rate of the impact was given by individual feelings of the implementation team.

1.2. Problems

South Moravian Region of the Czech Republic:

- **The lack of experts within this field - mostly the lack of youth**
 - **A small prestige of field and difficulty**
 - **Lack of students**
- **The low political support within this field - not in RIS3**
- **The lack of trust, big rivalry on the business - low level of systematic collaboration**
- **Low or no ability of business companies to finance research and innovation projects as well as their disability to cover coo-financing of the projects supported by state agencies**
- **Low ability of scientists to transfer results of their projects to the practice – science is evaluated more by the level of scientific articles than by the practical outputs**

North-East Region of Romania:

- Communication level between triple helix actors (government, business and academia) is low
- Reduced collaboration between the business and universities / research institute – companies are reluctant to invest in collaborative projects with the university, lack of dialogue and trust
- Reduced regional offer for technology transfer services level TRL6 - TRL9 (ex. pilot plants, demonstration laboratory for testing new products and technologies)
- Lack of actions to promote research, particularly in the field of water
- Lack of the framework for correlating the accompanying needs for personal qualification with the training of specialists (through universities), lack of support for the training of skills through internships, internships, study visits
- Shortage of young medium-skilled labour (skills, technicians), most employees who are 50 years and older - The continuous process of population aging and emigration of a personal qualification
- Low inclusion on the labour market of young graduates
- Reduced company, university and NGOs co-financing capacity

Latvia:

The identified problems in Latvia are categorised among the interaction of each triple helix stakeholder group.

Academia-Industry interaction.

Academia:

- Limited number of successful collaboration projects with industry;
- Research projects (Bachelor, Master and PhD) has no establishment in real industry need and problem-solving;
- Research results are not, regularly presented to the industry, lack of dialogue;
- Week/ limited relationships with industry stakeholders.

Industry:

- Industry is not actively involved in research projects, lack basic information;
- Has no clear idea, how to access and collaborate with Academia;
- Has limited knowledge and capacity to run research projects with Academia;
- Clusters do not prioritize research and development projects with Academia;
- Lack of perspective and knowledge on how to transfer innovation into successful business models.

Academia - Government interactions

Academia:

- New developments, promoting entrepreneurship at a university;
- There is no single strategy, many non-synchronized initiatives;
- Integration and synchronisation among different educational programs are needed;
- Passive in policymaking.

Government:

- Lack of policy and stewardship to facilitate Academia and Industry discussion;
- Needs an accountable and traceable process to follow Academia supported research and development projects;
- No targeted evidence-based information provided to the government for specific policy action or funding;

- **Not immersed in University real needs.**

Government - Industry interactions

Government:

- **Project-based Industry supporting initiatives lacks long term strategy;**
- **Needs an accountable and traceable process to follow industry-supported projects;**
- **“Closer to industry” Real industry needs grounded initiatives are required – improved dialogue with stakeholders;**
- **Lack of perspective and strategy from the Government and Municipal companies regarding the needs and applicability of R&D.**

Industry:

- **Is not informed about initiatives and opportunities offered by the Government;**
- **Focussing on the infrastructure projects, instead of research and development;**
- **Local market-focused, needs and wants to be defined by Latvia industry mainly;**
- **There is insufficient evidence-based information or/and specific requests from the water sector to the government to formulate a particular action or funding reallocation;**
- **No dedicated contact point for Industry to search for information and support.**

Similarity with South Moravian Region of the Czech Republic in challenges **between different Academia and Industry players** are **lack of trust, big rivalry - low level of collaboration. And ageing - the water sector (in Municipalities) holds the highest percentage of employees aged 50 years and older.**

1.3 Definition and objective of roadmaps

A strategic plan that defines a goal or desired outcome and includes the major steps needed to reach it.

2. Roadmaps

2.1 Critical Mass Development Model

2.1.1 Goal Definition

This roadmap aims to improve the sustainable economic growth of water and water technology sector in **each region**.

The South Moravian Region of the Czech Republic **aims to** establish an inter-regional hub in specific water technologies (software and IT HydroPower Equipment, Water Civil Constructions, Water Resources – Protection, Dom Safety, Draught and Flood protection) which operates in country level and as well as in neighbouring countries. Thus the region would like to define close and clear ties of the branch priorities to RIS3. In human capital development, the region aims to increase the number of students and young experts in water technologies, and special attention to pay in the establishment of Vocational Centre of Excellence. This will be reached by a broad and suitable mix of financial resources for R&D in the water technologies. As a result will be an increased number of research and innovation results (patents, new products, smart products, methodologies, etc.). With the marketing and communication, the South Moravian Region aims to increase the prestige of the water technologies and social responsibility of companies in the sector. This planned to achieve with the development of the strong communication platform of triple helix representatives.

In the North-East Region of Romania, the goals are related with the extension of drinking water and sewer infrastructure. Thus the region wants to decrease the bureaucratic process for clients to connect to networks and encourage them to connect. The region wants to increase physical production (in terms of the necessary infrastructure) and implement automation in water-channel systems (existing water and sanitation systems are quite old, and modernization and use of new automation technologies are needed). In the same way, the North-East region of Romania wants to pass the performance capacity within the regionalization process and to use investment rhythm available from European Commission funds.

Latvia aims to enable multistakeholder governance. In different stages of cluster development, the leadership role is best suited for different kind of stakeholders. Hence the water technology sector should be managed, and various initiatives lead by different triple-helix actors. The policies should include solutions to the challenges of multiple water users (e.g. agriculture, urban and industrial water consumers)

Specifically, attention will be paid on the development of new solutions in the resource recovery, sludge valorisation and energy efficiency and production. These directions can be developed by application of sensors, increased use of business intelligence, big data acquisition and management. In human capital development, Latvia aims to develop a connection in University study programs with international partners, e.g., Wetsus.

2.1.2 Approach

- **Which sector will be targeted/focused on?**

The South Moravian Region of the Czech Republic **aims to** target on water resources, sludge treatment, underwater technologies. Attention will be paid on industries like agriculture and forestry, environment protection, energy production and civil construction. Never the lees region would like to look at both Urban and Suburban areas. The region would like to use options available in IT and advanced manufacturing for water technologies.

In the North-East Region of Romania, the sectors targeted are mainly concerned with the expansion of infrastructure - water supply and sewerage in the region - the percentage of coverage of the regional water and sewerage infrastructure is below the national and European average, the structure and treatment of sludge from urban wastewater treatment plants, water recirculation and water management.

In Latvia the focus will be paid on the «key» industries related to wastewater production - dairy and meat production, beverages and chemical production².

- **How each region will improve the development of Critical Mass of the innovation ecosystem within their region?**

The South Moravian Region of the Czech Republic development of Critical Mass understands in several steps: 1) they will make an **analysis of the self-assessment and benchmarking of CMD aspects.** 2) **By making an analysis of applicable funds and finding suitable project ideas.** 3) **Finding 'change agents' and focusing on ties to RIS3.** 4) **Establishing indicators for monitoring of soft aspects (as for soft aspects we indicate skills concerning about education – indicate new ways of educational methods and approaches, involvement citizens into discussions – which is straight way to sustainable development with the aim to take co-responsibility and etc.).** 5) **Development of cooperation for the establishment of the vocational centre.** 6) **Focusing on school children with new educational materials and programmes.** 7) **Focusing on communication to all triple helix players as well as to the public.**

The North-East region of Romania will try to improve the critical mass development through the well-developed industry-academia corporation and looking out beyond the regional domain. The region will concentrate funding sources on regionally important and emerging sectors (reflecting regional strengths and potential) or societal challenge to enhance critical mass. The region will use first ESIF funds allocated to RIS3 topic and experience of first start-ups developed in RIS3 sector.

Critical Mass development in Latvia is planned in the following steps:

1) validating critical mass roadmap assumptions and organising stakeholder meetings, including policymakers for further development of the critical mass roadmap.

² <https://projects.interreg-baltic.eu/projects/best-119.html>

- 2) finalising the compilation and analysis of academia latest and running research projects from all research institutions in Latvia. The results will be compiled in a specifically dedicated platform.
- 3) Organising industry and academia conference and workgroups to initiate a discussion about potential partnership opportunities.
- 4) Creating links between companies and Research & Development projects, run by Academia, to initiate a further partnership.
- 5) Engaging the secondary school teachers in the process of mentoring the children interested in the water sector to pursue a career.
- 6) Incentivising the university staff to reach out to the schools that are showing promising results in STEM subjects and scientific-research works.

- Description of steps to improve innovation policies for enhancing the critical mass development of innovation ecosystems in the water technology sector.

The steps for South Moravian Region of the Czech Republic are the following:

- Elaboration of the strategic document “Water for South Moravian Region.”
- Negotiation of the mentioned document in the assembly and its approval of the final text
- Incorporation of the document in the Policy “Strategie Jihomoravskeho kraje”
- Lobbying for incorporation of the water technology issues in RIS3.

At the second stakeholder meeting in the North-East Region of Romania, the emphasis was put on developing better communication, in triple helix (private, university and public) co-operation for the practical identification of regional issues - this is how identified common interests, which by cooperation can solve some gaps or improve the existing situation. It is important to organize specialized training in companies and educational profiles to be up to date on the market, encouraging start-ups for young entrepreneurs who want to develop this sector.

In Latvia, these steps include engagement of the stakeholders in the relevant governmental institutions and ministries to inform and prioritise about the challenges the water sector is facing. Highlighting the strong research areas and potential research directions to be supported by national policies and national research funding programmes.

- Description of steps to establish an integrated network in each participating region where research and innovation efforts are commonly shared between knowledge institutions, local stakeholders and policymakers.

For the South Moravian Region of the Czech Republic, these steps include:

- Working groups for the implementation of measures for each roadmap shall be established and cover all branches of the triple helix.
- New projects of seminars, workshops and internships focused on practical aspects of initiation of entrepreneurship in water technologies.

The North-East region of Romania sees that strengthening the critical mass of the innovation ecosystem can also be enhanced by conducting responsible research (RRI), through close collaboration and through available and practical funding sources.

Start-ups should be encouraged, and this implies:

- Create a company, develop a business plan, recruit management, raise capital, license new company to develop and market products based on technology
- The startup also requires license-typically exclusive; worldwide; equity in lieu of fees, royalties or both; diligence; milestones; patent costs and patent management
- Return to university: patent costs, research funding; equity; royalties; other fees
- Proceeds: founders equity to inventors; or standard royalty distribution
- Other benefits: Same as licensing: jobs, prestige, investment, wealth creation, tax base expansion, technology champion

Priority in Latvia is to facilitate communication and work among Triple helix actors. This involves the need to intensify the role of the regional cluster within the field of the water technology industry. Cluster role defined as:

1. The organisation of thematic water topic conference and workshops; Development of a specific platform with indicated competences of Academia players;
2. Organisation events for the general public to popularise achievements by Academia;
3. To hire communication managers between Academia and Industry.
4. Create workgroups that include all triple helix players for specific water technology topic.

Empower the national RIS3 expert to work with this cluster to include their interests in the development of future RIS3 priorities and funding programmes that link to these priorities.

- Description of how will funding synergies be increased and what can OP ERDF contribute to this development?

In South Moravian Region of the Czech Republic funding synergy might be increased with:

- Financing of the cluster and its projects from regional, national as well as international funds
- Using ERDF funds for financing water projects
- Using funds from different ministries (Trade and Industry, Education, Agriculture,...) for financing water projects
- Coordination of Water research project proposals.

In the North-East Region of Romania, critical mass can be supported by OP ERDF fund by:

- Creation of Technology Transfer Centers
- Supporting spin-offs
- Infrastructure investments
- Investments in equipment for the preparation of the production of innovative products
- Modernization of production areas.

In **Latvia**, funding synergies will be increased through more active engagement of RIS3 national experts that are responsible for the national research ecosystem. The need for targeted support within the potential research excellence areas in the water technology sector will be backed by evidence-based strategy.

In the development of funding project applications, there is a high degree of mutual competition and insufficient cooperation between Latvian organisations and companies. Suggestions to improve the criteria and conditions of project tenders to sufficiently promote cooperation between Latvian organisations and companies will be submitted.

Considering the fact, that majority of regional water sector investments are public procurement infrastructure-related, there is an opportunity to incentivise innovative SMEs that take part in state and municipality organisation tenders. Further work will be done to convince the municipalities to involve innovation-related criteria, that incentivise innovative solutions, that result in benefits related to cost efficiency, operational performance, energy efficiency and positive impact towards the environment and human health. Public procurement, as a significant investment source in the regional water technology sector, should be considered as a driving reason for SMEs to provide innovative solutions.

2.2 Human Resources

2.2.1 Goal Definition

Goal definitions of Human Resources RM are different in case of each of the reporting countries (regions) according to the current status of tertiary education.

South Moravian Region of the Czech Republic

The education system is standardly developed the goal definitions are more oriented on extra-universities issues as are the following:

- **Stabil age structure of professionals and adequate base of students in each of the educational level**
- **Acceptable social status of professionals in water management**
- **A functioning system of extracurricular education from basic schools to lifelong education**

North-East Region of Romania

The statement of real goal definition is difficult because higher education institutions (HEIs) are currently facing by reduced legislative support and universities show both resilience and leadership in coping with the challenge of being a key actor for regional development.

Goal definition as a vision for universities could be the sketch of the universities that:

- **cooperate more,**
- **are specialized but flexible,**
- **take advantage of new opportunities,**
- **promote change,**
- **be a real brain for the region,**
- **contribute to the entrepreneurial discovery, multidisciplinary training, and creative development,**
- **attract funding and**
- **promote quadruple helix cooperation.**

Latvia

Development of RTU Engineering Bachelor Studies, 20+20 hour (full time) program in English language (ISCED 6-7, EQF 6-7³) and international double degree Engineering Master Studies program in English language (ISCED 7, EQF 7) to support growing needs of water technology educated engineers.

Development of Vocational education program, supporting the needs of regional SMEs towards specialists in water sector and change in professional qualification (in line with the idea of **lifelong learning**).

³ European Qualifications Framework – EQF, The International Standard Classification of Education - ISCED

2.2.2 Approach

- Description of steps to develop the human capital roadmap.

Steps defined by each of the counties (regions) are based on goal definitions of Human Resources RM mentioned above. While some of them meet as similar some of them are specific according to the local conditions.

South Moravian Region of the Czech Republic

- Including the water management and water care to the regional strategies of innovations, research and education of South Moravian Region.
- Support for secondary education in the field of water management by the regional government.
- Developing the tools for systematic connected lifelong and extracurricular education.
- Networking of all education authorities focused on the water within the region
- Education of the society outside of the water management field.

North-East Region of Romania:

- BSc and MSc students perform traineeship in RIS3 industries/companies
- Well-developed industry-academia corporation
- Participating in science, innovation and demonstration projects (ESIF and Interreg)
- Research institutes/universities attract talent related to RIS3
- Winning regional, national & European awards
- Coordinating H2020 projects
- Coordinating science, innovation and demonstration projects
- Forecasting the skills needs within the sector. Establishing strategic cooperation between Vocational Education and Training (VET) schools and companies active in the RIS3 sector. Education profiles and traineeships optimized

Latvia

Activities towards involvement of secondary schools

- Identification of criteria and assessing total numbers of school kids, potential students for RTU Engineering Bachelor Studies. This includes identification of possible schools with traditions in STEM (good results in centralized exams, good experience in scientific research work realization in country level, suggested dedicated teachers from personal contacts).
- Designing and validating motivation programs for secondary schools' teachers (in cooperation with RTU Development Fund, in cooperation with already existing tradition in Faculty of Materials Science and Applied Chemistry).
- Designing and validating water topic popularization events and other activities for pre-school and primary school kids in cooperation with Science & curiosity centres "ZINOO" (similar examples exist covering main STEM topics⁴) or with existing RTU initiative – RTU Children and Youth University (BJU)
- Evaluation, design and development of a program for the training of secondary school teachers on topics: scientific methodology, engineering design. This will strengthen Scientific Research Works more in the practical result rather than in fulfilling the

⁴ <https://www.zinoo.lv/tjd/>

template needs. It is necessary to discuss financial support for such activity from the Ministry of Education and Science.

- In communication with the Ministry of Education and Science, it is necessary to include in the calculation of the basic research funding (support mechanism) a criterion that affects the developed ones Scientific Research Works in secondary schools

Activities towards development of vocational education programs:

- Cooperation with Olaine VET (ISCED 3, EQF 3-4) in the development of joint study track with RTU. That would include synchronization of study programs among professional, bachelor and master degrees for Environment technologist and Biotechnologist programs.

- Description of steps to improve the integration of entrepreneurship into the education profiles?

South Moravian Region of the Czech Republic:

- Creation of the tools supporting the willingness of companies to participate in the educational process.
- Support of the stays of students within the companies with using the different kinds of education (lecturing, mentoring, shadowing etc.)
- Creation of tools supporting join research and the quick transfer of the results into the practical usage.

North-East Region of Romania

Romania presents ideas of stakeholders as are the following:
capital (Regional Water Company)

- The existence in Iasi of a university centre that makes contacts with the academic environment easier both for the provision of consultancy and for the selection of human resources.
- Potential to develop the number of clients and to develop the operating area.
- Development of organizational culture favoured by contact with external financiers
- Regional innovation systems are poorly known at employers, have a minimal impact, and companies' perceptions are not correlated with their real need for development and competitiveness. The education system as a whole puts the emphasis on developing memory capacity at the expense of discovery and the development of personal skills and talents.

Environmental Protection Agency Bacau

- At the level of the county, the agency collaborates with the environmental education units in the following activities:
- Monitoring the implementation of the Ecological Education Programs in the school units in the county;
- Organizing seminars, conferences, symposia, campaigns and other common information and environmental awareness activities on the occasion of celebrating international environmental events.-
- A conclusion of partnerships for environmental projects with the educational units
- Practical organization within the compartments of Agency, for students of Universities with whom Practice Conventions have been concluded.

Cribernet (Private company)

- **Creation of accredited / notified laboratories that can test products.**

Latvia:

- **RTU has attracted 2.4 million EUR in funding from the OP call "Innovation Grants for Students" [1]. This call is dedicated for (a) development of leadership, innovation, and entrepreneurship for students; (b) development of innovative ideas; (c) for attraction of private investments and (d) for collaboration of higher education institutions with companies. The project already is ongoing and connected with international innovation challenge platform "Demola Latvia" [2].**
- **There is an incentive in RTU for EQF 6 in 2020 to start study course "Innovative product development and entrepreneurship" which aims to develop students competence in new product development and technology transfer, as well as for the development of entrepreneurial skills and testing them into practice while promoting the overall development of creativity and planning skills, as well as the ability to present unique ideas.**

- **How far are the various EQF (European Qualifications Framework) levels represented in the education profiles of the region, connected with the innovation ecosystem?**

South Moravian Region of the Czech Republic:

- **The structure of educational levels participating in the water management within the region is standard.**
- **The most presented are levels 4, 6 and 7, but all the levels ((1), 2 - 8) are not only practically participating but also are ensured by the education within the region.**

North-East Region of Romania

In the North-East Region of Romania, at the high school level, there are profiles only for "Environmental Protection", which is based on the theoretical part and not on the practical side. There is a real gap between the optimization of educational profiles with the demands of private companies - there is a need for cooperation between companies and universities to identify areas for which in-depth masters and / or doctoral studies are required.

Latvia

In Latvia, the water industry connection with innovation ecosystem can be represented in EQF 8 since in 2019, RTU enrolled first students in programme Industrial PhD [1], [2]. There is an incentive in RTU for EQF 6 in 2020 to start study course "Innovative product development and entrepreneurship" which aims to develop students competence in new product development and technology transfer, as well as for the development of entrepreneurial skills and testing them into practice while promoting the overall development of creativity and planning skills, as well as the ability to present unique ideas. In 2019 in Latvia is started a programme where academic personnel

can raise their academical qualification in practice in industrial enterprises in areas of strategic specialization [3].

• Are there other instruments or support programmes in your region? If yes: Can these programmes be more interesting for applicants? What is the awareness about them in different branches of triple helix? What should be done to increase the awareness and encourage potential partners for application? If not: what steps should be taken to introduce such programmes in your region?

South Moravian Region of the Czech Republic

There are, e.g. regional support programs, external educational grants (national and international).

All the programs could be always more attractive. The attractiveness would be supported for example by using better marketing, higher financial support, more visible applicability of the received skills etc.

Latvia

Growth and Jobs» Specific Objective 1.2 «Research, Technological Development and Innovation»⁵:

1.1.1.2. "Postdoctoral Research Support"

1.1.1.3. "Innovation Grants for Students"

1.2.2.1. "Support for training of employees"

1.2.2.2. "Support for recruitment of highly qualified employees"

1.2.2.3. "Innovation motivation program"

For each county of the region, there is a Local Action Plan for the development of vocational and technical education, which mentions some of the leading 3 priority priorities established within the European Council:

1. Intelligent growth developing an economy based on knowledge and innovation;
2. Sustainable growth developing a more competitive, resource-efficient and environmentally friendly economy;
3. Growth inclusive - High employment rate, economic and social cohesion.

For the development of human resources, as in the case of critical mass development, there is a close link through workshops aiming at the link between faculties and the private business environment, making intermediation for better staff training (both during schooling and in the lifelong learning process).

In the region, there are both bachelor's, master's, doctoral programs and high-school study programs aimed at environmental protection, which means that in the region there are trained people who can be useful in the field. Still, there is a problem in the region for specialized young

⁵ https://www.esfondi.lv/upload/Planosana/DPP_25022015.pdf

people who tend to move to more developed areas where more employment and career advancement opportunities are provided.

Participation in the Interreg and H2020 projects facilitates international cooperation within the region. Valuable experience is gained and can be modelled through shared learning and observation of the implementation of best practices applied.

- Which elements are concretely missing? Can these be addressed through OP ERDF?

South Moravian Region of the Czech Republic

- Coherent regional strategy in education in the field of water management.
- Including the water management and water care to the regional strategies of innovations, research and education.
- Both points mentioned above could be solved as the part of the ERDF project on the level of the region of South Moravia.

North-East Region of Romania

In the Romania, the most important challenges faced by the region and mentioned by stakeholders are:

- Lack of correlation and support framework for labour market requirements (employer) with the training of specialists (universities) regarding the development of practical and entrepreneurial abilities
- Training talents (young graduates) in the region
- Lack of an organizational framework to facilitate collaboration / communication between stakeholders in the region.
- Universities in the region show leadership in facing the challenge of being a key actor for regional development in staff training.

One of the main innovations and technology transfer services that companies in the region need is support for recruiting qualified technicians

- Most universities and research institutes collaborate with SMEs, and there are even cases of good practice.

ERDF might include building the competencies and skills of HR that will work on ERDF projects, but human capital is a priority of ESF.

There are similar elements in Latvia which are missing if compared with Romania and the Czech Republic:

- Coherent national strategy in education in the field of water management;
- Training talents (from EQF 1-2) in the region.

Besides, there is missing Vocational education (EQF 3-4) for the water industry, which includes lifelong learning process for older people. Lifelong learning can be addressed through funding call 1.2.2.1. “Support for the training of employees”.

2.3 Internalisation roadmap

2.3.1 Goal Definition – Where to be in 5 years?

All three countries (regions) have many common points for the future, such as: implementing international projects, scientific, innovative and demonstration projects.

In the South Moravian Region of the Czech Republic, the goals are:

- to be even more active in interregional and cross-border cooperation, attended several projects dealing with water (Interreg V-A Slovakia - Czech Republic, Austria - Czech Republic and Interreg IIIC) and are also a partner in the project in H2020.
- to implement international projects,
- students and experience exchange, dealing with education in the field water management.
- be more visible in European and World water community and to become an inter-regional hub in Central Europe.

In the North-East region of Romania, the goals are :

- to implement international projects and become promoters of these project;
- project coordination H2020, coordination of scientific, innovative and demonstrative projects.(better identification of the needs of the population and society, examples of good practices, experienced specialists, completion of sub-stages of projects under the terms and conditions set, identification of roles and responsibilities in a multidisciplinary team and application of relationship techniques and efficient work within the team);
- cooperation with knowledge institutes, universities and companies from other regions and other member states (projects with experience exchanges between regions and communities, formal and informal collaboration between inter-community research and development centres);
- connect with other clusters at regional, national and European level. (identifying specialists in the field and communities).

The region and the member state are focusing on a specific societal challenge in the region, strengthening critical mass and creating attractive conditions for international co-operation. (the interconnectivity of regional elements with other partner-specific elements, mutual understanding of values defining a region through coexistence and development of direct human relationships).

In Latvia the goals are following:

- Research budget in the water technology sector should exceed level in previous period;
- Increased number of technology demonstration projects with interregional partners
- Interregional water technology deployment projects with industrial partners

- **Interregional water technology student programs**
- **Find a niche and shift the focus from local competition towards European or global.**

2.3.2 Approach

- **In which areas is the internationalisation of the innovation ecosystems required?**

Situation of the regions is similar in terms of - human capital development, exchange of experiences, learning good practices, forming consortia for working with more experienced partners.

The South Moravian region of the Czech Republic wants to develop the:

- Knowledge transfer between international regions
- Human resources exchange (students, experts)
- Forming consortia for international research projects
- Learning best practices.

In North-East region of Romania, the areas in innovation ecosystems refer to :

- Infrastructure development for innovation and TT
- Human resources
- Capacity building (Human Resources and Institutionalization)
- Horizontal priority 3: supporting clustering and internationalisation initiatives

The primary areas of Latvia of the innovation ecosystems are:

- Pilot/ demonstration project opportunities for regional SME companies
- Consortiums to join for regional SME companies, working with more experienced partners
- Knowledge exchange among business organisations towards latest market/ technology developments

- **Identify barriers for student or staff exchanges. Describe steps to overcome these barriers.**

In all three regions, increased interest is lacking in international cooperation from companies. In the case of exchanges of experience, we think that the most appropriate option would be the top-down approach in trying to find the best solutions for them, to find a good method of communication and to support initiative and cooperation between regions and international level to raise awareness.

In the South Moravian region of the Czech Republic, the open mind and interest in international cooperation from companies, and some students are missing.

The best way, how to overcome barriers for staff exchanges would be:

- taking their representatives to business missions to partner regions
- trying to find the best suitable opportunities for them
- trying to support them in startups and cooperation in and abroad regions
- cluster cooperation as a specific point.

In North-East region of Romania no longer see barriers for students. They develop activities within the ERASMUS program. The universities and public actors are open to GP and staff international exchange. In the other view, the staff exchanges in the industry, happen at a reduced level because (not very open). In this case, the approach should be top-down, starting from awareness (decision-making level) to training (executive level).

In Latvia :

- Lack of international collaboration hasn't been established strong partner networks
- Student exchange is organised between selected partners, do not exist a centralised approach, that supports industry needs, involving all academic organisations in the region.
- Successful initiatives haven't been well communicated and presented among regional partners to build sufficient awareness.

• Is there a possibility for interregional collaboration regarding environmental challenges? e.g. research or demonstration projects. What should be done to intensify such actions? What are the main barriers for interregional collaboration?

In South Moravian region of the Czech Republic, the main possibilities in environmental challenges could be in:

- joint research projects in sludge treatment and water resources protection
- pilot projects for keeping water in the countryside

To intensify interregional cooperation needs are:

- to increase the trust of companies
- to find reliable partners
- to bring and spread good practices and experience

In North-East region of Romania, the main needs of the region to boost interregional cooperation would be:

- Knowing the main funding programs in the field
- Improving projects writing skills
- Exchanges of experience and application of good practices
- Environmental challenger - Probably after the implementation of the iWATERMAP project, we will know what it wants in the field due to the stakeholders in the region.

To intensify interregional cooperation in Latvia:

- Engaging different regional partners to identify common environmental challenges.
- Synchronise the needs of every regional partner to define a common strategy.
- Identify main domains/ knowledge for each partner in the region, identify common synergies

- **Interregional collaboration in the water industry and technology development should be led centrally, supported by regional clusters. Network effects could bring additional trust and motivation to collaborate.**
- **Shift from a project to long term planning. Interregional collaboration programs should last for many years (10+), instead of short periods to realise projects.**

• **Is it possible to formalise cooperation between innovation ecosystems, to support start-ups, students, researchers or research projects? What should be done to stimulate such cooperation?**

In South Moravian region of the Czech Republic, the formalization of cooperation can be done through:

- **memorandum of regional authorities**
- **agreements between company associations like clusters**
- **agreements between universities and research institutions**
- **incorporating water and environmental issues**
- **coordinating interregional agreements and memorandum**

In North-East region of Romania, in general, it is possible to formalise cooperation through an agreement or memorandum. The private sector can be supported by the Enterprise Europe Network. North-East RDA is part of the ERBSN Consortium (Eastern Business Support Network) - is a member of the Enterprise Europe Network.

In order to stimulate this cooperation, there is a need for projects that can generate development, brokerage events. However, the first step is to set the objective and to identify and promote the benefits of such cooperation - without these well-established details, no one gets involved actively.

Stimulating cooperation in Latvia:

- **Developing interregional water industry cluster network, with clear objectives to facilitate research projects**
- **Startups in water technology which should be supported to access interregional industrial partners and experts**
- **startup incubators should be facilitated in academic institutions to stimulate cooperation with university students and researchers**
- **Interregional research, dedicated voucher programs should be introduced to stimulate startups and established businesses for research in institutes and universities, which would lead to better cooperation and technology transfer.**

• **How OP ERDF can support interregional collaboration?**

In South Moravian region of the Czech Republic, OP ERDF definitely can support interregional collaboration, but every project is different, so it mostly depends on conditions in the project. For example, there is a project - Interreg for CR - Poland, SR-CR, Austria - CR, CR-Bavaria, DANUBE, URBACTIII.

In North-East of Romania, OP ERDF still does not provide support, but maybe it should. For interregional collaboration to work, we need to develop: awareness, information, training.

In Latvia, OP ERDF :

- Incorporates requirements towards the funding distribution, important to identify mechanisms to promote local funding to support interregional funding projects
- Developing water industry cluster network, that supports local geographic areas, facilitate dynamic information flow and partner search in interregional level.

• A realistic assessment of creating the conditions for raising competitiveness, growth and jobs in the regions.

In South-Moravia region of the Czech Republic, the conditions for raising competitiveness is moderate:

- growth and jobs are limited by a low member of experts, especially young, in the branch
- start-ups and vouchers are at a low level in the water sector.

In the North-East Region of Romania, the conditions for increasing competitiveness, growth and jobs in the region are, however, low. To develop these issues requires better involvement and stimulation and the support is needed to improve the implementation of new technologies. (e.g. TT vouchers).

In Latvia, for accelerated technology, startup company development, and partnership facilitation among corporates in the water sector and startups would lead to regional development with interregional scale.

• How internationalisation could contribute to critical mass development in participating regions?

In the South Moravian Region of the Czech Republic internalisation could:

- increase the attractiveness of water sector cooperation inside the region
- help to involve Czech subjects in international research and innovation projects
- show the best practices to be followed
- attract more investments
- help to define the way and measures to reach water sector goals.

In defining the RIS3 policy mix of the North-East region of Romania, a series of horizontal and vertical priorities have been established, with specific measures for each of them. The ones that refer to internationalisation are:

Objectives:-

- Increasing by 20% the number of regional business networks and clusters at Q1
- Increasing by 20% the number of interregional cooperation projects promoted with the European Networks and the Specialization Platforms S3

Measure 3.1: Creation and consolidation of business networks and clusters In this sense, priority actions such as:

- Establish horizontal regional business networks (e.g. associations or producer groups) or vertical (clusters on the value chain);
- Supporting existing business networks and clusters for increasing economic performance and attracting new members;
- Assistance for the management of existing business networks and clusters; o Encouraging inter-cluster and inter-network cooperation, including in the direction of their entry into international associative structures.

Measure 3.2: Promoting interregional cooperation (especially S3 Platforms) and business internationalisation In this sense, priority actions such as:

- Interregional partnerships of quadruple helix actors in smart domains to create centre of excellence, training new skills, expanding cooperation networks, facilitating the mobility of teachers, researchers and companies;
- Services to support the internationalisation of the activities of companies in smart-domains, offered through European smart specialisation platforms, including through the members of the Enterprise Europe Network.

Measure 3.3: Attracting Foreign Direct Investment in Smart Priority Areas

In Latvia, internationalisation can contribute to developing the critical mass, through funding cluster network development in the water sector would facilitate knowledge exchange and improve networking among different regions, and facilitation interregional project development would result in new opportunities.

C. Conclusions

The three countries have similar status quo in terms of the main challenges surrounding critical mass development of the sector, internationalisation and human capital development.

An important aspect that needs to be improved in all regions is communication among the stakeholders. Both, in terms of the policy development and overall status quo of the sector. The sector leaders in each region should improve the information flow regarding the technological possibilities of industry 4.0. The latest advancements in the technological possibilities for the sector should be linked to real benefits for the companies. An improved understanding for the stakeholders is needed to highlight the importance of international collaboration in creating the global value chains that can significantly fast-track the implementation of Industry 4.0 solutions.

The three regions believe that the ERDF can support interregional cooperation by

1. **identifying better communication channels and practices that lead to better policy creation that fits the development trajectory of the water technology sector;**
2. **supporting projects with international stakeholders**
3. **developing the scope and conditions for the projects that facilitate increased competitiveness, growth and jobs of the participants (requires companies to grow, adopt new technologies in the field, and facilitate the partnership between companies in the sector).**

7) Province of Friesland

The province of Friesland developed the first Critical Mass Development Report, which also formed a core component of the Critical Mass Development Model and the backbone of the theoretical approach in the iWATERMAP project.

Policy instrument	OP Noord (2014-2020 Northern Netherland Operational Programme ERDF)
Definition	OP Noord indicates the ERDF strategy and programme for the Northern Netherlands for the period 2014-2020

1. Introduction

1.1 Current situation

Stage 3: Enhanced collaboration (more business involvement and expanding national and European cooperation)	
Winning regional, national & European awards	✓
Coordinating H2020 projects	✓
Coordinating science, innovation and demonstration projects (ESIF and Interreg)	✓
Establishing a Centre of Excellence (PPP in which industry is committed long-term and pays at least 25% in cash for pre-competitive research projects)	✓
Forecasting the skills needs within the sector. Establishing strategic cooperation between Vocational Education and Training (VET) School and companies active in the RIS3 sector. Education profiles and traineeships optimised	✓
Develop dedicated Master track in line with RIS3 topic and attract foreign talent to participate in excellent 2 year education programmes.	✓
High interest of BSc and MSc students to perform thesis or traineeship in RIS3 region	✓
Dedicated research programme and high amount of PHDs active in RIS3 topic	✓
Cooperation with knowledge institutes, universities and companies, from other regions and other member states	✓

Increasing amount of start-ups active in RIS3 topic	✓
Connecting with other clusters, regionally, nationally and European wide	✓
Region and member state concentrate funding on a specific societal challenge within the region, enhancing critical mass and creating attractive conditions for international cooperation	✓
Increased interest in scale-ups	✓

Stage 4: Pioneering region: Intensive cooperation on a European level	
Region and national member state concentrate significant resources on RIS3 topic. Centre of Excellence evolves into European Centre of Excellence (PPP in which domestic and foreign industry is committed long-term and pays at least 25% in cash for pre-competitive research projects).	✓
Critical mass allows for high risk research and innovation, starting with the lowest TRL levels and leading towards TRL6 within the research programme with international participants. → Region becomes the most important source of breakthrough technologies in the chosen RIS3 sector.	✓
Novel technologies enhance the competitiveness of the region, the member state and the European Union. New products and services find their way easily within the Global Value Chain. Offering unique products and services well beyond state-of-the-art.	✓
European Centre of Excellence coordinates MSCA Co-Fund project, attracting even more European and global talent and creating more visibility of the research institute.	✓
European Centre of Excellence has a pan-European influence on the research agenda of the RIS3 sector.	?
Establishing cooperation with other fields of science (multidisciplinary cooperation) and executing this research within the RIS3 region: widening the science input. Attracting companies from other economic sectors to participate in the RIS3 region.	✓
Europeanisation and internationalisation further enhanced, innovative companies from all over Europe and the world connect to innovation ecosystem and participate in high-risk research.	✓
Region develops support instruments for start-ups from the region itself and for other start-ups located anywhere within the EU, where possible in cooperation with EIT KICs.	?
Region has forecasted a high jobs growth within the region and initiates a dedicated programme for primary and secondary education to enhance student	✓

awareness and trigger the interest of young pupils for RIS3 sector (e.g. for specific type of STEM education programme).	
Unique ecosystem is recognised within Europe and the world, talent is attracted easily.	✓
Global Investment community eager to attend annual meetings to meet with start-ups, learn about new patents and offer funding opportunities.	?

1.2. Problems

Province of Friesland:

- WaterCampus innovation ecosystem has been built in a region without a university. The primary funding of the Wetsus institute is derived from various sources: regional and national public funding, university funding (in-kind), private funding (in cash) and EU programmes.
- Public funding schemes are changing frequently, and the situation can be drastically different after a national election, e.g. start of the Topsector approach and termination of the Technological Top Institutes programme in 2013.
- Brain drain from the region to more knowledge intensive parts of the country, e.g. main cities and university areas.
- Water technology SMEs have a need for new technologies and knowledge to continuously innovate and improve their technologies and solutions. Preferably through joint technology centers, labs and research programmes (starting at low TRL and leading to new patents, applications and market opportunities), such as WaterCampus Wetsus and WAC.
- OP ERDF Noord 2014-2020 excluded the investment opportunity in research infrastructures and focused on individual SMEs. By 2019 the absorption rate of ERDF Noord funding was very low in general and for the province of Friesland extremely low in particular.

1.3 Definition and objective of roadmaps

The present roadmaps will provide guidelines for the development of a mature water and water technology innovation ecosystem in each region.

Roadmaps are expected to form a solid basis for a thorough analysis of the key issues that hamper the development and implementation of innovation in the water field as well as the regional potential that remains untapped. Mapping these areas is a prerequisite for prioritizing goals and developing a realistic plan that will be enriched with feedback from stakeholders.

For the province of Friesland Roadmap consists of actions to be taken which will transform the WaterCampus into an innovation ecosystem with various new components of Stage 5 of the Critical Mass Development, while simultaneously addressing pressing current issues which hamper development or continuity of the innovation ecosystem and the innovation pipeline.

In addition, the Roadmap will indicate how more Europeanisation of the innovation ecosystem can be facilitated and achieved.

In this way it forms a strategic reference guide for the development in the period 2020-2027.

2. Roadmaps

2.1 Critical Mass Development Model

2.1.1 Goal Definition

This roadmap aims to improve the sustainable economic growth of water and water technology sector in each region.

WaterCampus Leeuwarden and Wetsus will continue to broaden and deepen the cooperation with universities, companies, regions and cities to develop breakthrough water technologies and shorten the time to market. This approach encompasses multidisciplinary research and cross-sectorial collaboration.

2.1.2 Approach

- Which sector will be targeted/focused on?

WaterCampus focuses on the water technology sector and by that it manages to connect with nearly every economic sector. All the processing industries are heavily dependent water technology: food & beverages, pulp & paper, oil & gas, chemicals, water sector etc. all have water technology incorporated in their processing plants. In addition, also tourism and agriculture, automotive and manufacturing depend to a high degree on water and increasingly on more sophisticated water technologies.

Climate change adaptation, pollution, over exploitation of aquifers, economic growth and urbanization all have in common that the need for water technology is increasing.

- How each region will improve the development of Critical Mass of the innovation ecosystem within their region?

WaterCampus will aim to optimize the funding synergies. Firstly, by allowing for investments in priority area (1.a) for research infrastructures, which will support the lab infrastructures of the WaterCampus. Secondly, by refocussing the OP ERDF and allowing also lower level TRL projects. Thirdly, by aiming for co-fund opportunities, in which regional funding, ERDF and EU co-funding (Horizon Europe) can be combined to multiply the impact and achieve a higher level of critical mass of innovation ecosystems.

- Description of steps to improve innovation policies for enhancing the critical mass development of innovation ecosystems in the water technology sector.

Maximizing the co-creation and co-funding opportunities in MFF2020-2027. Creating a high-trust environment in which the regional government, national ministries (Economic Affairs; Education, Science and Culture), European Commission and private companies can co-invest with a long-term agenda in mind.

- Description of steps to establish an integrated network in each participating region where research and innovation efforts are commonly shared between knowledge institutions, local stakeholders and policymakers.

Regional: developing a fit for purpose OP Noord 2021-2027

National: TKI-programme (funding for topsector water)

European: participating in EIT KICs, European Partnership Water4All, HorizonEurope, Erasmus and more.

Private companies: continue and expand (geographies and sectors) the regional, national, European and global participation of private companies in the Wetsus research agenda.

• [Description of how will funding synergies be increased and what can OP ERDF contribute to this development?](#)

In the province of Friesland, change the OP Noord and ERDF investment priorities for MFF2020-2027 to:

- Allow for investment in research infrastructures
- Allow for lower level TRL projects
- Allow the use of ERDF as a co-funding instrument for European Partnerships (HorizonEurope), European Innovation Ecosystems, and more.
- Allow for Seal of Excellence: (1) for SME instrument: so that market opportunities of promising start-ups and innovative SMEs are supported; (2) for RDI projects, increasing the critical mass of the RDI pillar especially in the case of mono-beneficiaries, such as Wetsus coordination of MSCA Co-Fund Actions. These are both very beneficial for the RIS3 strategy and wider economic objectives of the region.

2.2 Human Resources

2.2.1 Goal Definition

This roadmap aims to improve the stable and sustainable economic growth of the sector of water technologies through the qualification of human capital and by promoting the brain/talent retain. This roadmap intends also to strengthen the interaction between academia, administration and companies, by supporting their technological capacity building, increasing their capacity to absorb and create knowledge, and fostering an increasing innovation culture.

WaterCampus has already a well-established Life-Long Learning programme, which includes all EAF levels and also primary and secondary education. This approach will form the basis of the Human Resources activities. Actions will be taken to further enhance the efficiency, impact and European connectivity and integration.

2.2.2 Approach

- Description of steps to develop the human capital roadmap.

Starting from the existing Life Long Learning agenda new initiatives will be taken:

- Continue the development of CIV-Water as a European Centre of Vocational Excellence.
- Work towards a European Platform of Centers of Vocational Excellence.
- Enhance European cooperation in the field of primary and secondary education, e.g. RawMatters at Schools project with EIT Raw Materials.
- Develop a dedicated water technology BSc together with Stenden/ NHL
- More EU cooperation, student and staff exchange in the field of BSc level education
- Attract more Master students to Wetsus master track Water Technology.
- Explore EU opportunities for “Brain Circulation”, how can other EU regions create the right conditions for high-level PHDs to return to their region/ country of origin and perform meaningful and rewarding work.

- Description of steps to improve the integration of entrepreneurship into the education profiles?

Facilitate more cooperation between business and education institutes. Activities by CIV-Water in this domain are exemplary. CEW has a track record in this field and expressed the interest to develop a dedicated BSc programma together with regional universities of applied sciences. There is an urgency to develop this in the very short term, in order to connect with partners from other iWATERMAP regions and other EU regions and countries. Wetsus master and PHD programme are very well connected to entrepreneurship and there are plans for even more integration (e.g. water technology MBA).

- How far are the various EQF (European Qualifications Framework) levels represented in the education profiles of the region, connected with the innovation ecosystem?

For water technology this has already been implemented 100% in the Province of Friesland. What can be improved is a dedicated BSc degree at universities of applied sciences, more master students enrolling at Wetsus and continue to develop the CIV-Water contribution to the platform for VET-Excellence for the water sector on both national and EU level.

- Are there other instruments or support programmes in your region? If yes: Can these programmes be more interesting for applicants? What is the awareness about them in different branches of triple helix? What should be done to increase the awareness and encourage potential partners for application? If not: what steps should be taken to introduce such programmes in your region?

Various regional support programmes are dedicated to or open to Water Technology research, education, innovation or company support. Bison is an investment programme within the province, which invests in (water technology) start-ups within the region. There are also interesting developments together with NOM (Northern Netherlands Investment Agency) for a dedicated water technology investment programme.

- Which elements are concretely missing? Can these be addressed through OP ERDF?

A stable pillar of primary funding is missing in the Wetsus research programme. OP ERDF might be able to contribute to this in MFF2020-2027, especially by allowing low TRL RDI projects and through synergies with HEU, such as European Partnership Water4All and European Innovation Ecosystems. These type of opportunities would allow the co-funding of Wetsus through regional and national public funding, private sector contributions and co-funding from Horizon Europe.

Furthermore, ERDF can contribute to investments in regional research infrastructures.

ERDF might also contribute to the skills agenda and linked to that develop and execute education programmes and curricula, supporting the Life-Long Learning Cycle (EQF1-8).

Water4All might also offer European incentives for cluster organisations which are facilitating inter-regional collaboration and the piloting of novel innovations in demonstration sites and living labs.

2.3 Internalisation roadmap

2.3.1 Goal Definition – Where to be in 5 years?

WaterCampus Leeuwarden, has been building a position as European Hub for the European water technology sector. Water Alliance is coordinating global cooperation through the Global Water Technology Hub Alliance (<http://www.gwtha.com/>). The European Commission might be inspired to support this kind of sectoral cooperation at global level. It is the best entry point for European start-ups into the world market.

Exemplary is the achievement of Hydraloop. Water Alliance member Hydraloop has won Best of Innovation in Sustainability, Best Start Up and Best of the Best at CES 2020 in Las Vegas. The product has also been named to TIME's inaugural Best of CES list, which recognizes the 25 most exciting and creative products shown at CES this year.

Participation of Hydraloop was not only supported by the Dutch cluster organization Water Alliance, but also by the American cluster organization Water Council (based in Milwaukee).

Besides the global cooperation, also more EU collaboration will be forged. S3P Water Smart Territories forms an interesting pillar in this domain. There might be Interreg Component V funding to support close to market collaboration for these thematic platforms. In addition, the European Partnership Water4All will most likely form an interesting opportunity for Water Smart Territories to cooperate in.

2.3.2 Approach

- **In which areas is the internationalisation of the innovation ecosystems required?**

Further strengthening, maintaining, and expanding the European Water Technology Hub position of WaterCampus Leeuwarden. There would be interest for EU support to facilitate the internationalization of start-ups and SMEs from other EU regions. These start-ups could benefit from the experience and global network of the Water Alliance. They could participate in a dedicated European pavilion of global trade fairs with an affinity to the water technology sector.

- **Identify barriers for student or staff exchanges. Describe steps to overcome these barriers.**

Wetsus offers a master track (joined degree of the universities of Wageningen, Groningen and Twente). Because Wetsus itself is not a university, it is not able to send Erasmus students to other EU countries. It can receive foreign (Erasmus) students. These students perform their traineeship or thesis at Wetsus, or participate in the full 2-year master track at Wetsus.

In the BSc field more action needs to be taken in the city of Leeuwarden to develop a dedicated BSc programmes for water technology. The universities of applied science NHL-Stenden and Van Hall would be the institutions offering the BSc degree. Once fully established dedicated exchange programmes for students, staff and teachers can be developed.

- Is there a possibility for interregional collaboration regarding environmental challenges? e.g. research or demonstration projects. What should be done to intensify such actions? What are the main barriers for interregional collaboration?

WaterCampus Leeuwarden is actively working in various regional and EU projects to solve environmental challenges. Interreg NWE Water Test Network is a good example of a project in which start-ups and SMEs are supported to demonstrate their environmental solution in real life conditions. With iWATERMAP partners similar projects could be developed in other geographies.

Water Smart Territories might also support these types of activities. If the current list of projects is suitable remains to be seen. What would help is if Member States would soon agree on an EU budget for the next MFF and if programmes would be fully developed and published before the end of 2020. This way the iWATERMAP and WST regions can explore what the conditions are for interregional collaboration and possible European co-funding for projects and initiatives.

The circular economy (reducing waste by 50% by 2030) and the Green Deal are promising policy instruments, which could form the fertile soil needed for water technology SMEs and start-ups. Resource recovery from wastewater is an increasingly more interesting field to improve environmental performance, reduce GHG emissions and increase security of supply.

- Is it possible to formalise cooperation between innovation ecosystems, to support start-ups, students, researchers or research projects? What should be done to stimulate such cooperation?

Water Smart Territories and Water4All could form the right basis for this type of more formalised cooperation. In addition, there might be similar schemes possible between iWATERMAP regions in the framework of the new EU programmes in 2020-2027.

- How OP ERDF can support interregional collaboration?

OP ERDF could support interregional collaboration by allowing ERDF to be used as a co-funding source for Water4All. In Wetsus already 20 universities from 9 EU countries and companies from 19 different countries participate. WaterCampus even facilitates the cooperation with 32 different countries (and many more regions). This could be further enhanced, expanded and improved with ERDF co-funding.

- A realistic assessment of creating the conditions for raising competitiveness, growth and jobs in the regions.

Although relatively small in size, the Top Sector Water is considered a strong regional specialization. With around 2500 jobs in the water technology sector in Friesland, 100 innovative SMEs, 2 public water companies and 10 sectoral knowledge institutes. Wetsus, European Centre of Excellence for Sustainable Water Technology forms the core of the ecosystem. (Buck Consultants International). The Wetsus research programme is an industry driven research programme in which 50 professors from 20 research centers from 9 EU countries execute research and over 100 companies define the research agenda. The Wetsus programme has so far resulted in 33 spin-off companies, over 700 highly cited research papers, almost 90 high-value patents and over 100 graduated PHD students.

The challenge of the water technology cluster in Friesland is to make knowledge (even) more economical. This works if you look at the number of spin-offs from Wetsus (33) and startups (25). Turnover of companies in cluster was estimated at 450-480 million in 2017. The cluster is export-oriented: three-quarters of the companies operate internationally, the share of exports as part of the turnover is estimated at 35-40%. (Buck Consultants International).

- [How internationalisation could contribute to critical mass development in participating regions?](#)

For the Province of Friesland internationalisation is of vital importance for the water technology sector. Water technology solutions are often applied in specific settings with specific needs, the right market conditions usually exist in a few locations in the domestic market and in many locations on the world market. Water technology products and solutions are often niche solutions, with the niche being much bigger on the global level.

From education, research and innovation perspective, internationalisation is vital to attract the right talent, connect with more knowledge institutes and companies, connect with more economic sectors, more scientific disciplines and more funding agencies. Combining all this forms boosts the critical mass, relevance and impact of the innovation ecosystem.

C. Conclusions

WaterCampus Leeuwarden has come a long way since its initial beginning in 2003. At the same time, it has a lot more in store. For these developments ERDF is a vital component and setting the conditions for OP Noord right is extremely important.

The Achilles heel of Wetsus research programme can be strengthened by co-creation and funding synergies. ERDF, regional and national public funding, private funding and European programmes all form essential components. Especially important are ERDF investments in research infrastructures and the use of ERDF as a co-funding instrument for European Partnership Water4All.

The Life Long Learning cycle can be further strengthened and expanded together with European partners. Erasmus pilot project CoVE-Water is a good example in this domain, more will need to be achieved in BSc and MSc level cooperation.

Interregional and international collaboration can be increased by initiatives such as the Global Water Tech Hub Alliance. Anchoring this initiative in an EU context would make it more durable, financially sustainable and impactful.