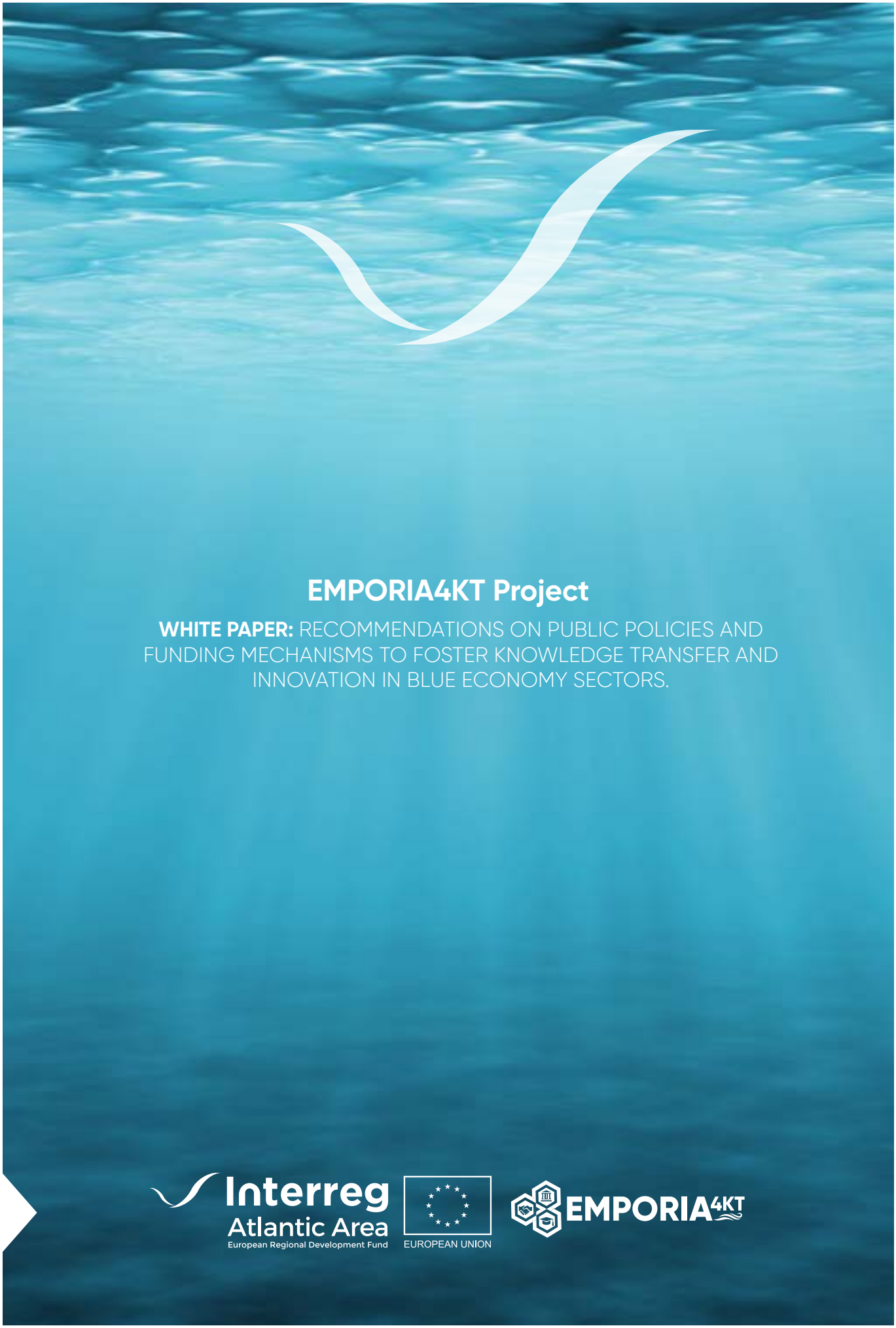

EMPORIA4KT Project

WHITE PAPER: RECOMMENDATIONS ON PUBLIC POLICIES AND FUNDING MECHANISMS TO FOSTER KNOWLEDGE TRANSFER AND INNOVATION IN BLUE ECONOMY SECTORS.

Interreg Atlantic Area
European Regional Development Fund

EUROPEAN UNION

EMPORIA4KT

AUTHORS:
Macarena Ureña Mayenco, Juan Carlos Moreno García, Carmen Girón Domínguez (Technological Corporation of Andalusia - CTA)

With collaboration of EMPORIA4KT consortium partners:
NOVA School of Science and Technology, Center for New Water Technologies, International Campus of Excellence in Marine Science - CEI·MAR, Frontier IP, Strane Innovation, Technopole Quimper, Liverpool John Moores University, Údarás na Gaeltachta, Sociedade Portuguesa de Inovação, AquaTT

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1. INTRODUCTION

The European Union (EU) Blue Economy (BE) represents all economic activities related to oceans, seas and coastal regions and covers areas such as fisheries, shipbuilding, tourism, and ocean energy and other emerging sectors [1]. The sector currently provides employment for almost 3.5 million people in Europe and continues to grow. However, investments in innovation are needed to create new business opportunities and to sustainably manage our ocean and sea resources.

The present work has been carried out within the **EMPORIA4KT EU Project** which is funded by the Atlantic Area (AA) INTERREG Programme through the European Regional Development Fund (ERDF). The EMPORIA4KT project was born to **boost the Blue Economy in the AA.** Its overall objective is improving **transnational cooperation and synergies between triple helix players** (Government; The Production Sector and the Science-Technology (S&T) ecosystem, including universities, public and private R&D&I centres [2]) to foster innovation and competitiveness in AA's Blue Economy, by focusing on upgrading academia skills for Knowledge Transfer (KT) and innovation.

As it is commonly known, KT is the exchange of knowledge between and among individuals, teams, organizational units, organizations, etc. KT is a powerful mechanism to boost innovation and **for the dissemination and application of research results** [3]. Thus, in order to drive sustainable growth for the EU Blue Economy, it is understood that better links are needed among the triple helix players: academia, business, and government sectors which often have different motivations.

Commercialisation of technological innovations is a key driver for long-term economic growth [4]. Usually, it is a long and risky process, involving many factors and external players to the research institution [3]. This is best illustrated in the figure below:

Figure 1: Definition of Blue Economy sectors,. Adapted from United Nations.

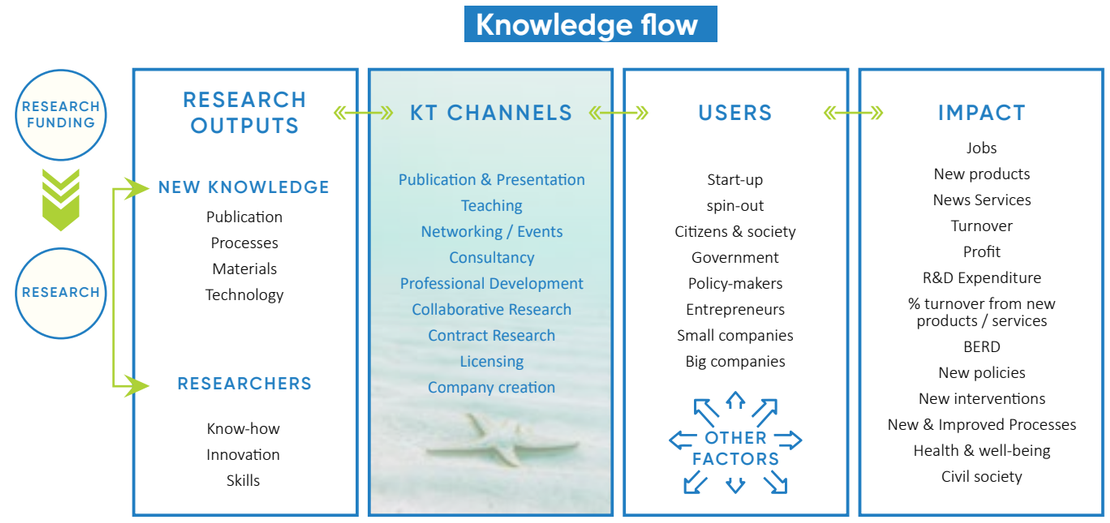

Figure 2- Knowledge Transfer process [3].

In that regard, the EMPORIA4KT project focuses on the transfer of one specific type of knowledge produced by academy, **Early-Stage Technologies (EST)** developed through academic research, a type of knowledge that often does not reach market. This work has developed under a unique time with the COVID-19 pandemic. In these circumstances, it has become even more evident that science and innovation are essential to face the great social challenges and to find solutions to the complex problems associated to them.

In the course of the project, a transnational vision has been acquired on the EMPORIA4KT Atlantic member countries (France, Ireland, Portugal, Spain, and United Kingdom (U.K.).) studying the mechanisms that each country has to drive and foster KT, including but not limited to **public innovation policies, funding mechanisms and key players and instruments.** It has also studied the elements that hinder the **market entry of innovation technologies** in the Blue Economy and slow down the progress of knowledge transfer in the AA regions.

Within this frame, this White Paper, developed under WP Nr. 8 "Create a positive influence in public innovation policies and funding", is devoted to providing **information on the main gaps in knowledge and technology transfer affecting the triple helix** in the economic sectors of the BE in the Atlantic Area. Secondly, it aims to produce a **list of recommendations** to address the existing gaps affecting KT in the Atlantic, to serve as a model **for improving public innovation policies, funding instruments** and **innovation metrics**. Thirdly, to **foster innovation and competitiveness in AA's Blue Economy**.

In methodological terms, this White Paper brings together conclusions after the analysis of the information gathered within 8.1 (Assessment of Blue Economy State of the art) and 8.2 (Mega data analysis of science and technology investments funds) deliverables, as well as analysis of results from national and international EMPORIA4KT bootcamps, where different co-creation activities were put into place to understand the different stakeholders' views, how academy-industry-government relate and what are the main obstacles and the results of the responses to the forms in WP 3.6 about funding sources.

The recommendations in this report are structured according to **four key factors** that have been studied throughout the development of the project:

- **Funding Policies Supporting KT**
- **Skills for KT**
- **Key stakeholders and resources acting as interface for KT**
- **Intellectual Property (IP) for KT**

In the next pages, for each key factor, a summary of the current barriers for the KT accross the Atlantic Area is presented as well as recommendations for policymakers to eliminate/mitigate existing gaps based on these factors, with special emphasis on the Blue Economy.

2. WHY IS IT NECESSARY TO IMPROVE KNOWLEDGE TRANSFER IN THE BE?

The knowledge in society is located on three essential pillars: Enterprise, universities and Public Administrations. The effective interaction between these three agents is critical to realising the European aspiration of becoming the world's most advanced economy and society. The European Union has continuously promoted this idea, and triple helix collaboration [2] was the focus of the European Modernisation Agenda for universities: Education, Research, and Innovation, presented in 2006 [5]. In 2009, the Communication from the European Parliamentary Commission to the Council, the European Economic and Social Committee, and the Committee of the Regions [6] suggested that universities should develop structured partnerships with the business community with the aim of

> ***"Acquiring increasing economic power, being able to respond more quickly to market demands and establishing partnerships which maximise scientific and technological knowledge."***

Historically, universities have focused exclusively on academic training and research. However, in recent years new demands have been made on them to develop mechanisms to transfer that knowledge and technology to society (co–creation and the dissemination of research results with and to non–academic third parties) [3]. **The aim of this process is to effectively incorporate knowledge into the production sector.** Indeed, universities and businesses have always operated at different speeds and independently of each other, mainly because they have very different interests, goals, and target publics.

However, nowadays, knowledge forms the backbone which sustains the world's most advanced economies, the relationship between the two could resemble what in biology is called "mutualism". Therefore, **creating a scenario in which all agents can obtain benefits seems to be the best way forward and the most logical option for the future.**

KT aims to maximise the two–way flow of technology, IP, and ideas. In turn this enables companies (existing and new) or other non–academic organisations and the public sector, to drive innovation leading to economic and social benefit and enables publicly funded research organisations (PROs) to advance research and teaching.

KT is now a recognised activity in which PROs are expected to engage and has been adopted as a part of the "third mission" alongside teaching and research by many PROs and universities across Europe [3].

In the context of EMPORIA4KT, BE is linked to many economic activities with a high socio-economic and environmental impact. A broader vision of the Blue Economy can offer important sources of sustainable economic development for the European economy, coastal communities in particular, and a better understanding of the value of the ocean and its ecosystems; therefore, innovation capacity and knowledge transfer potential play a key role in the sectors involved in the BE to change to a more sustainable economy, as well as the development of policies in line with this strategic approach at all levels of governance.

Creating effective ecosystems of innovation can improve technology transfer and the emergence and economic exploitation of new R&D&I results.

BE includes those activities that are marine-based or marine-related, not only established sectors (marine living resources, marine renewable

energy, port activities, maritime transport, coastal tourism, etc.), but also emerging and innovative sectors (i.e. ocean energy, floating solar energy and offshore hydrogen generation, marine minerals, desalination, submarine cables, biotechnology, etc.) which bring new opportunities for investment and hold huge potential for the future development of coastal communities.

The European Commission is determined to continue supporting sustainable growth in the marine and maritime sectors through **the European Union Blue Growth Strategy** [7].
The European Union puts highest priority to the increasing climate, environmental and social challenges that society is facing today, where research and innovation is a fundamental pillar to contribute to the transition towards a European Blue Economy.

The **2021 Blue Economy report** [8] highlights the need of research, innovation, and education to preserve marine ecosystems to optimise potential benefits of ecosystem services and marine and maritime economic sectors. This will contribute to deploying European knowledge and technological solutions for the reduction of marine pollution including plastics, mitigation of climate change in the ocean, sustainable use and management of ocean resources, development of new materials including biodegradable plastic substitutes, new feed, and food systems, coastal and maritime spatial planning, and ocean governance. Preserving and increasing the natural capital accumulated in the seas and oceans is critical to deliver sustainable ecosystem services and for the EU to achieve the **Sustainable Development Goals** (SDGs) set by the United Nations (UN) [9] and the aims embedded in the new **European Green Deal** [10].

The European Blue Economy can and must be a central and solid pillar contributing to the general resilience of our society. On this basis, a political and financial ecosystem can be developed in the field of the Blue Economy, bringing the benefits of knowledge and technology transfer to the whole of European society and economy:

- For **citizens** gaining new benefits, e.g., cleaner transport systems, access to efficient renewable energies, purchase of new bio-based products, better public services, etc.
- For **business development**, e.g., R&D&I public and private investments in BE, the creation of new technology-based companies, the opening of new value chains and markets, a new generation of innovative products and services based on the incorporation of new technology, increased entrepreneurship, and competitiveness through innovation, etc.
- For **universities and research and technological centres**, e.g., academia awareness on industry needs, collaborative projects with private entities, patent generation, young researchers' scholarships in private entities, new research lines, training and funding to mature EST for commercialization, etc.
- For **public services** by the administration, e.g., reducing the costs of providing services such as transport, energy, waste management, etc. and improving public competencies through innovation initiatives (agricultural and fisheries management, etc.).
- **For environment** improving the sustainability of the products and services, fostering knowledge and technology transfer can play an important role in achieving the Sustainable Development Goals and in addressing climate and environmental challenges, and is a key enabler for achieving the European Green Deal objectives.

For all the above reasons, the development of the Blue Economy should be based on scientific, technological, research and innovation developments.

Although the research community and industrial players already cooperate in several ways, there is an acute need to improve how these collaborations are established and sustained.

3. WHAT ARE THE MAIN BARRIERS AND MECHANISM TO IMPROVE THE KNOWLEDGE TRANSFER IN THE EUROPEAN ATLANTIC AREA?

As stated above, universities and other research institutions play a central role for the knowledge generation for society in three key ways. Firstly, **as producers of knowledge** through R&D&I activities; secondly, as **transmitters of knowledge**, through training and publication of results; and finally, through the **transfer of knowledge**. The most advanced economies are those which have managed to build a stable relationship between scientific knowledge and its application to goods and services across industry. This scenario must however be accompanied by a strong commitment from all the stakeholders involved, including the Administration.

In that regard, EMPORIA4KT, after studying and evaluating the current situation in terms of S&T ecosystem, knowledge transfer and Blue Economy sector in the Atlantic Area member countries, has identified four key areas for KT that still struggle to be effective and efficient: **Funding policies supporting KT, Skills for KT, Key stakeholders and resources acting as interface for KT, and IP for KT.** The main barriers identified in these pillars of collaboration and transfer are described below, as well as a series of recommendations to address them.

3.1. FUNDING POLICIES SUPPORTING KNOWLEDGE TRANSFER

Funding Policies Supporting Knowledge Transfer are of importance to the economic development of business innovation and the success of Business-University collaboration. In a heterogeneous system such as the one that characterizes the Blue Economy sector, **regional policies adopted by Public Administrations could be crucial to accomplish with upstream policies** to ensure the success of joint development of technologies that respond to the market needs of the blue sector in the Atlantic Area.

Alongside regional policies, European Policies encouraging collaborations between organisations through staff exchanges such as Marie Skłodowska-Curie Actions, as well as Green Deal policies, will provide opportunities for synergies among different Blue Economy subsectors in the development of new technologies. **Flexible policies targeting knowledge transfer among the triple helix are needed** to ensure that the sector adapts to the changing trends of the market and society.

The problem of access to finance is transnational as it has been assessed in the **"Mega data analysis of science and technology investments funds" and the "Assessment of Blue Economy State of the art"** of the EMPORIA4KT project.

That problem is deeply rooted in the context of the Blue Economy and for new cutting-edge industries spawning in the sector like blue bio-based industries. Although **public funding is fundamental in creating pioneering technologies and businesses, the private sector should also play a leading role in the development and use of cutting-edge technologies.**

In that regard, the main transnational barriers identified and some key recommendations to transform the Atlantic Area countries studied, can be described as follows.

Main barriers identified

Gaps between the private sector and universities.

- SME and companies have limited experience and knowledge of dealing with universities and other research organizations and vice versa.

- Insufficient knowledge of bussiness awareness of the technological offer of public research organisations and S&T offer not aligned with business needs.

*Furthermore, **companies are not aware of the research done by universities**. One of the biggest problems in the cooperation between universities and companies is a **mutual ignorance of their needs and concerns,** and the tendency to have different interests and objectives.*

- Academic interest is driven by producing journal articles and research funding whereas industrial is more profit motivated.

- Science-business linkages are relatively weak, both in terms of scientific co-production and business-funded public R&D

- Limited career incentives for researchers to collaborate with industry.

*There is still **strong separation between universities and the private sector.** The lack of mechanisms to foster SME & Large businesses collaborations with research institutions (R&D tax credits, VAT values, lack of assistance in finding research partners, etc.). Even if in the country exists some mechanisms for collaboration, SME and companies dedicate a significant part of their time to finding external funding for their activities. This requires a highly specialised approach which involves continuously updating the information on proposals put forward by private and public entities for the financing of innovative business initiatives.*

Lack of versatile mechanisms for the financing and promotion of collaborative innovation and KT.

- Limited public incentives for universities and businesses to undertake collaborative projects, particularly at a national level.

*There are different needs for **technology and knowledge transfer offices** from different regions and sectors of the Blue Economy. For instance, in France and Spain there is a large dependency of national R&D and innovation funding system (funding innovation projects in fisheries sector, conservation of marine biological resources and the aquaculture sector) that not always meets the need to promote university collaboration with the blue industry. For example, reinforcement of the aquaculture sector by knowledge transfer mechanisms to share R&D and innovation results. In some cases, it appears to exist problems understanding the ocean market sector from the policy maker's side. Ireland also faces a lack of investment in Blue Economy with most of the investment being focused in the large urban areas.*

- Excessive dependence on public funding. Private financing systems for innovation can be considered still emerging.

***Private financing mechanisms for innovation can be considered still emerging**. Existence of private investment in science for research and innovation projects is little nowadays, and financing agencies are more devoted to the R&D projects. There is a lack of versatile mechanisms for private financing and excessive dependence on public funding.*

- Problems associated with the decentralisation of funding programmes: administrative and management difficulties, etc.

- Interface institutions have difficulties in financing its structures and have limited resources.

- Overlapping in the functions of the various public administrations and fragmentation of multiple departments and governmental bodies of technology transfer.

- Regional policies which prioritise protection over creation.

- Difficult access to research carried out in the past that may have potential for application in the market currently.

- R&D&I investment is concentrated in a limited number of companies and regions.

- There are not enough funding mechanisms for proof of concept of innovations generated in research centres, like testing demonstration projects at sea. Funds for the implementation of pilot projects are also limited.

- Government's efforts to increase technology transfer have been disproportionately targeted at the university, rather than business.

*Some countries, like UK, invest their **government's efforts to increase technology transfer targeting the university,** rather than business sector [11]. Furthermore, it is common to find huge bureaucracy in structural funding regarding mechanisms that promotes relationship between academia and industry.*

- Limited knowledge about IP management, both by Industry and administration when setting up financing mechanisms.

***Attracting private finance for the Blue Economy** sector is still difficult, independently of the investor (investment fund agencies, private equity, angel investors, venture capital...).*

- Promising start-ups lack specialized private and public support and investment and blocks their growth.

Key recommendations

The objective is to raise awareness amongst all three agents and encourage them to know the needs of their region in the Blue Economy sector, helping in building of finance mechanisms that can meet the national funding policy's needs, but also **meet the specific funding needs of the region and Blue Economy sectors [12].**

For instance, an example is the Spanish Institute for Energy Saving and Diversification (IDAE) [13] funds for R&D at national level and regional governments, since they are frequently in collaboration to boost emergent sectors for Ocean Energy. Also, UK's CATAPULT network, organisations that promote research and development through business-led collaboration between scientists and engineers to exploit market opportunities [14].

Regarding funding mechanisms, funds should be disbursed in the form of grants, and **a small proportion of the Fund should be set aside to provide support for business training and mentoring,** to maximise the success rate of the awards that are made. General guidance for the different technology transfer offices is needed, regardless of the region or sector. For instance, **creating an institution that helps to support university SMEs understand the complex policy system and assess to the finance.**

There is a need to create innovative management support structures and to generate more platforms, tools and institutions that promote communication amongst different stakeholders in KT. Similarly, it is quite widespread in the AA that interface actors have difficulties in financing their structures and limited resources, which highlights the need to create **lines of funding for the creation and maintenance of effective collaborative institutions for KT.**

Support is needed to implement strategies and policies in universities and R&D centres based on dialogue with business and knowledge transfer and on promoting the dissemination of good practices in this respect. Academic institutions that are receptive and flexible in terms of collaboration with companies with a strong orientation towards licensing and the creation of spin-offs, with an innovation model clearly oriented towards the commercialisation of products and which encourage the creation of **joint research groups** with the private sector are sought after.

*As suggested in the EC Blue Bioeconomy Forum (Roadmap for the BE), one initiative would be to build a **European blue bioeconomy ecosystem** that will: 1) foster the interaction between the regional players and develop the research and innovation network at local level (e.g. financing new infrastructures; encouraging schools and universities to adapt their training according to the need of the industry; 2) encourage the development of an European network of blue*

bioeconomy regions, where more advanced blue bioeconomy regions could help and pull "follower regions" on the development of regional ecosystems. Such initiative could build up on the regional smart specialisation strategies and could be easily integrated in the work that is currently carried out by JRC and DG REGIO on the interregional S3 platforms.

Innovation is a process which can take place at anytime and anywhere. For this reason, it is necessary that the parties involved perceive it as an ongoing activity rather than a simple knowledge transaction. The process requires a suitable ecosystem (business angels, venture capital, interface institutions, public policies for incentives, etc.) and above all, an entrepreneurial culture with values which focus on exploitation of knowledge coupled with a strong sense of cooperation.

Private investors **use private capital to finance R&D and innovation business activities**, like voucher funding for start-ups to use scale-up, for example market acceptance vouchers. This common strategy in Anglo-Saxon countries **offers interesting possibilities which are not available from public funding**, which is the main source of financing for companies in AA´s regions. In this respect, it is important to note that collaboration with universities plays a crucial role in such projects by helping to convince investors about the viability of ideas. Venture capital funds is the private capital most needed for supporting new emerging sectors in Blue Economy according to the online survey among EMPORIA4KT partners.

Finally, it is necessary to fund actions aiming at valorising the knowledge and results of research projects previously funded under projects of excellence or fundamental or basic research. For instance, implement a public policy with a funnel funding scheme that would support R&D from fundamental research to higher levels of TRL.

Currently, academia R&D+I funding mechanisms are focused on TRL 1-3, while academia has the knowledge and capabilities to develop a technology up to TRL 6, sometimes higher. Funding instruments to developed technologies up to TRL 4-6 are dedicated solely to companies, with the added disadvantage to public universities which is the ownership of the intellectual property going directly to the companies with no mandatory share of commercialization benefits with the universities in case the product makes it through the market.

An appropriate funding mechanism is recommended for activities to advance the early stages of pre-competitive development (**Proof-of-concept**) and to facilitate the transfer or exploitation of results, in the form of products, goods, services or other applications, which are beneficial to the economy, society, culture or public policy. The funding will be aimed at carrying out additional activities to confirm the innovative potential of these projects and facilitate their transfer.

An example is the call "Proof-of-concept" by the Spanish Ministry of Science and Innovation, Proof-of-concept projects may not be oriented towards the continuation of the research of the previous project, so the activities will be oriented towards progressing in the early stages of pre-competitive development. The call finance activities for the development, valorisation, protection, transfer and exploitation of the research results and EST.

The following summarized list of recommendations helps to synthesise the solutions suggested for the funding policies supporting the Knowledge Transfer problems in the AA:

01› Supporting regional funding policies by promoting collaborative regional networks in support of technology transfer and development

02› Encourage the decentralisation of funding sources for KT in BE and its promotion in the regions of the Atlantic Areas.

03› Create links between local research laboratories and SMEs/small businesses.

04› Create funding mechanisms for proof-of concept of EST generated in research centres.

05› Encourage mobilisation of private capital to finance R&D and innovation business activities.

3.2. SKILLS FOR KT

According to the European Directorate-General for Research and the European Directorate-General for Enterprise and Industry [15], to achieve successful KT, the personnel working on it must possess a wide range of skills to carry out their tasks effectively. However, continuous professional development exists in a limited number of countries, but it is often inadequate in terms of cost and/or delivery. The collaboration between businesses and universities is based on the mutual effort of individuals within these organisations. Incentives are needed to attract talent and abilities at academic and business level, to train and coach people, to create a risk-taking and collaborative culture and to stimulate the entrepreneurial spirit.

In the context of the BE, **Blue Skills** have been included as a key pillar in the Atlantic action plan 2.0 [16], with a strong focus in bridging the skills gap between education offer and labour market needs, especially with regards to technological developments and innovation, improving the communication and cooperation between education and industry. As the 2021 Blue Economy report states [8], the BE sector may have great potential for growth and innovation, along with positive social and environmental impacts, although **there is insufficient well-trained professionals and high-level personnel working** in these industries.

The current dynamic is changing by considering the shifts that will occur in upcoming years, e.g., automated ships, ocean energy, and coastal tourism, etc. The skills required become more complex with each phase of product development. Whereas in initial phases, specialised technical skills are needed, later phases also demand business skills [17]. Multidisciplinary skills are needed for game-changing technologies development, there are skills gaps in different positions, for example, management positions require more advanced technical skills, technical experts require more non-technical skills, specialised positions combining two or more types of technical expertise, etc [18].

To overcome that skill gap in the Atlantic Area countries studied (France, Ireland, Portugal, Spain, and United Kingdom (U.K.).), the main problems are identified, and some key recommendations are mentioned to transform the KT ecosystem:

Main barriers identified

Skills gap between education offer and labour market needs.

- Need to improve training in business management and awareness in the academic world.
- Not so many programmes to promote employability and entrepreneurships for PhD and not enough job opportunities for researchers and PhD graduates in the private sector.
- There is a lack of involvement of the private sector in doctoral theses.
- The business sector does not seem to be able to capitalise on the scientific strength.

***Companies are not aware of the benefits of R&D and innovation, and the schemes and opportunities available to them**. There is talent (PhD) but lack of private investment to enable the promising start-up to grow compared to U.S.A., where big investments funds detect the promising technology creation. That is because the business sector does not seem to be able to invest on scientific strength.*

- Low awareness of mobility programmes and the incorporation of researchers and PhDs in companies

*There is a lack of effective systems to connect the excellent human resources available in universities with the demands of the private sector. In Spain, the Ministry of Science and Innovation launched the **Bridge System** where interested companies access CVs of PhDs and researchers, but is normally under-utilised.*

- Clear need to close the skills gap between the education on offer and the labour market by increasing cooperation between academia and industry and increasing the attractiveness of the blue sectors.

- It is necessary to evaluate and reward the technology and/or knowledge transfer carried out by research public bodies and universities.

Low mobility and unstable working conditions

- Lack of stable and permanent contracts for post PhD researchers.

- Low wages for PhD. Typically, jobs are lower paid in the rural /coastal areas.

> *High rate of higher education graduates suffer from a very strong **underutilization of PhD skills** and receive low salaries. **Low wages for PhD** students and young researchers are common for most of the countries studied. Trying to find a position that fits with their skills is completely challenging. Moreover, there is a **lack of research jobs available to graduates in the private sector**. It appears to be an inability of the industrial players (from large to small companies) to absorb the doctors from the R&D institutions in addition to the **low number of PhD in the business environment.***

- Excess bureaucracy hinders recruitment.

- Lack of skills, financial resources, and autonomy in universities for the KT.

> *There is a **lack of synchronisation between recruitment of researchers and obtaining funding** to establish competitive research groups **in academia** at European level.*

- Staff mobility (incorporation of researchers into companies) is a very unknown instrument, and there are problems associated with the mobility of researchers and the limitations of resources and communication infrastructures in remote areas.

Lack of specialized skills

- Few training programmes only dedicated to raising awareness of the researchers to the commercialisation of technology in the BE and that explain what the road to market could be (licensing, partnership, business creation…).

- Science policy has not yet explicitly incorporated internationalisation as a mechanism for evaluating the merits of the researcher.

- Lack of human resources with experience in business-oriented R&D&I projects and management of funding grants.

- There is a lack of training in key skills to capitalise on research results, such as business, finance, communication, IP, entrepreneurship, etc.

Key recommendations

Strengthening exchange programmes for research personnel is suggested to enhance internships, grants, and promotion of employment of academia researchers into business, **staff mobility grants** are one way to bridge the cultural gap between universities and companies. To achieve this, **programmes should permit university researchers to develop mid-long projects in companies**. This would allow researchers to transfer their knowledge to R&D and innovation departments, but also interact with business development, production and/or marketing departments, thereby **broadening their skills and furthering their understanding of the skills needed in business**. Moreover, these new professionals will bring back those skills to the academia, helping in the process winning grants and contacting with new enterprises and clients for the university, but also having the Blue-related skills needed for the business sector like **sampling, recording, and working on marine environmental or engineering level besides scientific level.**

Policy making is needed for broadening tertiary education with more inclusive and flexible learning, and equipping students with labour market relevant skills and competences [20].

Companies should have a strategic role in **doctoral programmes**. The various measures available to them include:

- Increasing the recruitment of people with doctorates.

- Encouraging the completion of doctoral programmes among their employees.

- Becoming more actively involved in the definition of the areas of research being studied in doctoral theses.

- Incentivising doctoral programmes which are in accordance with their business interests, etc.

Moreover, financial resources, besides legal changes, are needed to solve the researchers' precarious situation. Government should put the financial **support for entrepreneurs, such as start-ups, university spin-offs**, and SMEs, at a higher priority.

> *For example, Portuguese **Bluetech Accelerator** [21] is an accelerator program designed for start-ups working on solutions in the areas of shipping, ports and digital. The program is powered by the Portuguese Republic Ministry of the Sea and will allow for the start-ups to showcase their solutions in major events like the European Maritime Day and to work alongside with world class partners.*

> *Another example is the **Youth4Ocean**, an initiative where young people between 16 and 30 years old can submit their projects (innovative business plan to use marine resources sustainably, a project in mind to raise awareness of consumers on sustainable seafood, etc.) and apply for accreditation as Young Ocean Advocate. Applicants get the chance to showcase their project, participate and pitch their ideas in European events, connect with mentors, network with leading European experts, participate in working groups along with stakeholders and decision-makers to address ocean challenges, and benefit from leadership resources to make a positive change.*

It is key to promote the creation of education programmes and job positions for **transfer managers,** i.e., fully qualified researchers, with practical understanding of all the operational procedures associated with academic institutions. The role should also have the capacity to **develop a wide network of contacts within the university and interact regularly with the Results and Technology Transfer Offices (TTOs).**

Other skills required include good communication skills, a sound knowledge of intellectual property protection and marketing, and a sound knowledge of several languages.

The skills required for blue bioeconomy business success become more complex with each phase of product development. Whereas in initial phases the needs are for specialised technical skills, in latter phases, these are expanded to include specific types of business skills. Members of the investment community active in the blue bioeconomy have remarked that entrepreneurs and project leaders often lack necessary **business skills for growing a small startup or business**. The lack of multidisciplinary skills can constitute a bottleneck to innovation. Therefore, the Blue Bioeconomy Forum suggests further supporting the development and training of the next generation of skilled entrepreneurs (including technical and basic business skills) along the lines of the EMFF Blue Careers, BBMBC, and Blue Labs initiatives. In that sense, relevant authorities should be encouraged to implement scholarship schemes and training programmes that address the mix of skills needs that the blue bioeconomy sector requires, in particular: marketing, sales, management, finance, accounting.

*For example, Portuguese Collaborative Laboratory (CoLABs) aims to create specialised, professional, or **advanced training programmes** in close collaboration with international experts of research and innovation agendas oriented towards the creation of economic and social value. The main goal of CoLABs is to create skilled employment and scientific employment directly and indirectly in Portugal through the implementation of research and innovation agendas aimed at creating economic and social value [22]. Finally, UK has this role of transfer manager working in an organisation that promotes interaction among technology transfer organisations, the Alliance of Technology Transfer Professionals (ATTP) [23].*

*Also noteworthy is the launch of the first **European training and employment platform** in the field of the Blue Economy within the framework of the European MarENet project, coordinated by the Campus del Mar, whose training offer is largely based on the existing demand in the sector and includes 12 courses in France, Ireland and Spain.*

On the other hand, as suggested in the EC Blue Economy Forum, it is necessary bring together different scientific disciplines to promote innovation, turning scientific findings into healthy businesses. Such activities relate to the "New Skills Agenda for Europe" as well as national, regional and sector initiatives that should boost the labour market across the Member States. These initiatives are aimed at a) retraining and up-skilling the current labour force and b) enabling the system to better prepare the future labour force.

The following summarized list of recommendations helps to synthesise synthesise the solutions suggested for the Skills for Knowledge Transfer problems in the AA:

06› ***Promoting new policies to encourage staff mobility (incorporation of researchers into companies)***

07› ***Attract the private sector to hiring PhDs and researchers by assessing the impact and likely return to the state from research investment in marine related research.***

08› ***Allowing private sector to collaborate in the promotion of new doctoral programmes.***

09› ***Value entrepreneurial experience or work in private laboratories in the criteria for the advancement of researchers in public research.***

10› ***Raising awareness among doctoral students and researchers about entrepreneurship in private research.***

11› ***Develop a high-education curricula for MS or PhD that allows the creation of a role/profile of qualified people well-trained in business, communication, and networking skills, to boost the number of collaboration R&D&I and innovation projects in the AA.***

12› ***Boost specific training in key areas of BE KT and enterpreneurship, to train new professionals on sampling, recording, and working on marine environmental engineering and sciences.***

3.3. KEY STAKEHOLDERS AND RESOURCES ACTING AS INTERFACE FOR KT

To innovate and to generate wealth from the results of R&D&I in academia, the backing of private enterprise is required. Therefore, apart from supporting basic and applied training and research, additional measures are needed to dynamize transfer processes and capitalisation of R&D&I results by using instruments, institutions, actors and initiatives, public or private, which promote cooperation actions and stablishing links so that the results of research carried out in companies and universities can be transferred to society as a whole (Technological Centres, Entrepreneurship Programmes, Knowledge Transfer Offices, networks and platforms, etc.)

The efficient functioning of KT systems depends to a large extent on the existence of channels and mechanisms that induce and facilitate the exchange of knowledge between different players. Therefore, cooperation between the public research sector and the private sector have been one of the priorities for innovation policies. However, despite continued efforts to promote collaboration between universities, research centres and businesses, barriers persist that prevent these players find opportunities for cooperation that will benefit both sectors and society.

The creation of **interface stakeholders** has been a determining element in the promotion of the culture of transfer and networking among universities, research centres, industries, and public administration, However, it is quite generalized that these entities have difficulties in financing its structures and have limited resources, which affect the main objective of creating and maintaining effective collaboration mechanisms. This barrier is increased by the lack of positive perception of the need for collaboration with other agents, and limited knowledge about the advantages of networks. Adaptation to the current situation is necessary, as it has become evident the difficulty of innovating unilaterally.

To overcome the barriers among different players for KT in the Atlantic Area countries studied (Portugal, Spain, France, Ireland, and U.K.), the main problems are identified, and some key recommendations are mentioned to transform the KT ecosystem:

Main barriers identified

Low collaborative culture in the private sector and universities

There are several barriers which have traditionally hindered collaboration between academic researchers and companies. These include insufficient mutual awareness or understanding between the parties, and the lack of a real or virtual space in which agents can interact. creation of **specialised online platforms** which are structured around specific thematic groups and subgroups and are aimed at companies and university research groups working in each particular area.

- Cultural differences of the agents caused by their differing goals: the universities generate and transmit knowledge created from basic research whereas Industry focuses on the application of knowledge to generate profit.

*Many companies do not know **how to access** the knowledge and skills of research groups, reflecting the need for greater exchange, dissemination, and implementation of existing knowledge.*

- Different timescales in the implementation and development of projects

The impact of knowledge transfer is not considered from early stages and is mainly view as a mandatory "box to check" needed to ensure funding for a specific call of projects.

- Under utilization on both sides of the Open Innovation model.

- Lack of tools (databases, etc.) which are specifically aimed at encouraging collaboration between business and Universities.

- Insufficient internationalisation and specialisation in some interface stakeholders.
- Low reward for KT effort in academy environments

Roles and resources of interface institutions

- High number of interface agencies with duplication of functions and lack of coordination and complementary approach between the various agents involved.

*One of the most important problems identified in this area is the excessive proliferation of liaison bodies which often leads to **duplication of functions** and confusion about who the end users of these instruments really are.*

- Obsolete management support structures.

*A key aspect is that the industry sector does not have the capacity to know **what is being researched**. That highlights poor alignment of national policies and institutions that strengthen the valorisation of knowledge.*

- Interface institutions have difficulties in financing the structures, means and resources necessary for their function.
- Inability to effectively disseminate and diffuse knowledge.

*There is much to improve in the **dissemination** of the offer of existing technologies, research results and in the social practices necessary for their implementation.*

- Lack of clarity and commitment about the role of intermediary organisms and lack of proactivity and knowledge of the S&T ecosystem.
- Support activities by interfaces institutions undervalued.
- Difficulty in obtaining market information and market opportunities.
- Services of interface institutions aimed principally at the universities rather than business.
- Explosion of networking as a form of collaboration: difficulty of choosing the most suitable network and limited knowledge of the advantages offered by networks.

*There are numerous institutions that act as an interface (networks, clusters, platforms, etc.) and actors have difficulty in **choosing the most appropriate and optimal network** for their interests.*

Type of KT

- Excessive bureaucracy limiting fluid relationships between universities and businesses.
- Difficulty in defining and deciding what type of collaboration to establish between both parties: contract research, licensing, spin-off, etc.

Key recommendations

One of the most effective results come from the development of **sectorial initiatives** (workshops, meetings, etc.) with clear thematic objectives and the involvement of the whole value chain of an industry. This type of event is aimed at bringing together clients, suppliers, entrepreneurs, potential investors and representatives from the academic world so as to encourage effective interaction between them.

*For instance, the Spanish events **"Summit4Oceans. Sevilla Blue Economy Virtual Event"** that aims to involve and sensitize companies, governments, administrations, academia and citizens in the Blue Economy, and "**Meeting of Entrepreneurs in the Blue Economy**" organized by the Instituto Tecnológico de Canarias to develop an Innovative Entrepreneurship Network in the fields of the Green Economy and Azul.*

Cluster initiatives have born to increase the competitiveness of all the bodies and organisations which are involved in them based on technological innovation, the improvement of processes of commercialisation of products and services, and internationalisation. There is extensive documentation which shows that companies which are integrated into well-consolidated clusters generally obtain better results. A distinctive feature is that clusters have services available which increase the likelihood of knowledge transfer successfully.

*An example are the Spanish **Platform for the Blue Economy**, made up of representatives of different institutions, companies and research centres related to the sea in Andalusia and the **Blue Cluster Platform**, one space for collaboration, exchange of information, knowledge, experiences, communication, products and services, in order to promote cooperation, collaboration and communication between the entities of the Spanish Maritime Cluster and Latin America to create synergies, knowledge and value.*

Therefore, **integration into well-defined clusters is highly recommended** and where these are non-existent, efforts should be made to develop them by cooperating with other companies and universities and seeking the active involvement of public administrations.

*For instance, the figure of **multisectoral private cluster with private funding for R&D**, such as Technological Corporation of Andalusia (CTA) [24], that includes triple helix players within their governance structure, and with a focus in the **promotion and private funding of R&D&I activities and knowledge transfer among different sectors and players**, have been proved a success case of public-private collaboration model. CTA do so by supporting innovative projects, products and services, internationalisation of micro, small and medium enterprises, open innovation activities, dissemination of new knowledge and skills, etc.*

*In that sense, **maritime clusters** are an element of paramount importance for the Blue Economy, some examples are the Spanish Maritime-Marine Cluster of Andalusia [25] (support local stakeholders active in the Blue Economy to identify areas for further development and ensure sustainable growth and jobs) or the Portuguese sea cluster Cluster do Mar Português [26] .*

*To use the benefits of a new figure, the **Digital Innovation Hubs (DIH)** from the European Commission. They are another excellent initiative to further promote KT within SMEs that intends to build a European network of DIHs to help companies improve their processes, products, and services by using new technologies. DIHs provide access to technical expertise and experimentation by acting as knowledge transfer platforms.*

Entrepreneurship promotion from universities is one of the key solutions for enterprises to know about academia research, its technologies development and to understand their structure, systems, and collaboration interest.

The business sector needs to encourage and support the provision of specialised services to guide entrepreneurs in their first steps in their chosen field, to maximize the success rate of such initiatives. Due to their higher level of risk and greater potential impact on the economy, support for new technology-based companies (TBCs) is particularly vital. In many cases, the origin of these new TBCs takes place in an academic institution, with university researchers who are interested in marketing their innovations. More effective collaboration between the business sector and academic institutions in designing specific support services for entrepreneurs would lead to an increase in their numbers and a higher probability of success. **Creation of entities that reinforce the entrepreneurship knowledge among students and researchers** is suggested.

*For instance, the French initiative from its Ministry of Economy **"Disrupt campus",** develop training courses in entrepreneurship and innovation that are delivered in a "start-up" mode by French universities and that closely associate businesses engaged in digital transformation initiatives. Moreover, France has the program **"Deeptech Tour",** an initiative made by Banque Publique d'Investissement (BPI) (a French national public investment bank) and the French government. It is aimed to raise awareness about entrepreneurship amongst researchers and more than 12 French universities.*

Other solutions are **business innovation centres** as part of the University´s infrastructure to optimise relationships with industry supporting enterprise, business startups and business engagement.

*For instance, the **Irish Business Innovation Centre** [27] that provides business supports and excellent facilities including labs and co-working spaces. Other example is the **3M BIC** (Buckley Innovation Centre), this centre was established by the University of Huddersfield (UK) and provides a primary focus for The University´s engagement with business and offers access to services and support to facilitate business growth and productivity. Through a variety of mechanisms and partnerships, the centre offers access to markets, finance, technology and skills, and is an important interface with the University to drive collaborative R&D, consultancy and employer engagement for our students and graduates*

To reinforce society's culture of the benefits between universities and enterprises collaborations, **impact assessments** that studies the likely return to the state are a key resource to engage both sectors.

*For instance, Irish Marine Research and innovation Strategy 2017-2021 (MRIS) allows **research funders, working in partnership with the Marine Institute, to assess the impact and likely return to the state from research investment in marine related research. [19].***

The implementation of **tools,** primarily of a technological nature, to facilitate the management of university-industry relationship, would be a step forward in the search for a common language and goals. As such, the most interesting examples focus on the development of flexible databases and user-oriented initiatives, aimed primarily at bringing companies together and analysing their technology needs with university groups. These tools can take on many forms and are unique assets for the institutions which own them. Moreover, some of them involve relatively little investment, although they do require a change of attitude towards a prospective partner and a clear commitment to collaboration as a response to the various challenges that arise. In short, the **databases to facilitate information management** are also of great significance in the process of collaboration between business and universities since they allow automation of the management of relevant information, a more efficient analysis of available supply and demand, improved methods of searching for compatible partners, and, in general, a simplification of the process of knowledge transfer between universities and companies. So that both companies and universities are able to improve the monitoring of their patents, licences, publications and active lines of research. We would underline two critical aspects of the design of these databases:

The volume of information to be managed and the need for regular updating.

A key aspect is that the industry sector does not have the capacity to use what is being researched. There is much to improve in the dissemination of the offer of existing technologies, research results and in the social practices necessary for their implementation. Better dissemination would maximise the success of a specific transfer process, with a consequently higher impact.

*An example is the Spanish open innovation platform **conneCTA** [28], an Open Innovation tool to find strategic R&D&I allies. It is a meeting point for all these innovative entities where they can offer and find technological offers and demands. It will boost technology transfer, as it will make it easier for the capacities and results of R&D&I activity to become opportunities for collaboration that are beneficial and profitable for all parties.*

*Another example is the French **"An entrepreneur in a lab"** [29] initiative that was born according to the principle of open innovation and co-creation. An entrepreneur with a given problem meets the participants (doctoral students, doctors, researchers) so that they can bring him new avenues of reflections and solutions, applying the principle of open innovation and brainstorm.*

The university-industry relationship is symbiotic. companies need universities in order to grow in the same way that universities need companies as channels for the transmission of their knowledge. For this reason, it is important to design a conceptual framework of mutual cooperation which emphasises **good practices or success cases** as a driving force. It is recommend creating a **collaborative guide** which compiles the main principles for coexistence in simple and accessible language so as to increase awareness and understanding between all agents. The main aims of any such document would be: compiling details of experiences and different activities carried out by organisations and universities which have excelled in the establishing of good practices; providing comprehensive information including different forms of collaboration and guidelines for identifying and evaluating potential partners.

As an example, the European Commission/DG Research and Innovation has just launched a call for submitting excellent examples of strategies, initiatives and tools that boost valorisation of research-based knowledge and data at European, national, regional, local and organisational level. The Knowledge Valorisation Platform [30] connects players across the EU to share their best practices, knowledge and expertise in putting the excellent research results and data we produce in Europe into practical use. This initiative gives stakeholders the opportunity to get more visibility by publishing their best practices in this repository. Moreover, it is a means to establish new contacts across geographical and sectoral boundaries, to stimulate collaboration and to foster peer learning.

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Other mechanism is to **share infrastructure and science and technology resources**. For example, hiring university facilities and research materials at reasonable prices. In this way, in addition to increasing the number of innovative business projects, there are additional reasons for companies to collaborate with universities.

On the other hand, the enrichment and recognition of the **academic Knowledge Transfer system** is considered vital, equating it with the value of fundamental research. It is necessary to stablish an adequate evaluation framework, that recognizes and reward individual effort in transmission and transfer processes of knowledge produced in universities, compatible and complementary with the one already established evaluation systems for research activity. In the process of collaboration between companies and universities, personal relationships are a fundamental aspect of maximising results. As such, the intermediaries who liaise between the different organisations play an essential role. A **transfer manager** must be fully qualified, and have a sound, practical understanding of all the operational procedures associated with academic institutions and private companies. Other skills required include good communication skills, a sound knowledge of intellectual property protection and marketing,and a sound knowledge of several languages

*For instance, countries like Spain or Ireland have developed an organism within universities devoted to give necessary resources and services to bring research and commercial expertise together to address market needs whilst providing a return to the university to further advance its research mission, the **Offices for Transfer of Research Results** (OTRIS) [25], the TTOs [26] or the Irish **Business Innovation Centre** from the National University of Ireland Galway (NUIG) [23]. It also provides business supports and excellent facilities including labs and co-working spaces.*

*Other countries like France have subsidiary entities, like **SATT** [27] created by one or more universities and research organisations, responsible for detecting and evaluating inventions originating from public research laboratories to support them until they are transferred to companies. It also acts as an acceleration company.*

The following summarized list of recommendations helps to synthesise the solutions suggested to enhance key stakeholders and resources acting as interface for Knowledge Transfer in the AA:

13› ***Promote the creation of private clusters with private funding for R&D and innovation activities and knowledge transfer among different sectors and players.***

14› ***Encouraging the creation of specialised support bodies for entrepreneurs and Technology-Based Companies***

15› ***Promoting the creation of databases to facilitate information management***

16› ***Create public investment to raise awareness about entrepreneurship amongst researchers and support their entrepreneurship ideas.***

17› ***Encouraging coordination between the various agents who support University-Business collaboration***

18› ***Creation of business innovation centres to support and facilitate labs and co-working spaces from universities to private sector.***

19› ***Develop an academic KT system that recognizes and reward individual effort in KT.***

20› ***Entrepreneurship promotion from universities as a key solution for enterprises to know about academia research, structure, systems, and collaboration interest. In other words, to promote the creation of technology-based spinoffs and start-ups.***

21› ***Clustering initiatives, more specifically maritime and marine clusters, to support the relationship among enterprises from the same sector but also to provide services to connect them to universities, RTD, government, and other organisms.***

22› ***Share infrastructure and science and technology resources***

23› ***Open innovation as a necessary approach for a successful R&D&I strategy.***

24› ***Promoting and sharing good practices based on the impact of University-Business relationships.***

3.4. IP FOR KT

It is well-known that **Intellectual Property Rights (IPR)** give creators of innovations a competitive advantage, allowing them to exploit and commercialize it; therefore, IPR plays an important role in driving economic growth. The Blue Economy sector is an evolving, emerging, and innovative sector that brings economy growth, not only to traditional sectors, but also to new and emerging ones (blue bioeconomy and biotechnology, offshore hydrogen generation, robotics for maritime works,…) [31], [1].

Innovative knowledge generated in academia can be transferred through many mechanisms, such as through the publication of scientific articles, participation in conferences or the publication of patent applications. All these different activities allow business to acquire new information to be potentially used for the development of new and improved products and services. However, knowledge is often exchanged through contractual mechanisms to allow economy growth, R&D collaborations and technology transfer between public research organisations and industry. University-industry relations are an increasingly important way of enhancing the impact of scientific achievements on European competitiveness [32]. Therefore, management of intellectual property protection is one of the key aspects of the relationship between the triple-helix.

During the study of the IP management for KT in the countries studied of the Atlantic Area (Portugal, Spain, France, Ireland, and U.K.), main problems are identified, and some key recommendations are mentioned to transform the KT ecosystem:

Main barriers identified

Lack of specialisation in key areas

» Intellectual Property Rights requires a high level of **legal specialisation**, being difficult to estimate the necessary levels of protection during the early stage of research.

» SMEs have limited knowledge and experience about establishing agreements and protection of IP within the innovation an Open Collaboration system with universities and vice versa.

» Excessive interest in commercialising results of research as quickly as possible rather than developing a long-term legal protection strategy.

IP Exploitation

» Difficulty of exploiting commercial patents at a national and international level. Low level of internationalisation, in both the academic and business environments

» Lack of understanding the value of intellectual property and its benefits.

» High cost of patent or utility model maintenance.

Among the countries studied, time and costs associated with a patent are still high, being another variable to slow the process of protection and capitalisation. Furthermore, there are barriers regarding the development and promotion of a patent in a wide scale international level.

» There is no funding mechanism for the request and maintenance of IP.

» No rewards for knowledge transfer in academia. Instruments or mechanisms for measuring indicators at the academic level do not promote transfer actions with the private sector.

Measurement system to reward, recognize and give prestige to Research, Development, and Innovation (R&D&I) hardly contemplates Knowledge Transfer, discouraging the researcher and research institutions that promote such transfer.

» Early-Stage Technologies are very far from market penetration and exploitation

Universities and R&D institutions often deal with Early-Stage Technologies (EST), far away from market penetration and use, which makes any projection of future benefit extremely risky; at this stage it is very difficult to define the potential fields of use and therefore to ***establish an adequate protection strategy.***

Key recommendations

The innovative technology-based companies which are generating new ideas tend to be extremely small and lack expertise in intellectual property. As such, they need to obtain extensive knowledge of the international legal and judicial framework, as well as technical information which is specific to the field they are working in. It is necessary **specialised IP advisory services (public or private)** but should not be limited exclusively to the protection of intellectual property, but also need to address the early stages of commercialisation so as to ensure that technology is adequately protected without compromising its use.

Open Innovation initiatives outweigh the risks of R&D for businesses, being a IPR tool appropriate for early-stage technologies, since non-core assets are shared in the collaborations, creating routes into increasingly diverse technologies [33].

For example, the Spanish Ministry of Science and Innovation has an ***Open Innovation*** *initiative called "Línea de Fomento de la Innovación desde la Demanda de Compra Pública (Línea FID-CPI)" which promotes Open Innovation (and other mechanisms) within the Public Administration, where academia and business can present innovative technological solutions that improve goods and services to society. [34].*

On the other hand, establishing a **better understanding of the value** of intellectual property among researchers is a priority, **raising awareness** and normalizing that IP rights goes beyond individuals or private rights should be taught **starting at university degrees level**. Moreover, raising awareness of the laws surrounding IP and the patenting laws shall strengthen collaborations between university and industry partnerships.

Tools and instruments such as **IT platforms** focused on training, awareness raising and familiarisation of the academic and business community on key KT and IP issues should be promoted. In other words, generate information tools that help to understand IP legislation, patents, rights and obligations, the implementation of transfer mechanisms, national and international patent applications, etc.

France has a programme called "My research and After", a ***training programme on entrepreneurship*** *made by "Reseau C.U.R.I.E" on topics related to promoting public research, technology transfer and innovation stemming from public research. This program covers a wide field ranging from "junior" training on the fundamentals of promoting research to "expert"* ***modules on intellectual property strategy*** *or remuneration for transfer*

The academic institutions should support services to teachers, researchers, students and/or employers to maximise the potential of knowledge through the creation, management and consolidation of **spinoffs and start-ups**. With this aim in mind, the importance of entrepreneurship should be emphasised to commercialising research results, whilst specific support should be provided to decision-making processes.

On the other hand, one of the most effective tools for bridging the gap between high scientific potential and low levels of business innovation are the so-called **creative incubators.** Businesses should play an active role in setting up these initiatives so as to create value, share knowledge and take maximum advantage of the available technology.

For instance, ***UK's Enterprise Zones****, a government's long-term economic plan, supporting businesses to start and grow. Enterprise Zones are part of the Government's wider Industrial Strategy to support businesses and enable local economic growth. The government designates areas across England which provide* ***tax breaks and government support*** *for the business to start.*

Measures implemented by governments that favour and reward collaborative R&D&I, KT, IP exploitation, etc. through the promotion of new laws, tax incentives, etc., are recommendable.

Initiatives such as the Spanish government's recent ***draft law on startups****, which incorporates a series of fiscal measures to encourage the creation and implementation of this type of emerging companies,* ***tax incentives*** *for companies associated with expenditure and investment in R&D&I projects under the Corporate Tax Law, there are some actions that support and consolidate KT and IP.*

Another recommendation is the regulation of contracts. Specifically, create standard contracts that define responsibilities, contractual elements related to intellectual property, etc. and that prevent issues such as unequal relationships, rights and obligations, abuse of situations, etc.

This is useful for universities and SMEs, which often do not have access to specialised legal advice. They will be easily accessible contracts that will help both parties in the negotiation process and the subsequent implementation of the project.

Ireland has a National IP protocol from 2019, a ***policy document****, which sets out the framework underpinning research collaboration and access to intellectual property from state-funded research. It also acts as* ***resource guide*** *which provides an overview of the national IP management guidelines and links to a wealth of resources that support these guidelines. It also provides an overview of the knowledge transfer structures in Ireland and the kinds of agreements that can be used to formalize research-industry engagements. It also provides a suite of model agreements and guides relating to spin-out companies [35].*

The following summarized list of recommendations helps to synthesise the solutions suggested to enhance Intellectual Property Rights for Knowledge Transfer in the AA:

25› Raise awareness of the value of intellectual property among Blue Economy researchers starting at university degrees level.

26› Strengthen collaborations between university and industry partnerships teaching (students and researchers) of IP and patenting laws.

27› Create specialised intellectual property advisory services (public or private) for the Blue Economy area.

28› Promoting Open Innovation tools to protect early-stage technologies and promote collaborations for universities and businesses.

29› Generate strategies to help develop start-ups and spin-offs from universities, like establishing areas with tax breaks and government support for businesses that support collaborations with universities.

4. CONCLUSIONS

The knowledge in society is located on three essential pillars: Enterprise, universities and Public Administrations. universities and businesses have always operated at different speeds and independently of each other, mainly because they have very different interests, goals, and target publics.

Therefore, **creating a scenario in which both agents can obtain benefits seems to be the best way forward and the most logical option for the future to effectively incorporate knowledge into the productive sector.** The 2021 Blue Economy report [36] highlights the need of research, innovation, and education to preserve marine ecosystems to optimise potential benefits of ecosystem services and marine and maritime economic sectors. This will contribute to deploy European knowledge and technological solutions using the innovation capacity and knowledge transfer potential as key roles in the sectors involved in the Blue Economy to change to a more sustainable economy, as well as the development of policies in line with this strategic approach at all levels of governance.

In that regard, EMPORIA4KT has identified four areas that influence KT: **Funding Policies Supporting KT, Skills for KT, Key stakeholders and resources acting as interface for KT, and IP for KT.** The main barriers that prevent efficient KT in the AA within the four areas have been identified and a total of 29 key recommendations have been suggested, based on best practices, to influence public innovation policies and funding mechanisms for Early-Stage Technologies Knowledge Transfer.

The objective is to increase KT and innovation in the Blue Economy among the different players of the triple helix, hence, to boost AA's competitiveness, so that best value for money on investment made by public and private bodies is achieved.

In summary, several recommendations have been suggested, and they can be categorized as follows.

Mechanisms to monitor needs for KT

To do so, the presence of Blue Economy clusters (marine, maritime, aquaculture, renewable energies, biotechnology, etc.) and research and technology transfer offices from universities is encouraged to monitor and match industry and academia needs.

The creation of private clusters has been proved a successful experience to promote R&D and innovation activities, and KT among different sectors and players. Different activities shall be promoted from these entities, always with the focus of identifying needs in different industry sectors that can be met by universities (research and technology transfer, analysis services, infrastructure, education etc.), in addition to identifying needs in university that can be covered by businesses (soft skills, industry contacts, IP services, policy and bureaucracy interpretation, education, etc.), acting as the foundation of the KT promotion.

Mechanisms to meet the needs of industry and academia for KT

As mentioned in the marine biotechnology strategic research and innovation roadmap [37]

> ***"mechanisms are still required to support industry-academic collaboration on business and market development."***

Policies, services, and collaborations are still missing in the Blue Economy sector, and several activities need to thrive from the abovementioned government-promoted entities. On the one hand, long-term relationships between academia and industry should be encouraged by, for instance, promoting dialogue (events, committees, fairs…), policies that assure equal collaboration agreements and contracts such as sharing infrastructure resources agreements, R&D projects, etc.

Incorporate new public policies that would fund **both fundamental research** (essential to feed the pipeline of innovation in long term) and **increasing higher TRL technologies**, following a funnel approach: invest in higher number of projects with lower value of funds while increasing the funds per project with the increased TRL. The investment would apply, if all triple helix actors, plus citizens, were involved in the development of the technology into a product.

A collaborative tool that fosters the approach of the university and the enterprises is **Open Innovation**, i.e., a paradigm where entities can and should use external ideas as well as internal ideas, and internal and external paths to market, to advance their technology [38]. This tool can be approached in different ways as an online platform (platform conneCTA [28]) or as events and workshops ("An entrepreneur in a lab" [29]), the main aim is to interchange needs, ideas and knowledge. It is indeed a powerful tool for Knowledge Transfer to protect EST and to promote their commercialisation through collaboration.

Governments should also encourage mobilisation of **private capital** to finance R&D and innovation business activities by subcontracting or partnering with academia. Moreover, private sector and private funding should be tackled as a mechanism needed for KT, besides the abovementioned, since they have the power to attract human resources with scientific background to achieve excellence and innovation in the enterprises.

This could be encouraged in many ways, but in the Blue Economy sector, it is suggested to generate new policies to **encourage staff mobility** (incorporation of researchers into companies) and allowing private sector to collaborate in the promotion of new PhD programmes, to make universities aware of their needs, and to influence in the future incorporation of the PhDs in businesses.

Furthermore, **entrepreneurship, IPR and communication** are other powerful tools to enhance KT in the Blue Economy sector. Researchers are bound to know and practice entrepreneurial skills, and governments have several options to do so. Starting from raising awareness through information mechanisms (social media, university events, etc.) about IPR and entrepreneurship to develop high-education curricula for MS or PhD that allows the creation of a role/profile of qualified people well-trained in business, communication, networking skills, etc.. Spin-offs founded by researchers that know about research areas, university structure, systems, and collaboration interests are more likely to collaborate with academia. In addition, the value of intellectual property is not usually understood in the Blue Economy sector, therefore it is suggested to start raising awareness at university degree level. Also, it is a good practice to learn from among some AA countries, to create a network of training research centres to train new professionals on sampling, recording, and working on marine environmental, engineering, and scientific level. In other words, to stablish long-term relationships between university and industry it is recommended to promote the creation of technology-based spinoffs and start-ups from the academia, boosted with the abovementioned recommendations about entrepreneurship.

Other mechanisms to support entrepreneurship ideas is to foster **public investment**, i.e., investment by the state in entrepreneurship ideas born in academia, whether through central or local governments or through publicly owned industries or corporations.

Finally, to support KT, long-term relationships between universities and businesses, support in form of services from experts in IPR, spin-off creation, etc., is still needed in the Blue Economy sector. Research and Maritime, Marine clusters and Technology Transfer Offices shall be approximated (mostly regionally, since each region has their own needs) to address the needs of universities and academia, as mentioned before, but also to improve the **services** they offer. It can be tackled by dedicating necessary resources and services to transfer research

to market needs whilst providing a return to the university to further advance its research mission to the knowledge transfer offices. Those organisms might have also support for entrepreneurs and spin-offs (courses, specialised services, lawyers, and other entrepreneurs). Moreover, services that facilitate infrastructure, such as labs and co-working spaces from universities to private sector is also suggested, as well as offering specialised intellectual property advisory services for specialising the Blue Economy area.

KT monitoring mechanisms

To assess the impact and likely return to the state from the private and public investment in marine and maritime Knowledge Transfer, and to ensure that investment continues over time, several **innovation metrics to monitor the suggested** mechanisms are needed (related research, licencing, start-up spinoff creation, communication actions, number of PhD hired, etc.,). Some suggestions of innovation metrics and how to measure them follow.

- Number of PhDs hired by Blue Economy sector and by region. A specific number that shall be monitored, as a further task, beyond monitoring needs, that feeds back their main task.
- Recognize positively entrepreneurial experience or work in private entities in the criteria for the promotion of researchers in public research funds.
- Monitor the number of spin-offs created by academia as a way of promoting the commercialisation of EST among businesses.
- Promote the creation of databases to facilitate the information management and monitor the above-mentioned metrics.

4.1. EMPORIA4KT KEY MESSAGES

Knowledge Transfer and commercialisation of Early-Stage Technologies in the Blue Economy can be fostered by:

1. Creating a scenario in which university and industry can obtain benefits from the effective incorporation of knowledge into the productive sector.
2. Implementing public funding policies with a funnel funding scheme that would support R&D from fundamental research to higher levels of TRL
3. Multidisciplinary skills are needed for KT and technological development. Focus should be put in bridging the skills gap between education offer and labour market needs.
4. Open Innovation is a collaborative tool that fosters the approach of the university and the enterprises.
5. Encourage mobilisation of private capital to finance R&D and innovation business activities by subcontracting or partnering with academia.
6. Entrepreneurship, IPR and communication are other powerful tools to enhance KT in the Blue Economy sector.
7. Foster public investment to support entrepreneurship ideas through central or local governments or through publicly owned industries or corporations.
8. Research and Maritime, Marine clusters, and Technology Transfer Offices need to have reinforced resources to be able to re-evaluate the services they offer to boost KT.
9. Innovation metrics are needed to monitor the mechanisms that support and foster KT, being a tool to attract private and public investment to the matter.

5. LIST OF ACRONYMS

ATTP *Alliance of Technology Transfer Professionals*
AA *Atlantic Area*
BPI *Banque Publique d'Investissement*
BE *Blue Economy*
CoLABs *Collaborative Laboratory*
EST *Early-Stage Technologies*
ERDF *European Regional Development*
EU *European Union*
IP *Intellectual Property*
IPR *Intellectual Property Rights*
MRIS *Irish Marine Research and innovation Strategy*
KR *Key recommendations*
KT *Knowledge Transfer*
NUIG *National University of Ireland Galway*
OTRIS *Offices for Transfer of Research Results*
PROs *Publicly funded research organisations*
TTOs *Results and Technology Transfer Offices*
IDAE *Spanish the Institute for Energy Saving and Diversification*
SDGs *Sustainable Development Goals*
UN *United Nations*
WP *Work Package*

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