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Challenges of educating for Innovation and Entrepreneurship: the role of the Higher Education Institutions

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Master Thesis

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*To my beautiful mom, the reason for my existence, and to my incredibly strong father, the pillar of all this conquest. To my always-so-close family. No **thank you** will ever be enough.*

To my amazing friends, the queens of my heart and the reason for many of my random smiles and giggles, may life allow me to make you as happy as you make me!

To my MESG friendship acquisitions, the proof that time doesn't measure the impact someone can have on you, and good moments can come when you less expected them. Thank you for all the lunch picnics, volleyball games and beer at 10 am.

To my friends and colleagues, the DIGI2 team, who helped me grow and open my horizons. I wish we can all prosper and create history together.

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Abstract

Innovation has been debated and evaluated as the engine that leverages the evolution of goods and services. It is also the inspiration and nourishment of Entrepreneurship. Side by side, Innovation, and Entrepreneurship struggle to reshape the mentality and functioning of society. The role of Higher Education Institutions in promoting this innovative activity is to stimulate the evolution toward a knowledge-based society, which is highly important, entailing a high demand for new studies. Higher education institutions have long actively contributed with all their studies and training to do more, but the promotion of innovation and entrepreneurship in the students themselves has only intensified in recent years. The focus on partnerships has been increasingly valued, namely with the industry itself or the generalized market, and with the collaboration of research centres. From these synergies, a triangular scheme called the Knowledge Triangle resulted, which holds not only the bearers, but also the transmitters of knowledge at the vertices, and their interaction has several aspects to consider.

The present study has as a Case Study the INVENTHEI European project, which builds on existing practices and infrastructures to enhance regional innovation ecosystems and promote innovation-driven research. One of the objectives is to set up HEI-driven European Network of Innovation districts. This work aims to describe and analyse the current tactics and procedures used by Higher Education Institutions for the transmission of innovative knowledge and capacities. This study also intends to understand how to encourage more students to become entrepreneurs and innovators, knowing the challenges of the market and being equipped with all the skills to know and overcome the obstacles that may arise.

For this research, multiple actors in the academia were interviewed, from faculties and other academic staff, as well as representatives from industry and research centres. The first round of interviews allowed to understand the vision and the multiple opinions of the situation. After the evaluation and structuration of the information gathered, a second round was made to validate the findings and provide accuracy to the conclusions. As the main achievement, we were able to provide an IVAP (Innovation Vision Action Plan) with adequate procedures and examples of activities, that can be applied accordingly to the pillars of the above-mentioned Triangle of Knowledge. This IVAP will constitute a tool to turn the Higher Education Institutions (HEIs) into innovation engines in their local ecosystems and create/follow the path to strengthen the entrepreneur and innovation capacities of the participants.

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List of abbreviations

ANI	National Association of Innovation - Portugal
DIGI2 (Laboratory)	Digital and Intelligent Industry Lab
EIT	European Institute of Innovation & Technology
EIT- HEI Initiative	Innovation Capacity Building for Higher Education
EM	Entrepreneurial Mindset
EU	European Union
EURASHE	European Association of Institutions in Higher Education
FEUP	Faculty of Engineering of the University of Porto
HEI	Higher Education Institution
I&E	Innovation & Entrepreneurship
IATED	International Academy of Technology, Education and Development
INVENTHEI	Innovation and Entrepreneurship in HEIs
IVAP	Innovation Vision Action Plan
KICs	Knowledge and Innovation Communities
NGO	Non-Governmental Organisation
PhD	Doctoral Program
R&D	Research & Development
SAI	Strategic Innovation Agenda
SYSTEC	Research Centre for Systems and Technologies
TF4iM	Teaching Factory for intelligent Manufacturing
TTK	University of Applied Sciences
UIIN -	University Industry Innovation Network
UPCE	University of Pardubice
UPORTO -	University of Porto
UPTEC	Science and Technology Park of the University of Porto

USC	University of Santiago de Compostela
USFD	University of Sheffield
VUT	Valahia University of Targoviste

1 Introduction

1.1 Project background

Knowledge has become an important production and development factor in current society, which is known as the knowledge society ((O'shea et al., 2005); (Ranga & Etzkowitz, 2015); (Audretsch, 2014)). This means that the economic and social development of regions, states, and countries are strongly related to their ability to deal with knowledge. Therefore, universities, as organizations that produce and disseminate knowledge and also have great potential to apply knowledge, started to play a larger role in the economy and society, becoming a key element in the innovation systems (Etzkowitz & Leydesdorff, 2000). The participation of higher education institutions (HEIs) in this transmission of knowledge contributes to the emergence of highly dynamic innovation districts and favours the setup or inshore of knowledge-intensive companies on cutting-edge technologies, value-added products and services, and innovative business models.

Innovation districts, by definition, are geographic areas where leading-edge anchor HEIs and companies cluster and connect with start-ups and society, business incubators and accelerators. According to this model, the potential for innovation and economic development lies in a more prominent role for HEIs. The innovation districts also have an enhanced capacity to provide students with new ideas, skills, and entrepreneurial talent. Students are the new generation of professionals, but they can also be trained and encouraged to become innovators and entrepreneurs, contributing to the creation of jobs and economic growth. (Katz, 2014)

In the knowledge society, universities are increasingly challenged to become more socially and economically relevant organizations (Nelles & Vorley, 2011). To do so, universities have gone through academic revolutions. The first revolution added the mission of generating knowledge through research to the traditional mission of preserving and transmitting knowledge with which universities were established. Then the second revolution made economic and social development the third mission of universities in addition to teaching and research (Etzkowitz, 2003). This means that besides conserving and transmitting knowledge, universities also need to create knowledge and put it to use (Etzkowitz, 2013).

This research will support and be supported by the INVENTHEI project, as both aim to investigate the needs of academia for a better understanding of how to transfer knowledge generated by education, and research, and how to scale it to a successful business. This entire

process is reflected in the knowledge triangle, which relates to education, research, and business, and will also be a framework to support the analysis of the findings of this study.

INVENTHEI is one of the projects funded by the EIT's HEI Initiative: Innovation Capacity Building for Higher Education, which is a joint EIT Community activity coordinated by EIT Raw Materials. The initiative is a key objective for the European Institute of Innovation and Technology (EIT) as part of its new strategy, the EIT Strategic Innovation Agenda 2021−2027. The initiative aims to support higher education institutions with expertise and coaching, access to the EIT innovation ecosystem, and funding, enabling them to develop innovation action plans complementing the needs of individual higher education institutions.

The results of this work will function as a handbook of how to act in the different pillars of the Knowledge triangle in regard to the transmission of knowledge, especially related to Innovation and Entrepreneurship. It will be presented as a process of educating the students to become innovators and entrepreneurs.

The INVENTHEI project builds on existing practices and infrastructures to enhance the regional innovation ecosystems and promote innovation-driven research. One of the objectives is to set up HEI-driven European Network of Innovation districts. Together, the consortium involved in the project will build on existing experience and will explore synergies with research and innovation activities to nurture and foster an innovation and entrepreneurial culture in the participating universities. INVENTHEI will implement an IVAP built around 3 dimensions connected to the EIT pillars:

- Learning and Mentoring programmes - focused on training, mentoring and engagement of students and staff (education pillar);
- Learning and Teaching structures - focused on providing testbeds and innovation-driven research (innovation pillar);
- Learning and Collaboration - focused on programs for collaboration and exchange between industry, research, and academia (business pillar).

The project acts on four domains that are directly linked to the EIT Pillars, being them:

Domain 1 – Fostering institutional engagement and change

- Enhance the scale and scope of student engagement activities, including improving student support offices to advise on entrepreneurship and innovation

- Develop inter and multi-disciplinary support structures, testbeds, and other structures to foster innovations

Domain 2 – Strengthening partnerships (knowledge triangle integration)

- Establish new and enhancing the nature, content, and type of collaborations with external partners, including businesses, research organizations, governmental bodies, NGOs, and other societal partners

Domain 3 – Contribution to developing innovations and businesses

- Create structures and conditions for innovation-driven research

Domain 4 – Enhancing the quality of innovation and entrepreneurial education

- Develop innovation and entrepreneurial training programmes and mentoring schemes for staff and students.
- Organize internships in businesses.

This IVAP builds on existing practices, knowledge, and research facilities to guarantee a critical mass of highly educated young innovators and entrepreneurs in the participant HEIs' regions and to foster a European Network of innovation-driven research ecosystems, with a particular focus on the manufacturing and health domains.

The project concept is built on a deeply collaborative approach, where partnerships are not only nurtured and strengthened, in the logic of the knowledge triangle integration but also put into practice and showcased. In addition, we plan to include society and societal development at the centre of this "upgraded" knowledge triangle.

Who are these key actors and target groups? HEIs (managers and staff), HEIs faculty,

business/industry (managers and workers), students/alumni and government/public bodies/policymakers. Starters, co-creators and multipliers, these actors will be key agents of change in the way HEIs, businesses and governments cooperate within the framework of innovation districts, establishing and strengthening their links and preparing themselves to anticipate and respond to the upcoming demands on skills requirements, cherishing a new generation of young innovators and entrepreneurs and underpinning upskilling, reskilling and continuing professional development opportunities to ensure that all workers meet the needs of the labour market.

HEIs (managers and staff) will be more aware, prompt, and able to effectively increase their innovation and entrepreneurial capacity and better integrate into and engage with innovation

ecosystems, positioning themselves as “first movers”, which in turn will allow them to be more competitive and attractive not only for students and faculty but also for strategic partners, such as companies and regional actors, with whom these organisations will have stronger and more meaningful links.

HEIs academic staff will update, diversify, and improve their pedagogical approaches, playing a key role in the mitigation of the barriers that prevent I&E from reaching their potential in HEIs. They will be more aware of the importance of their role in fostering intra/inter-institutional collaboration and in supplying the t-shaped skills, which must be considered within the P21 framework (Tsekeris, 2019). Businesses/industries will embark on a process of change, not only on the inside but also in the way they partner with education and government organisations. Students/alumni will enhance their knowledge and t-shaped skills. They will be offered unique and innovative learning opportunities, preparing them to be the next generation of young innovators and entrepreneurs, who equipped with the right set of skills will easily transition to the labour market and lead changing processes within the local innovation districts. This target group will also be given the chance to be involved in participatory procedures, identifying needs for improvement, and shaping new programmes and curricula. In fact, students/alumni will directly/indirectly benefit from all the project outcomes.

1.2 Problem Description

Universities need to interact closely with industry and government for socio-economic development. This is known as the triple helix of innovation. The triple helix of innovation refers to the interweaving of university, industry, and government with a spiral pattern of linkages to advance economic and social development through the strategy of innovation (Etzkowitz & Leydesdorff, 2000). It implies the breaking down of traditional organizational, cultural, and normative barriers that in the past have separated these spheres to the detriment of economic competitiveness and technological progress (Etzkowitz & Leydesdorff, 2000). Studies taking this perspective share the perception that civil society is not addressed by the Triple Helix model. However, instead of

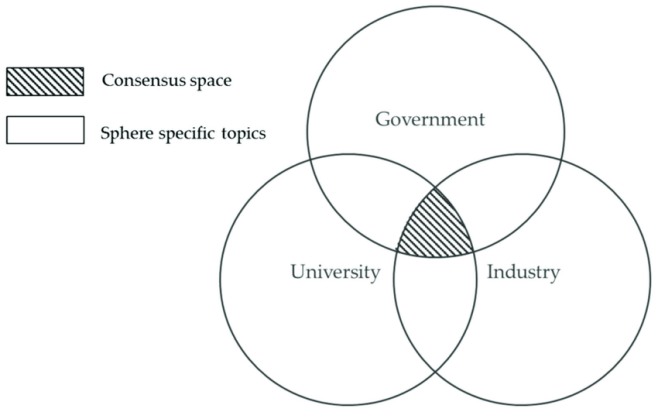

Figure 1: Triple helix of innovation

SOURCE: RESEARCHGATE.NET

seeing the Triple Helix as an out-of-date concept, the authors value its conceptual elaboration on the [1]interactions of university, industry and government and include civil society in their analytical framework. In other words, they see the transition from the Triple Helix model to the Quadruple Helix model as an evolutionary process (Cai & Lattu, 2022). The Quadruple Helix model provides an elastic conceptual framework for its tractability in bringing different elements (e.g., civil society, users, stakeholders) into the fourth helix. This helps to include emerging elements in innovation ecosystems in analytical focuses (Cai & Lattu, 2022).

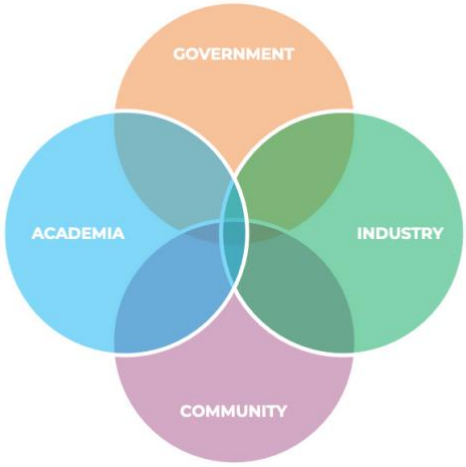

Figure 2: Quadruple Helix of Innovation

SOURCE: GRRIP.EU

From the university management point of view, the need to fulfil the three missions simultaneously and the need to closely interact with industry for socio-economic development implies and requires changes in the function and structure of universities (Etzkowitz & Leydesdorff, 2000). Realignments include new understandings and metrics for the traditional teaching and research missions, internal organizational changes that are more conducive to interdisciplinarity and collaborations with research centres and industry, new modes of governance and management, and new organizational capacities, among others.

These changes in universities have gained substantial importance in recent literature and they are usually discussed from the perspectives of innovation (Clark & Stoddard, 1996); (Van Vught, 1999)) and entrepreneurship (Clark, 1998); (Etzkowitz & Leydesdorff, 2000); (Etzkowitz, 2003); (Etzkowitz, 2013); (Yusof & Jain, 2010); (Urbano & Guerrero, 2013). Studies claim that the changes taking place within universities somehow manifest themselves in the form of innovation and entrepreneurship activities. These activities include both traditional activities of innovation and entrepreneurship, more related to economic development, and those related to social development (Abreu & Grinevich, 2013). They also claim that these activities, besides contributing to economic and social development, should contribute to the sustainability of the university (Etzkowitz & Leydesdorff, 2000). University

[1] Search https://grrip.eu/why-is-quadruple-helix-engagement-so-important/ for the full information.

attracts students worldwide and exposes them to this close connection to the professional world. It "can assist companies in integrating internal and external communities as a 'living social laboratory' for the immediate implementation of research and innovation ideas" (Pancholi et al., 2020). The same author also states that Innovation Districts also help develop a sense of pride and belonging for their residents, provided they are transparent about the projects they are tackling and the success they have.

Many initiatives have been created to contribute to the change and enhancement of the quality of the I&E training in the universities. HEInnovate[2] is an example of that and it's a self-reflection tool for Higher Education Institutions that wish to explore their innovative potential. It guides the entity through a process of identification, prioritization, and action planning in eight key areas. Universities and HEIs play a crucial role in this concept "as placemaking facilitators in achieving a cohesive community and their societal integration at the local level" (Pancholi et al., 2020). Being an entrepreneurial higher education institution depends upon individuals and innovative ways of doing things.

1.3 Research Questions

The present thesis aims to understand what has currently been done in universities to promote and sustain the innovative and entrepreneurial traits of students, identify the main terms and definitions, and identify behaviour gaps. This work intends to study the applicability of the processes created and followed in the INVENTHEI project, transposing the conclusions to the generality of the research/academic environment.

For this study, the questions to be answered are:

Q1: How can universities become engines of innovation in their local ecosystems?

- What kind of activities, initiatives, and procedures, can be installed to instigate the interest in teaching/studying innovation and entrepreneurship?
- How to define synergies with other institutions that contribute to the dissemination of innovation knowledge and applicability?

Q2: How can universities better prepare their students to become innovators?

[2] "**HEInnovate** is a self-reflection tool for Higher Education Institutions who wish to explore their innovative potential. It guides you through a process of identification, prioritization, and action planning in eight key areas. The self-assessment is available in all EU languages." (https://www.heinnovate.eu/)

- How can the students be persuaded and appealed to study this work field?
- What are the most productive methods to teach these concepts?
- How do students feel about innovation and entrepreneurship?

The main goals related to this research concern understanding the approach undertaken so far by academia regarding the promotion and sustainability of the training on innovation and entrepreneurship, as well as reinforcing its importance. Searching for the most viable approaches to follow, taking into consideration the student's perspective, and adapting each method to the desired outcome (meaning the links with industry and/or research) can provide instructions to be adapted to different situations and serve as examples to follow and/or apply to the context. The main outcome concerns the definition of a procedure to follow regarding the training and promotion of the innovative and entrepreneurial initiatives desired.

1.4 Study and Project Development at DIGI2 Laboratory

The DIGI2 Laboratory, a research unit that belongs to SYSTEC (Research Centre for Systems and Technologies), works in different fields being them related to technological innovation (including artificial intelligence, robotics, and edge computing) and innovative initiatives for education. The study followed a case study approach, being focused on a European project called INVENTHEI, which gathers Portuguese partners from the University of Porto, UPTEC – Science and Technology Park of the University of Porto, and others like INOVA+ (Belgium), University of Santiago de Compostela (Spain), University of Sheffield (United Kingdom), University of Pardubice (Czech Republic), Valahia University of Targoviste (Romania) and TTK University of Applied Sciences (Estonia).

INVENTHEI envisions that by 2025 a critical mass of highly educated young entrepreneurs and innovators will be trained by the participating higher education institutions (HEIs), contributing to the emergence of highly dynamic research and innovation ecosystems favouring the setup or inshore of knowledge-intensive companies on cutting edge technologies, value-added products and services, and innovative business models in the manufacturing and health domains. These research and innovation ecosystems will be anchored on the concept of “innovation districts”. These districts, by definition, are geographic areas where leading-edge anchor institutions and companies cluster and connect with start-ups and society, business incubators and accelerators

1.5 Report Outline

The present work is organized into chapters; starting in the **Introduction**, with an overall approach to what is being studied, what will be done, what needs to be addressed, and other related environmental issues. Following the **Literature Review**, where this chapter is organized by topics, starting with the definition of innovation, then the definition of entrepreneurship, and then the correlation between both these concepts. This chapter also includes the knowledge triangle, which is highly related to the EIT Pillars and the project that is used as a case study. The next chapter approaches the **Problem Characterization**, where all the details of the study are explained, meaning the fragility that motivated the study at the start, the gaps in the literature and the formalization of the hypothetical solution. The following chapter – **Methodology**, explains how the research was planned and elaborated, defining the methods for gathering the data, the analysis of the results and how to deal with each tool. The **Results** chapter gathers all the conclusions that the work allowed to be taken, each study and the solution that could be ensured and justified. Finally, the **Conclusion**, with an overall revision of the work process and its results, with a proposal on how to follow up with the research and what still needs to be addressed.

2 Literature Review

2.1 Innovation in the Academia

Innovation is the core action for the development and productivity of any economic activity. Investment activity and its results are directly dependent on the type of innovation that has been used.

There are various definitions of "innovation" that appear in the literature. Joseph Schumpeter is often thought of as the first economist to draw attention to the importance of innovation. He defined, in the 1930s, five types of innovation:

1. Introduction of a new product or a qualitative change in an existing product
2. Process innovation new to an industry
3. The opening of a new market
4. Development of new sources of supply for raw materials or other inputs
5. Changes in industrial organization.

Therefore, innovation can involve both the creation of entirely new knowledge, as well as the diffusion of existing knowledge (Rogers & Rogers, 1998).

Schumpeter, which may be called the founder of the theory of innovation in the economy generally, regarded innovation as the economic impact of technological change, as the use of new combinations of existing productive forces to solve the problems of business.

Schumpeter identified five types of innovation. The description of this model is presented on (Fig.5) below.

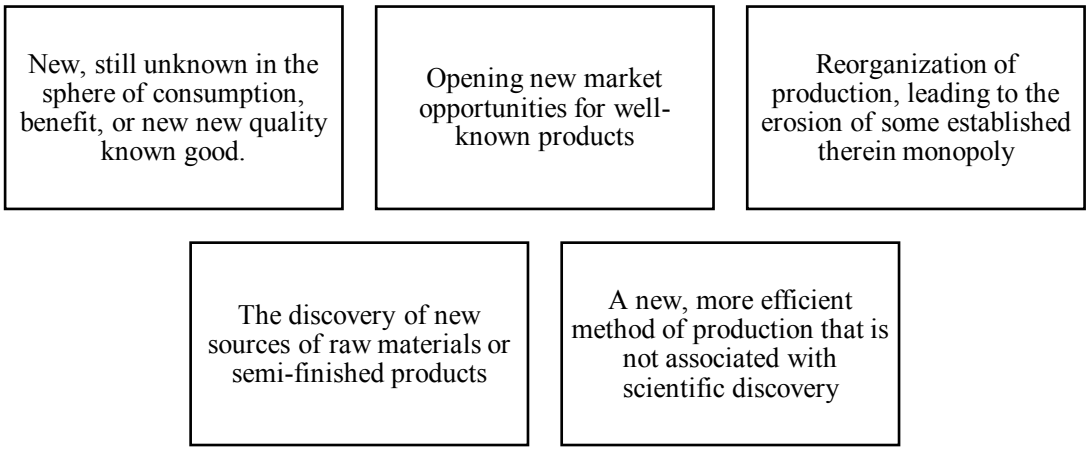

Figure 3: Five types of Innovation

(SOURCE: SCHUMPETER, 1982)

Another definition, according to Urabe (Urabe, 1988) may be that Innovation consists of the generation of a new idea and its implementation into a new product, process, or service, leading to the dynamic growth of the national economy and the increase of employment as well as to a creation of pure profit for the innovative business enterprise. Innovation is never a one-time phenomenon, but a long and cumulative process of a great number of organizational decision-making processes, ranging from the phase of generation of a new idea to its implementation phase. A new idea refers to the perception of a new customer need or a new way to produce. It is generated in the cumulative process of information-gathering, coupled with an ever-challenging entrepreneurial vision. Through the implementation process, the new idea is developed and commercialized into a new marketable product or a new process with attendant cost reduction and increased productivity.

Literature indicates that innovation can have benefits for all economic activity by implementing projects, creating new products with higher quality, and reducing production costs. In addition, innovations can accelerate processes and save time.

The complex nature of innovation is reflected in the involvedness and diversity of the concept of innovation. A wide range of innovations is included, with varying degrees of inherent in their knowledge. Innovations are applied to a variety of industries and fields of activity to be implemented in multiple market segments, etc. Classification innovation plays an instrumental role as it allows not only streamlining existing views, but also a means of finding and identifying poorly studied issues of innovation. The type of innovations and their classification on various substantive grounds is relevant not only to the development of a consistent innovation management theory but also to the management of innovation-based organizations. Managers of innovation in their activities should always consider that different types of innovation have their own characteristics concerning development, implementation, and dissemination. These characteristics require specific management approaches, the relevant structures in innovation, and its techniques and styles.

2.2 Entrepreneurship in the Academia

Entrepreneurship does not have a unified and accepted definition. Entrepreneurship education in higher education institutions (HEIs) increasingly aims at fostering an entrepreneurial mindset (EM) in students (Larsen, 2022). Diverse theories have described entrepreneurship differently as dynamic change, novel combinations, exploiting opportunities, innovation, price arbitrage, risk, uncertainty, ownership, new venture formation, asymmetries of information, superior decision-making, personality traits, monopoly formation, or something else. Previously

considered contradictory terms, such as "corporate entrepreneurship", "social entrepreneurship", and "opportunity entrepreneurship", can now be considered complementary terms in the lexicon. Entrepreneurship can be described through a wide range of subdomain terms in a lexicon.

The earliest historical references to entrepreneurship come from the field of economics and the nature and sources of profit. Profits were obtained if a good was purchased at a market value that exceeded the intrinsic value of the land labour and capital that was invested into producing it. Entrepreneurship became associated with all activities that create residual profits in excess of the rate of return for Land, Labour and Capital (e.g., (Glancey & McQuaid, 2000) (Kirzner, 2015); (Schumpeter, 1982)).

There arose two opposing theoretical views regarding how entrepreneurs achieved this residual profit: the risk theory of profit by Knight and the dynamic theory of profit by Matlay. These opposing theories led to contrasting definitions that can be viewed as alternative dimensions of entrepreneurship. It is a multi-dimensional concept that entails owning a small business (Risk Theory), being innovative (Dynamic Theory), acting as a leader (Traits School), or starting up a company (Behavioural School). It includes spotting opportunities to drive the market toward equilibrium (Austrian School) or causing disequilibrium through “creative destruction” (Schumpeter). It includes doing this on your own, in a team or inside a company. As a result of the knowledge society, universities have assumed new missions and relationships in order to contribute to economic and social development, while also maintaining their own sustainability (Schmitz et al., 2017). HEIs have traditionally been focused on their moto of research and teaching and are now starting to shift their focus towards a third objective regarding entrepreneurship. “Traditionally, universities were only focused on two missions (research and teaching). However, over time, there was a need for many academics to participate and be involved in entrepreneurial activities, which are considered the “third mission” of universities” (Gomes et al., 2021).

Some authors suggest that existing works in the literature on entrepreneurial ecosystems still lack a solid theoretical basis, making the approach to the concept somewhat ambiguous and immature and, thus, reducing its generalization and policy applicability (Santos, 2021).

2.3 The correlation between Innovation and Entrepreneurship

Despite the increasing research on innovation and entrepreneurship in academia, literature is still fragmented. In addition, not enough attention has been given to the roles of innovation and entrepreneurship in the teaching mission. As shown by the definitions of academic innovation,

cutting-edge teaching techniques, innovative programs, and curriculums can also support innovation and entrepreneurship. However, they are not further explored in the analysed literature.

Given the interrelatedness and complementary roles of innovation and entrepreneurship, there is a need to address them together at theoretical and empirical levels within universities. As Drucker (2006) noted, entrepreneurship and innovation are systematic behaviours, and therefore a systematic approach is required to integrate them into studies. It is particularly important to consider innovation and entrepreneurship from a knowledge perspective (creation, dissemination, and application) to boost economic and social development while preserving the autonomy and sustainability of universities in a knowledge-based society.

Innovation and entrepreneurship share the same roots in Schumpeter (1934), but they have been treated within different scientific directions (Landström et al., 2015). Only a few studies have attempted to develop conceptual frameworks considering their relation and complementary roles ((Brazeal & Herbert, 1999); (Zhao, 2005); (Brem, 2011)), but innovation and entrepreneurship can be seen as continuous and complementary processes. Innovation is the source of entrepreneurship, and entrepreneurship allows innovation to flourish and realize its economic and social value (Zhao, 2005). Both innovation and entrepreneurship are present along the process, but the focus goes from innovation (more related to novelty creation) at the beginning of the process to entrepreneurship (more related to value creation) at the end of the process. They do not always occur concurrently, and they are partly parallel and overlapping (Brem, 2011).

There is, thus, a need for more profound theorization and empirical research that can produce additional comprehension into this domain of the cause-effect relationships between entrepreneurship, innovation, and local and regional dynamics (Santos, 2021).

2.4 The Knowledge Triangle: INVENTHEI Domain's integration

The concept of the knowledge triangle focuses on the three-way interrelationships between differentiated elements, as well as on the ways in which they may be integrated again. (Lassnigg et al., 2017)

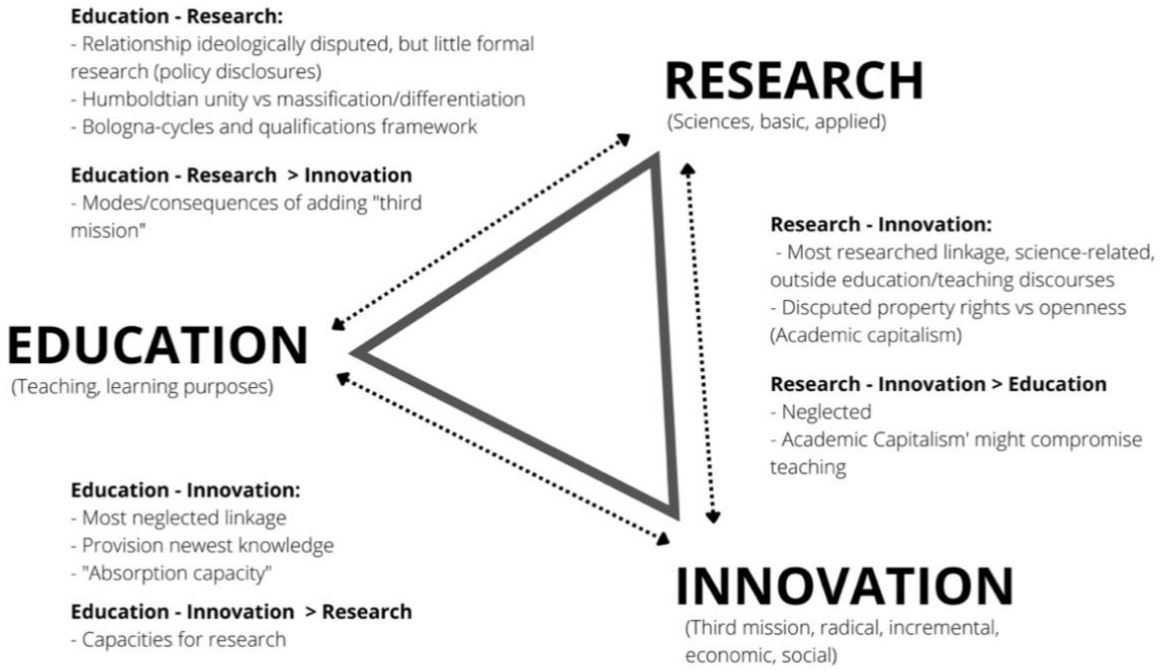

Figure 4: Mapping of main topics and discourses in the knowledge triangle

SOURCE: *HIGHER EDUCATION INSTITUTIONS AND KNOWLEDGE TRIANGLE: IMPROVING THE INTERACTION BETWEEN EDUCATION, RESEARCH AND INNOVATION* (Lassnigg et al., 2017)

The term "Knowledge Triangle" is used in several different contexts. These definitions differ in terms of the denomination of the vertices and the objective of the framework. The first and most obvious differences are the names of the vertices. Although most scientific papers deal with this as the interaction of Education, Research, and Innovation, political papers and concepts often use other vertices: E.g., the European Association of Institutions in Higher Education (EURASHE) draws a Knowledge Triangle with the vertices "education- innovation- employability"; the European Institute of Innovation & Technology (EIT) uses "education- research-business" (Fig.5).

Other notions include "education, research, and knowledge transfer" (UIIN 2014), "knowledge, research and innovation", teaching, research, and engagement (Hazelkorn & Herlitschka, 2010) or assign an "economic development mandate" (Rothaermel et al., 2007) to universities as their additional mission for fulfilling their role in the knowledge society.

There are two concepts of the Knowledge Triangle that allow much political significance and represent two very different perspectives not only about the framework itself but also about Higher Education as a field: the EURASHE and EIT approach.

EURASHE represents vocational tertiary education facilities in European Countries (e.g., polytechnics, universities of applied sciences). There is a wide variation in the way vocational education is organized at the post-secondary level across Europe, such as a variety of national (and regional) educational traditions, socioeconomic circumstances, and as a result, the distribution of vocational education across secondary, post-secondary, and tertiary levels.

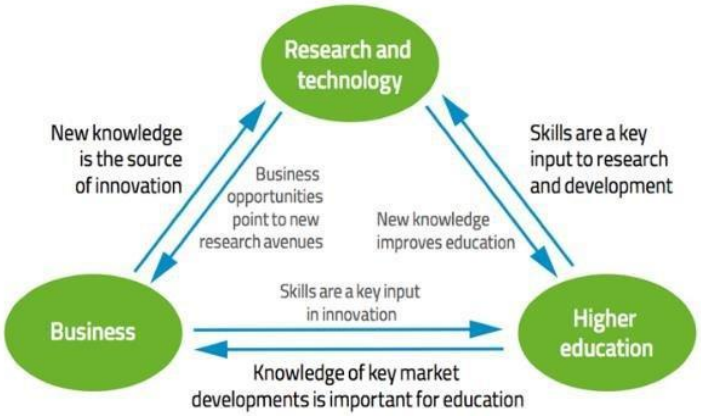

Figure 5: Knowledge Triangle EIT

SOURCE: EIT 2012:5

The EIT was established in March 2008 as a body of the European Union and its mission is "to increase European sustainable growth and competitiveness by reinforcing the innovation capacity of the EU". The EIT can also be regarded as a model of innovation governance and financing in the European Union. It has been given an important role as part of Horizon 2020, the framework programme for research and innovation for the period 2014-2020, with the objectives of addressing societal challenges and assisting the EU to gain leadership in enabling and industrial technologies.

The EIT was conceived as a kind of "ideal" European HEI (Higher Education Institution), designed as a strong and world-competitive entity to meet the challenges of the knowledge triangle in a knowledge economy. Both EIT and EURASHE refer to the European countries' notion of the knowledge triangle as the one that uses education, research, and innovation (e.g., European Commission 2010:12) as the vertices of the knowledge triangle.

In 2010, the EIT established three Knowledge and Innovation Communities (KICs) on climate change mitigation and adaptation, ICT, and sustainable energy. They operate in 19 "co-location centres" across Europe and in each of these centres, actors of each vertex of their Knowledge Triangle cooperate: "KICs carry out a whole range of activities, covering the entire innovation chain – including training and education programmes, reinforcing the journey from research to the market, innovation projects and business incubators."[3]

[3] Search more on https://eit.europa.eu/our-communities/eit-innovation-communities

The assets of the KICs are, according to EITs own description, their high degree of integration, addressing education, research, and entrepreneurship simultaneously; the long-term perspective for all partners involved, since each KICs has a minimum run-time of seven years; efficient governance in decision-making planning; the co-location model, which also enables the KICs to respond to regional needs or challenges; and the KICs culture, meaning "integrating education and entrepreneurship with research and innovation and operating according to business logic and a results-oriented approach". (Lassnigg et al., 2017)

It is by their nature that universities provide services in at least two corners of the Knowledge Triangle: Education and Research. In line with the Humboldt ideal, although they integrate research and teaching, they are considered full universities in the sense that they integrate research and teaching. Universities have changed their role and expanded their range of activities due to several key developments (Unger & Polt, 2017):

- With the increasing decentralization of HEI governance, institutions are becoming more autonomous and funding schemes emphasize performance and competition. In this way, universities can allocate resources autonomously, set strategic targets, and set their own unique profile in research and education.
- While international collaboration facilitates the exchange of knowledge and experience in research and education, it also leads to increased competition between institutions for research talent and students.

An entrepreneurial university publicly acknowledges the role and importance of graduates as the institution's ambassadors' but also as sources of inspiration for the future positioning and development of the university. (Unger & Polt, 2017)

3 Problem Characterization

3.1 Define the research objectives related to the gaps identified in the literature

Universities are institutions that undoubtedly enhance the growth of any sector. Either because of the human resources, they train for the different business areas, or because of the knowledge that they spread. By providing students with the skills necessary to face future professional careers, they also have the challenge of showing them the different paths they can follow. Or, at least, encourage the possibility of innovating and thinking outside the box. Many people may already be born with an innovative and entrepreneurial feeling, which they notice early on, but others may have it dormant and waiting for the right stimulus to be released. It is a challenge for higher education to promote and enhance innovation as a response to the increasingly growing and demanding market.

When we talk about innovation, we are not referring to any specific area, as all sectors are open to new concepts or applicability of resources, hence it is essential to instil these valences in students.

Much has been done in this direction, from projects and incentives at the European level, to national initiatives. But what barriers can be found in this process? How can higher education institutions become engines of innovation and turn students into the fuel that energies them?

After analysing the literature, it is possible to understand that Europe has been taking a stance that sustains innovative growth that spreads to all community members, by establishing funds and structures that support innovative initiatives and that promote local growth and establishment partnerships, both nationally and internationally.

The main interest of this project is based on the understanding of the situation in Portugal regarding the challenges of higher education in promoting and encouraging innovation.

3.2 The institution where the project took place

The research laboratory that hosted the research for the present work is a great example of how academia and its faculties can set up and train research and development units within their walls, also providing the key elements to make them work. The Digital and Intelligent Industry Laboratory (DIGI2 Lab) develops multiple projects funded not only by the EIT (European funding) but also by national funding initiatives, in which partnerships are established not only with universities from other countries belonging to the European community but also with national and international companies. The wealth of these partnerships is unquestionable, and the value of exchanging knowledge, practices and results reflects the fruits of promoting

innovation. Entrepreneurship enters here insofar as it is from centres like these that new start-ups, scale-ups, and spin-offs often come out. Elements that take what they learn, and what they have been studying and give it a purpose and market applicability.

3.3 Describe the opportunity raised by the institution

To have a more practical appliance for the research later results, this study has a case study on the INVENTHEI project. INVENTHEI envisions that by 2025 a critical mass of highly educated young entrepreneurs and innovators will be trained by the participating higher education institutions (HEIs) (Gonçalves et al., 2022), contributing to the emergence of highly dynamic research and innovation ecosystems - the innovation districts (Shah et al., 2020) - favouring the setup or inshore of knowledge-intensive companies on cutting edge technologies, value-added products and services, and innovative business models in the manufacturing and health domains. These innovation districts, by definition, are geographic areas where leading-edge anchor HEIs and companies cluster and connect with start-ups and society, business incubators and accelerators. According to this model, the potential for innovation and economic development lies in a more prominent role for HEIs. The innovation district also has an enhanced capacity to provide students with new ideas, skills, and entrepreneurial talent. Students are the new generation of professionals, but they can also be trained and encouraged to become innovators and entrepreneurs, contributing to the creation of jobs and economic growth. The new Strategic Innovation Agenda (SIA) of the European Institute of Innovation and Technology (EIT) for 2021 - 2027 includes as one of the specific objectives the creation of systemic impact in higher education at the institutional level, by supporting HEIs to increase their innovation and entrepreneurial capacity and better integrate into and engage with innovation ecosystems.

INVENTHEI builds on existing practices and infrastructures to enhance the regional innovation ecosystems and promote innovation-driven research. One of the objectives is to set up an HEI-driven European Network of Innovation ecosystems. Together, the consortium will build on existing experience - e.g. the EntrepreNow conference offered by UPORTO, the curriculum in challenged based multidisciplinary learning offered by FEUP/UPORTO, the experience in mechanisms to facilitate effective collaboration between academic and external organisations of USFD, and the Porto Innovation District - and will explore synergies with research and innovation activities to nurture and foster an innovation and entrepreneurial culture in the participating Universities.

The field of I&E education is developing and a good number of European HEIs are engaged in entrepreneurship education, successfully implementing a wide range of innovative and experimental approaches to entrepreneurship education. These approaches, however, have not just evolved overnight and there are still many obstacles to I&E education that HEIS had to and still needs to overcome. Three dimensions stand out as barriers to I&E education: Resources, Institutional Infrastructure and Development.

The level and scope of entrepreneurial education are closely linked to the number of resources available for entrepreneurship education and HEIs often rely on external funding to support their I&E education. HEIs continuously must think of new projects and initiatives to obtain new funding.

The project orientation often applied in I&E education means that many initiatives require specific infrastructures and a specific context where academia and industry can collaborate. The problem is that I&E teaching does not really show any results before some time has elapsed, and the setting up and sustainability of these infrastructures becomes a problem. The pedagogic principles guiding the teaching of I&E where the students are urged to take responsibility for their own learning are different from the way teaching is traditionally done in academic institutions. However, many HEIs have very few resources for the professional development of academic staff. Thus, they are not able to offer their staff the opportunity to develop their entrepreneurship skills and attitudes through training. The strategic barriers to I&E education are mainly that support is needed from top management and from outside stakeholders, and that it is a challenge to motivate management and make them understand the approach. As such, leveraging and using the “upgraded” knowledge triangle (which includes societal development at the centre) approach, will facilitate the creation of systemic, institutional change.

To summarize, and as mentioned previously in the introduction chapter (section 1.3), the opportunity raised by the institution is condensed in the research questions. The main issues to be solved regard the proper way for a university to become an engine of innovation in their local ecosystem, translating this into approaches and procedures to follow, and how to prepare its students for this evolving innovation and entrepreneurial environment, understanding their position, ambitions and willing to pursue this work field.

4 Methodology

4.1 Comparative analysis of existing approaches and reasons for the choice of the adopted approach

A scientific methodology may be considered as a set of processes of academic work or the set of procedures of the investigation process. The correct and clear application of the scientific methodology guarantees the scientific rigour of the research. It protects research from subjectivity and directs it to produce valid and scientific knowledge. To describe the scientific methodology in a theoretical way, it is necessary to choose strategies among the approach, the nature, the research objectives, and the technical procedures.

For the present work, the research started with the state of the art, searching for theoretical arguments to explain what has been done so far, how to improve it, how to adapt it to different scenarios and what isn't defined yet and would be interesting to be.

Literature reviews require a clear question, a research strategy, the establishment of inclusion and exclusion criteria for articles, and, above all, a careful evaluation of the selected literature. An analysis of this type of selection, including concepts such as characterization analysis and quality analysis, is needed to study the analysis of the literature that has been informed by still research questions.

An author may conduct a literature review for a variety of reasons, including (Aromataris & Pearson, 2014):

- Present general knowledge about a topic.
- Show the history of the development of knowledge about a topic.
- Identify where evidence may be lacking, contradictory, or inconclusive.
- Establish whether there is consensus or debate on a topic.
- Identify characteristics or relationships between key concepts from existing studies relevant to the topic.
- Justify why a problem is worthy of further study.

As traditional literature reviews lack a quantitative or reproducible method for estimating the efficacy of treatments, a considerably more structured approach is necessary. A systematic review also referred to as a "research synthesis," combines many relevant studies in one document. Although a systematic review follows a similar pattern to a literature review,

focusing on data rather than concepts and theories, a systematic review aims to discover "all" of the evidence relevant to a question (Aromataris & Pearson, 2014). Systematic reviews have well-defined and internationally accepted characteristics. A systematic review has the following characteristics:

- Objectives and questions are clearly articulated.
- Criteria determining the eligibility of studies a priori (in the protocol).
- Identifying all relevant studies, both published and unpublished.
- Review of the quality of included studies, the validity of their results, and any exclusions due to quality.
- Data analysis of the included studies.
- Analysing and synthesizing the findings.
- Reporting the review methodology and methods transparently.

There is an increased need for timely evaluation of distributed user systems in different contexts due to fast-changing technologies. This has led to increased use of questionnaires, in-depth interviews, and focus groups in commercial usability research as well as in academic research contexts (Adams & Cox, 2008). Interviews are usually conducted on a one-to-one basis. They require a great amount of the investigator's time during the session and after that, for transcribing and gathering the data. The primary purpose of interviews is to collect facts or gain a deeper understanding of opinions, attitudes, experiences, processes, behaviours, or predictions through interviews. (Rowley, 2012)

Questionnaires are usually paper-based or delivered online and consist of a set of questions that all participants are asked to complete, and they can be delivered to many people with little effort. However, many participants also mean a large amount of data needs to be analysed. Depending on what is being investigated, sometimes it is helpful to start with a questionnaire and then follow up some specific points with an experiment, or a series of interviews, to fully explore some aspect of the phenomenon under study or start with interviews and then move on to questionnaires to validate certain findings.

4.2 The method used in the project

The data was collected by performing, initially, interviews[4] with individuals from industry, academia, members of research centres and members of ANI (National Association of Innovation - Portugal). An amount of 15 interviews were made and the type of data collected was qualitative. The interpretation and analysis of this data consider subjectivities and nuances that are not quantifiable.

Other than the interviews, the case study approach, which is a deep and exhaustive study of one or a few objects, was also used. The INVENTHEI project served as a stage for the research. Among the purposes of the case study, there is the intention to explore and describe real situations, formulate hypotheses, develop theories, and explain variables that cause a complex phenomenon.

At the final stage, a survey[5] with more open questions directed to the students was made available and meant to understand their position considering that they're the target of this study. This tool helped to compare the vision of the knowledge providers to the vision of the ones that will be receiving the training, so it's highly important to know if they are aligned.

The following diagram works as a tool to better describe the stages of the work:

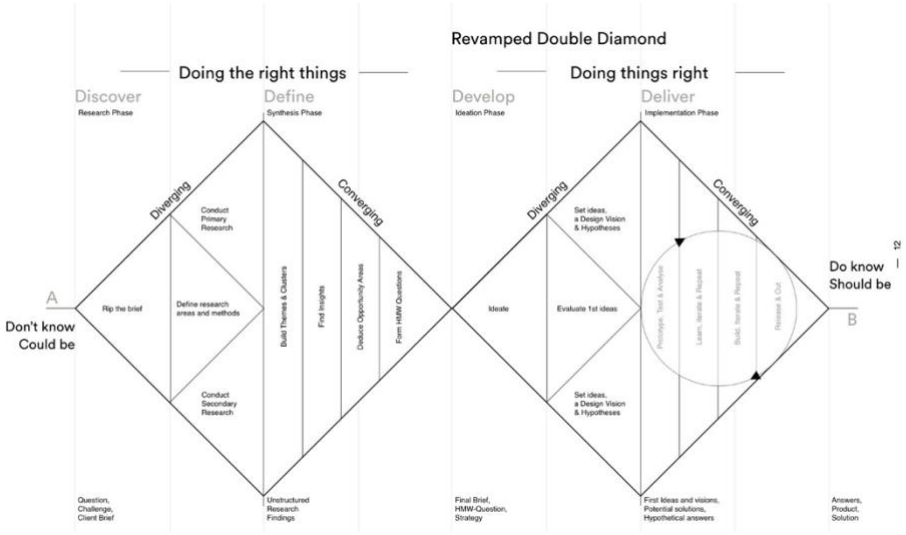

Figure 6: Revamped Double Diamond Design Process Framework

[4] The interview questions can be consulted in annex 1.

[5] Survey questions can be consulted in annex 2 or in the link: (https://docs.google.com/forms/d/e/1FAIpQLSc6NeZnNK_P203jO_li2ggUCRJ6HRP9FtNx4Th40K3PEfdtrw/viewform?usp=sf_link)

SOURCE: UX COLLECTIVE, BY DAN NESSLER

The study began with the discovery of the theoretical bases that underlie the research, as well as the search for opinions, experiences, and other significant data, through interviews, which allowed to create insights and funnel the information to certain evident conclusions at this point. The first phase focused on the opinion of knowledge providers, from academia, industry, and research. The results of the first round of searching for information allowed to draw key conclusions to conduct the next research.

Converging those first results, a new discovery was launched, with the purpose of validating the findings. An online questionnaire was carried out, with the aim of collecting the students' opinions on this topic, thus obtaining the other side of the story. If on one hand, we have providers saying, "we do it this way", on the other hand, we need to have receivers evaluating whether "we like it this way" or if "it works better this way.

The final convergence includes modelling the process of instigating innovation and entrepreneurship in higher education, considering the challenges that it presents, and creating a set of actions to be applied in certain scenarios.

Table 1: Division of interviewees

	Academia	**Industry**	**Students**
Number of respondents	10	5	20

The scripts and the results of the interviews and questionnaires mentioned above can be found in annexes 1 and 2, respectively, and will be discussed in the next chapter - results. The version in the annexes refers to raw and loose information within each topic, with basic structuring.

5 Results

This section encompasses the evidence collected in the work and the related analysis. The results are structured into sections, where the first one reports the view of faculty members, research, and industry, constituting themselves as the providers of knowledge, and integral to its dissemination. The second section sets out the views of students, the receivers of knowledge. This distinction aims to compare the approach of those who transmit and those who receive, to understand what will make more sense for both, thus optimising the processes. The third section consists of the actions carried out in the INVENTHEI project, comprising activities mentioned both by members of universities, research, and industry and by students. In this way, it was possible to have a more practical view of the applicability and replicability of various initiatives.

5.1 The vision of Academic and Non-Academic staff

In this Section the insights obtained from the interviews carried out with professors (academic staff), researchers and other individuals with a professional area of interest (non-academic staff) are presented.

The first insight is that Universities wish to interact with this evolving innovation and entrepreneurial environment and to do that, they need to develop a wider knowledge transmission capacity. This means bringing together better organizational management models, creative initiatives, and opportunities, without sacrificing excellence in teaching and fundamental scientific research. Universities have been finding ways to respond to the challenge of transmitting and enhancing knowledge related to innovation and the practical application of the concept. However, they cannot lose the rigour of fundamental education. This has been materialised in a set of best practices in processes and organisational structure, knowledge transfer related to technology, collaborative projects, business involvement, and the social and economic fabric in the training activities themselves. Also, worth highlighting that some of the interviewees say that universities may not be sufficiently well prepared for innovation. This can be justified by the fact that they have been, since the beginning, more focused on theory and fundamental research, which produces knowledge that can be converted into published articles or sold in patents.

Secondly, from the responses, we were able to conclude that over time, Universities have been building competence centres that made them very competitive in certain areas in comparison with others in which they are not knowledgeable nor competitive. Creating interface research institutions that are already parallel to the university, and are capable of recruiting people from

multidisciplinary teams, and people who know the theoretical aspect but who can move from the theoretical to the experimental are critical and key to responding to this paradigm.

Additionally, we could collect that most students do not really know what research and innovation is, so it is essential to instil this knowledge from the beginning. In addition, there should be more space for discussion and brainstorming, this being the first point to create new and innovative ideas. Other than that, a greater number of projects, courses, internships, and other activities, in partnership with the industry, is a good start, not only for research groups but also for students in general.

Also, Universities need to become more active in the promotion of the innovation and development of their local ecosystems. For that, there should be more hands-on courses and projects within the industry, with industry partners, as a start, not only in the thesis context but throughout the student's journey.

Creating technology parks or incubators is also a very important initiative in this ecosystem growth, as it allows early-stage companies to be promoted and trained more easily and creates more favourable conditions for evolution. What is often seen is that companies are more advanced than universities in some fields, which might be disappointing. Those competence centres should work hand in hand with companies to understand:

- The status in which the more advanced companies in that business sector/complex problem are.
- The pain points that the companies are facing and have no time to solve by themselves (perhaps due to not having the ability - time or investment - to innovate or due to the academic skills that the company doesn't have or wants to create internally).

After understanding this, academia should build a strong relationship with the top investment companies in that specific sector to be able to test on the market all the research that is being done. Universities need to become more active in the promotion of the innovation and development of their local ecosystems. For that, there should be more hands-on courses and projects within the industry, with industry partners, as a start, not only in the thesis context but throughout the student's journey.

To become competitive again, the academia must understand which are the problems that should be solved (that the companies want to be solved and don't want to solve by themselves) rather than duplicating work as we often see in the industry or just solving a problem no one is looking to solve. From the interviewee's points-of-view there is still a lot to improve. Universities need to work hand in hand with companies and build spin-offs and/or competence

centres when needed. Merit in the universities is often measured in papers or presentations on summits (which favours endogamy) and that can be relevant, but even more, relevant (for the country's economy and for the sustainable business of the university) are having discoveries working on the market and patents. An open and healthy ecosystem is still way ahead of us.

Investing in more projects, courses, internships, and other activities within newly developed innovation concepts would be a helpful start. However, the concept of innovation and research must be better explained since most students associate the two terms with theoretical work only. Over the years clusters have been formed in each area, which makes the integration harder, but the lack of information is still what makes it difficult to understand either Research or Innovation. Businesses and R&D professionals need the education to develop the skills they need. Therefore, it is clear in this approach the importance of education as the basis for fostering innovation. It's crucial to create more space in the curriculum with some specialized training focused on this area - Innovation and Entrepreneurship. There is a lot of specialized knowledge, and it is relatively sophisticated work but helping students to cover a lot of ground in terms of preparation is a key to their development and upskilling and creating opportunities to expose themselves to challenges.

Lastly, most of the time, researchers develop projects with a lot of fear of error. The research careers are still very precarious and require a lot of bureaucratic processes that don't allow continuity for more than certain years. In addition, there's no effective management in most centres, so the professionals often get overloaded with work, inhibiting their ability to innovate and give wings to creativity when solving the challenges proposed to them in a certain project. Something that is critical is to constantly validate the research in the market and understand its needs. The sharing of updates must be constant, within the team, so that everyone is always aligned. It is imperative to have a rich and adequate scientific background to foster innovation and entrepreneurship.

Therefore, higher education plays an imperative role in this regard. For a start-up, initial monitoring is essential for it to grow and develop, and the structures that some universities provide for this purpose, such as business incubators, are essential to provide this support. These structures allow entrepreneurs to evolve in a more comfortable environment, surrounded by a series of support mechanisms to get to know each other and evolve.

5.2 Student's perspectives concerning I&E teaching in HEIs

Definition of Innovation, Entrepreneurship, and the co-relation between both:

The students surveyed in this study rated innovation and entrepreneurship according to the notions present in the literature, always reinforcing the ability of both to respond to everyday problems, providing disruptive solutions and new approaches to different situations. Regarding the correlation between the terms, there is a unanimous view that to be an entrepreneur, the existence of innovation is implicit. Otherwise, the same value will not be assigned.

The need to address I&E topics:

Teaching Innovation and Entrepreneurship skills in higher education institutions still hasn't impressed the students. It's possible to recognize that entrepreneurship is more neglected than innovation. This can be related to the fact that the respondents are mainly linked to engineering careers. This field approaches the innovation, indeed, but doesn't explain enough how to scale it and handover concrete applications. This is probably one of the most evident flaws in I&E teaching.

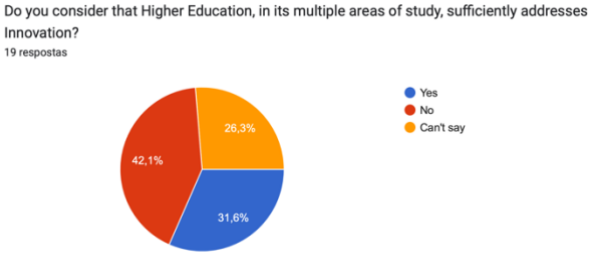

Figure 9: Student's perspective on how HEIs address Innovation

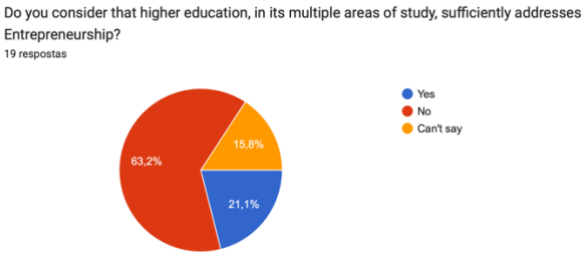

Figure 7: Student's perspective on how HEIs address Entrepreneurship

Students consider the endowment of these skills as essential in their educational path. If it is up to the academy to provide students with theoretical knowledge, its applicability in a real context, as well as the promotion of a creative, innovative, and entrepreneurial spirit, make perfect sense to build complete professionals.

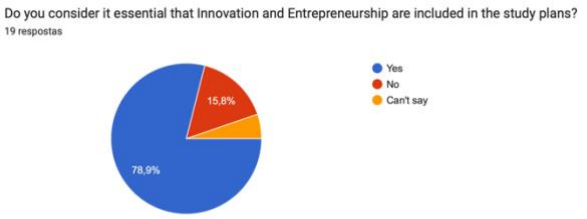

Figure 8: Student's perspective on the need to include innovation and entrepreneurship in the courses

Most effective mechanisms for teaching Innovation and Entrepreneurship

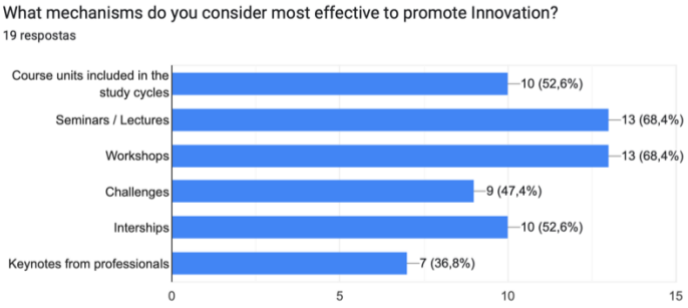

Figure 10: Results regarding most effective mechanisms when teaching Innovation in HEIs

Key **Figure 11: Results regarding most effective mechanisms when teaching Entrepreneurship in HEIs.**

Seminars and workshops which are specific to these topics and internships where they can apply the acquired knowledge summarize the students' view of the "ideal" method of transmitting knowledge and training.

How to turn universities into engines of innovation in their local ecosystems:

There is unanimity when it comes to providing students with skills in Innovation and Entrepreneurship. Students refer that the creation of spaces and contexts that favour creativity, as well as subsequent monitoring and training, would be the ideal instigators. Synergies with local entities, as well as other companies of different proportions, could also launch the challenge and interest in producing innovation.

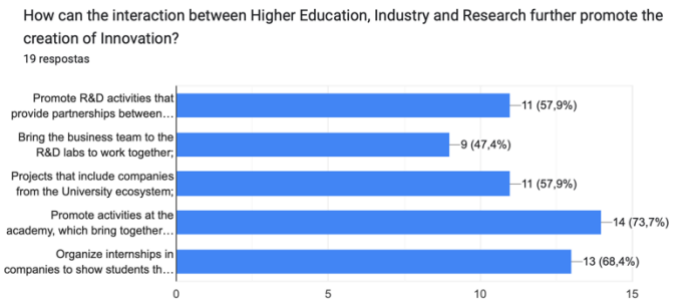

Figure 12: Results regarding the importance of the interaction between Education, Industry, and Research

Barriers to teaching I&E skills

The barriers seen by the students in this process are related to the theoretical vision of many institutions, reinforcing the educational capacity, but neglecting the more practical vision of the concepts. There is still a vision related to society, which admits that the Portuguese community does not yet have a visionary power, so the need for these skills is not yet felt to a large extent.

5.3 Actions performed in the scope of INVENTHEI:

Leaning and Mentoring

For the education vertex of the Knowledge Triangle, which is connected to Domain 4 – Enhancing the quality of innovation and entrepreneurial education, INVENTHEI's partners are implementing actions that contribute to:

1. Enhancing the scale and scope of student engagement activities with research and business.
2. Developing innovation and entrepreneurial training programmes and mentoring schemes for staff and students.

As an illustration of the activities that were implemented:

- UPORTO organized the SciTech student competition, involving external organizations and students (both from the Faculty of Engineering and the Faculty of Sciences), and the EIT Health Innovation days, involving hospitals and municipalities and students. UPORTO also organized the winter schools for the EIT Manufacturing Doctoral School and promoted the involvement of PhD students and researchers.
- UPTEC organized the School of Start-ups for researchers, involving researchers that were trained and mentored in entrepreneurship.
- USC implemented a social innovation training program related to the ageing process for master's students and academic staff.
- VUT implemented training in social innovation focused on master's students.
- TTK implemented an entrepreneurial training program, including hackathons, for staff and students involving external partners, organizing student innovation-seeking missions.

- USFD worked on curriculum design for "academic collaboration with industry" and "entrepreneurship". UPCE organized a series of courses focused on business involving students and 7 staff members.

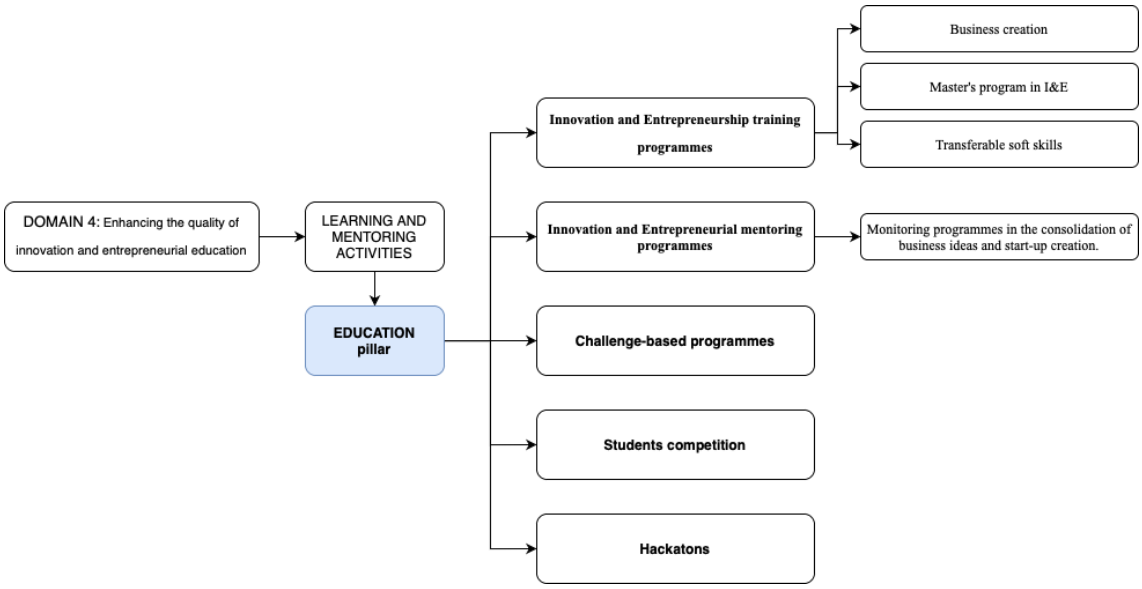

Figure 13: Identified activities on the Education pillar

Learning and teaching structures

For the Research vertex of the Knowledge Triangle that is connected to Domain 3 – contribution to developing innovations and businesses, this task will implement actions that contribute to:

1. Developing inter-and multi-disciplinary structures accessible to students, young researchers, and companies.
2. To create structures and conditions for innovation-driven research.

As an example of the activities that were implemented:

- UPORTO involved the Competence Centre for Healthy and Active Ageing and FEUP's Digital and Intelligent Industry Lab (DIGI2 Lab). FEUP is implementing a teaching and learning factory with the support of EIT Manufacturing (TF4iM -Teaching Factory for intelligent Manufacturing).
- USFD defined a collaborative test bed for the development and scale up of new biomedical glass and ceramic materials -including manufacturing technologies.
- UPCE exploited the Health Care Centre at the Faculty of Health Studies to train both professionals and non-professionals from external partners and the public and involve

students and faculty staff in the implementation. UPCE also trained students in the Educational and Research Centre in Transport.

- TTK developed innovation programs engaging students and enterprises in participating Institutes in the field of digital printing and material virtualization, logistic and supply chain virtualization.
- USC reinforced already existing research and teaching institutions (such as the Psycho-gerontology service and the Spanish Red Cross Chair for the Improvement of the Quality of Life of Older People).
- VUT plans to attract students from different fields of study to the activities of the

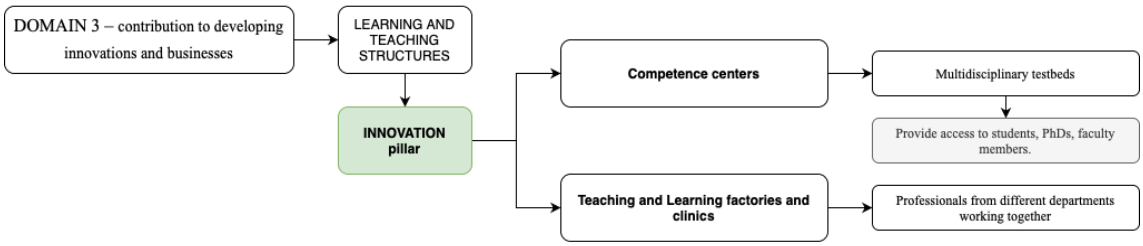

Figure 14: Identified activities on the Innovation pillar

"Future entrepreneur" centre.

Learning and Collaboration

For the business vertex of the Knowledge Triangle related to Domain 2 – strengthening partnerships, this task intends to implement actions that contribute to:

1. Establish new collaborations and enhance the nature, content, and types of collaborations with external partners
2. Organize internships in business for students, young researchers, and staff.

As an example of the activities implemented:

- UPORTO linked the existing Porto4Ageing and FEUP PRIME programmes and BIN@ network and UPORTO spin-off/The Circle club. During the BIN@Porto event (October 2021), start-ups benefited from innovation booths, pitch sessions and B2B meetings. In addition, UPORTO explored UPinTECH, a programme that provides hands-on training to students and young researchers in technology transfer and entrepreneurship.
- UPCE explored new and developed ongoing collaborations in the fields of electrical engineering and information technology, transport technology and health. The

collaborations will be focused especially on internship organizations for students to gain practical abilities in innovation and entrepreneurship.

- TTK looked for negotiations with new partners and explore new collaborations - cooperation based on new economy models (green energy, sustainable economy, digitalization) and internships.
- USC will explore relations with external partners and involve them in the I&E in the field of gerontology. Additionally, USC prepared a workshop about innovation in ageing involving students, academic staff, and external partners.
- USFD intends to demonstrate the value of research audit in identifying opportunities for collaboration and partnership with industry and other non-academic entities (e.g., healthcare providers), and demonstrate the audit toolkit throughout the consortium.

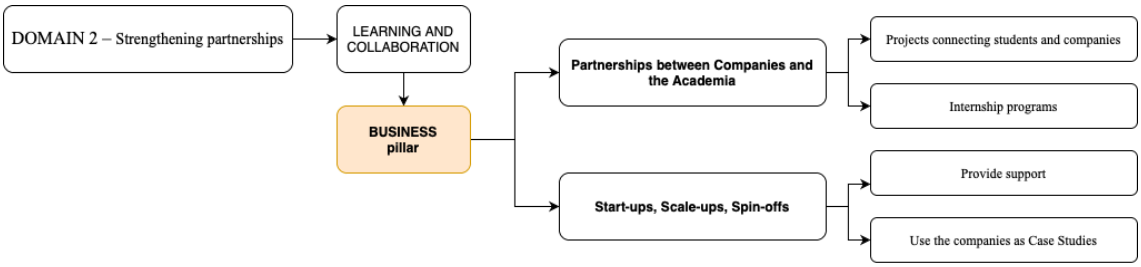

Figure 15: Identified activities on the Business pillar

In all this process, it is extremely important to recognize that in all vertices, pillars, and collaborations, there are people capable and nourished with knowledge, mostly from higher education institutions. People are the fundamental link in the transmission of knowledge and in the advancement toward a knowledge-based society.

5.4 How INVENTHEI practices contributed to the topics of this study

To develop the minimum viable innovation vision of INVENTHEI and implement activities that allow the consortium to learn and use these findings to update the IVAP, on the first phase of the project there was support to 10 start-ups, training of 290 students and 38 staff (academic and non-academic) and the mentoring of 20 students and 18 staff (academic and non-academic) in innovation and entrepreneurship. INVENTHEI's methodology is inspired by the Lean start-up (Bortolini et al., 2018) and will be used for the definition and implementation of the IVAP by partner HEIs. The main findings of these activities were used to improve the IVAP which is currently being scaled in the second phase of the project. During phase 2, the project kept this approach, using the learnings from the IVAP to improve it every six months. This study is part

of the validation and the improvement of the IVAP, by evaluating the impact of the activities in each domain/pillar and constituting a proof of concept for future initiatives.

The research allowed acquiring knowledge to contribute to the creation of two scientific articles, the first to outline and summarize the present work, with the same title this dissertation: *Challenges of educating for Innovation and Entrepreneurship: the role of the Higher Education Institutions*, and a second one with the title *Developing and scaling European HEIs' innovation vision through learning and mentoring programs*. Both papers were submitted for the ICERI 2022 conference – the 15th annual International Conference of Education, Research, and Innovation. The contributions will be included in the IATED Digital Library.

A detailed description of the activities developed and applied in the INVENTHEI project can be found in Annex 3, where it is organised according to the project pillars and contextualised also associated with the scheme of figure 18, present in the conclusion chapter. This description of the activities had the collaboration of the INVENTHEI project partners, among which representatives of the universities of Santiago de Compostela, Valahia University of Targoviste, TTK University of Applied Sciences, University of Pardubice, University of Sheffield, and, of course, University of Porto. All this evidence will be essential in the creation of the INVENTHEI Handbook, a document outlining the most optimistic approaches to be followed in each field.

6 Conclusion and future research

Universities function as nutrients for the growth and strengthening of knowledge. So, well-prepared students, with multiple skills that transcend technical capabilities, will be better able to face the challenges and adversities of professional life. The teaching of these transversal skills is not expected to be generalized, but the integration of this type of content in the student's curriculum must be ensured and promoted. Students don't all have to be entrepreneurs and innovators, but it is essential to have support for those who want it. The challenge for universities is to not neglect elementary education by including other topics in plans and studies but to provide a wide range of opportunities and knowledge so that students can be what they wish to be. Universities have been creating and supporting initiatives and physical locations to bolster and model business ideas, and later create companies, being the research centres and business incubators, unanimously classified as essential.

Companies are made up of people with knowledge, most of them coming from higher education, but not only. Sharing practices and long-living experiences is in the interest of the students, as well as collaboration in the context of internships, dissertation writing, and other presentations. Research centres, many of them bridging the gap between industry and education, are a crucial element in the creation of innovative knowledge and their role must be better disseminated and explained to the community.

The INVENTHEI project allowed to study more closely these challenges for Higher Education Institutions, providing insights from different perspectives and different institutions across Europe. The main goal of this project goes by providing a service which detects the areas of interest where to apply initiatives whether to teach or to foster I&E skills. To address these issues raised, the scheme presented below provides solutions for the different pillars and related links (within the Triangle of Knowledge). This process was developed not only through the information collected, but also based on the activities of the INVENTHEI project, which served as validation for the effectiveness of the study.

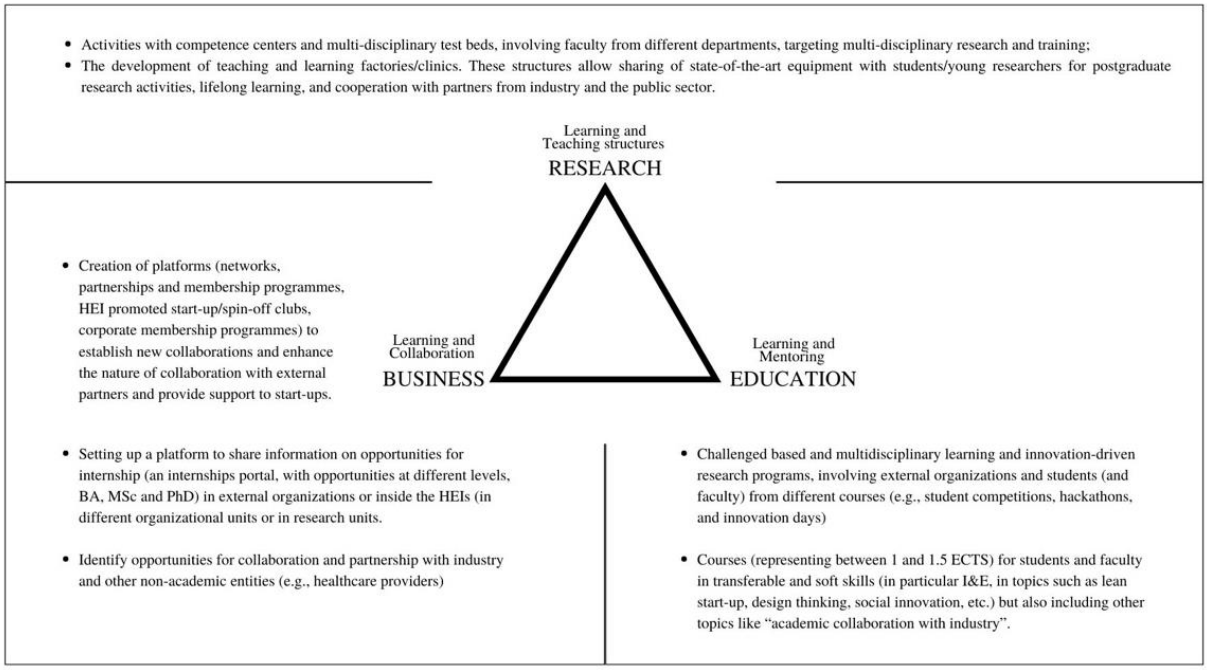

Figure 16: Schematization of the type of activities per domain

To conclude the present study, the research questions discussed based on the results of this work are as follows:

How can universities become engines of innovation in their local ecosystems?

- Develop inter and multidisciplinary support structures, testbeds, and other environments to foster innovation.
- Establish new collaborations and enhance the nature, content, and types of collaborations with external partners, including businesses, research organizations, governmental bodies, NGOs, and other societal partners.
- Create structures and conditions for innovation-driven research.

How can universities better prepare their students to become innovators and entrepreneurs?

- Enhance the scale and scope of student engagement activities with research and business.
- Develop innovation and entrepreneurial training programmes and mentoring schemes for staff and students (domain 4), in the learning and mentoring pillar.
- Organize internships in business

A diagram representing the taxonomy and some examples of activities can be seen below. The examples were taken from current activities being done by the INVENTHEI partnering universities.

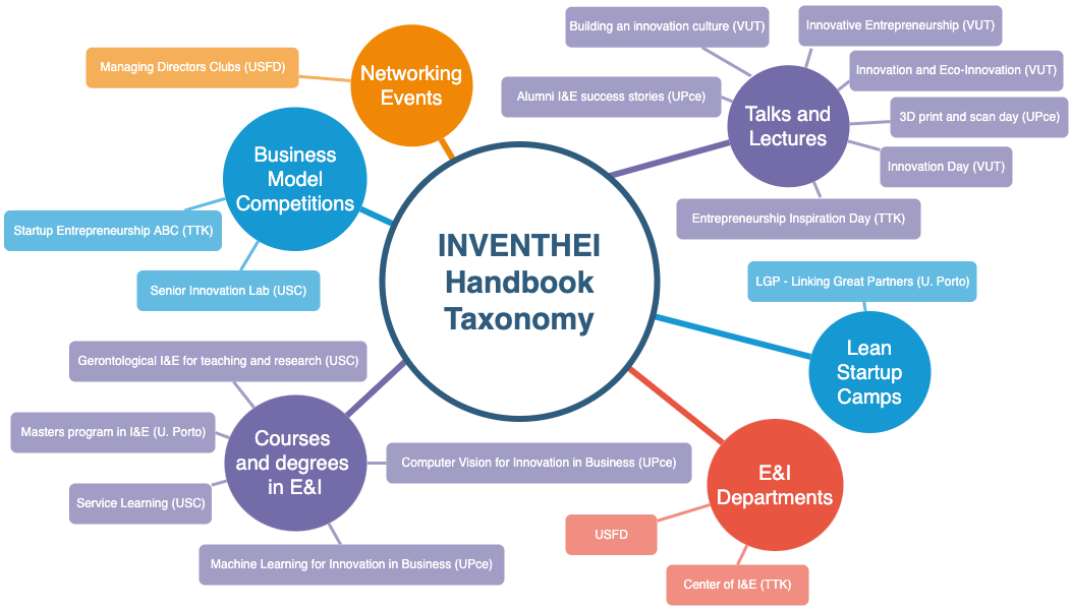

Figure 17: Taxonomy diagram with INVENTHEI activities examples

SOURCE: MIETE-FEUP DISSERTATION 2022

According to the scheme above, it is possible to see that the fundamental activities of INVENTHEI can be taxonomically organized according to six main topics: Networking events, Business Model Competitions, Courses and degrees in I&E, I&E Departments, Lean Start-up Camps and Talks & Lectures. This organization, in terms of synthesis for the INVENTHEI Handbook, is very relevant, because it highlights the most productive activities in each topic, each of which constitutes good practices to follow.

Future work related to this research will involve, within the scope of the INVENTHEI project, establishing the practices considered effective so far, and scaling the access to them. It is also the general will to extend this purpose to other universities, serving the University of Porto as a beacon and example to follow. This will lead to a growth in the network of HEIs, the instigators of social and economic development through innovation and entrepreneurship.

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Annexe 1: Interview guide and results

- Work field

1. In the past, R and D were pointed out as separate activities. Towards an increasingly strong and continuous engagement of science with production, do you believe this still happens? Comment, please.

Research + Industry	I believe it does, we still divide research and development as separated activities, although i think that we should combine them for better results within industry, mainly because research sometimes is very idealistic and once you go to the shopfloor you see that the ideas don't always work as investigated, and the development need to be updated.
Academia + Industry	I think that they may be considered separate activities if and only research is not seen as an end for itself.
Research	Research and development are a component of Innovation and is situated at the front end of the Innovation life cycle as separated activities.
Industry	Yes, research and development are still two separate domains. In industry, the mindset is mostly on product development using out-of-the-box solutions that can be bought or even quickly developed in-house. Research is only necessary when no solution exists for a particular challenge.
Research + Academia	They have been seeing work to bring research and development together, mainly in research centres.
Research + Academia	I believe that this perspective of dividing research and development is more related to a more entrepreneurial context, namely industry, and even so, I consider that it essentially occurred in the past
Research + Academia	Research without a planned development to test it in the market / real world is probably useless and a waste of time and money for everyone involved (and with impact on the country's productivity).
Research + Academia	Yes, they are. For example, for academia, the idea is mainly to explore new approaches, and not so much on the development of new products. Only TRL 5 or 6 can / should be achieved. Above this, spinoffs and startups are, most of the time, required.
Industry	I believe that occurred more in the past, now doesn’t make sense.
Research + Academia	A more thorough understanding of a concept's or phenomenon's essential components is the goal of basic research. In R&D, this insight is typically the first step. Without having any specific applicability to products, rules, or operational procedures, these activities offer a foundation of information. The efforts employed to further knowledge with a particular objective are referred to as applied research. The tasks could include choosing and creating new items, guidelines, or operational procedures. While basic research takes time, applied research takes more effort and costs more due to its intricate and complicated nature. Only applied research should be distinguished from development in this situation.
Industry	Sometimes it does occur. When there’s a lot to address in terms of research, companies delegate that to research centres, by doing projects together.

Industry	It was more seen in the past, the management models assumed that and the companies followed.
Research	Many research centres work together with companies in projects, and it's assumed that the centres do the research, and the companies do the development, but it isn't this linear. The R&D process should be continuous, especially because of the feedback associated to each phase in each step.
Research + Academia	There are management models that approach that, and the evolution among them refers that separating the terms it's not applicable to every context. For more applied research it may make sense, but not for product development, for example. The engagement of science with production is extremely important.
Research	Separate the activities turns the whole process more long, because of the lack of communication among the persons involved.

2. If universities are going to interact with this evolving innovation process, they need to develop a wider knowledge transmission capacity without sacrificing excellence in teaching and fundamental scientific research. How so?

Research + Industry	More projects, courses, internships, and other activities within the new innovative concepts, with partnerships with industry, should be a good start, not only in research groups but also with students overall... I think most students don't actually know what research and innovation are, so this should be passed on since the beginning. Also, regarding research group, there should be more room for discussion and brainstorming, since I believe this is the first point to create new and innovative ideas
Academia + Industry	Universities (at least in the US but we have some examples in Europe as well) have throughout times-built competence centres (probably not called like that) that made them very competitive on certain areas (in comparison with others in which they are not knowledgeable nor competitive). What we often see is that companies are more advanced than universities in some fields, which is at least disappointing. Those competence centres should work hand in hand with companies in order to understand: a) the status in which the more advanced companies on that business sector/complex problem is; b) the pain points that the companies are facing and have no time to solve by themselves (perhaps due to not having the ability - time or investment - to innovate or due to the academic skills that the company doesn't have or wants to create internally). After getting that knowledge the academia should build a strong relationship with the top investment companies on that specific sector in order to be able to test on the market all the research that is being done (ie, to make it applicable).
Research	Separating the role of researcher and professor. Incentives for academic entrepreneurship. However, it's beneficial for the Universities and their students to have entrepreneurial Professors who know how to do technology transfer.
Industry	Approximate the industrial reality to the teaching process. For example, by solving specific problems from industry, which might take the form of internships (e.g. LGP courses), from early stages in the bachelor's or master's

	courses can spark new ideas and opportunities in students. Approximating the challenges in the industry while you teach how to solve those problems is a very good way of learning and you have positive feedback about your developments, which might foster the students for entrepreneurship. Additionally, optional courses about innovation and entrepreneurship can also be an interesting step.
Research + Academia	Universities have been increasingly challenged and in a role that they have historically begun to play well from the moment when science and technology, during the 20th century began to have a significant level of economic impact and that it was realized the influence that science and technology could have in this way that of course the role of universities as say engines of social and economic development began to and has been sophisticated the requirements.
Research + Academia	Universities have been finding ways to address these challenges, which has materialized in a set of good practices in terms of processes and in terms of organizational structure and around technology transfer in the area of collaborative projects in the area of business involvement and the social and economic fabric in their own training activities
Research + Academia	One idea would be to create a support office for knowledge transfer
Research + Academia	Knowledge transfer is something that requires more care than you think. We must assume that this process is made up of phases, starting with a fundamental investigation, which can be considered through teaching, then assuming an investigation so that only in the end we can transfer the acquired knowledge. It is important, however, to maintain freedom and confidence in learning and resort to stimuli that enhance the transmission of knowledge
Industry	It is always important to mention that there will be no negligence in the transfer of basic knowledge, the theoretical capacity of universities, which is basically their purpose. But promoting other initiatives that stimulate knowledge in innovation and entrepreneurship is equally important. I don't think it should be something imposed on students, it should be optional, but within this opportunity to choose it should be very well proposed and faithful.
Research + Academia	The transmission of knowledge can never be devalued. Theoretical concepts will always be fundamental to any professional area, so much so that I consider that not neglecting them is an even greater challenge than teaching innovation and entrepreneurship.
Industry	Produce strategies that support motivation, competence, and directed learning. These curriculum, teaching, and assessment techniques include carefully scaffolded instruction and continuous formative assessment that support conceptual understanding, considering students' prior knowledge and experiences, and offering the right level of challenge and support on pertinent and interesting learning tasks.
Industry	A system of supports that facilitates I&E development by addressing the needs of students and their barriers to learning.

Research	In an environment where information is developing quickly and technology and work processes are changing quickly, researchers, educators, legislators, and business leaders have stressed the need to promote "twenty-first century" skills for more than two decades. The capacity to find, analyze, synthesize, and apply knowledge to novel situations; interpersonal skills that enable people to work with others and engage successfully in cross-cultural contexts; self-direction abilities that enable people to manage their own work and complex projects; competence in finding resources and using tools; and the capacity to effectively communicate in a variety of ways are some examples of these abilities. All of these abilities are closely related to entrepreneurship since they broaden horizons and foster innovation.
Research + Academia	Universities should always assess the worth of the information they pass forward. Yes, transversal fields should be encouraged, but higher education institutions don't view them as their "main business." Therefore, it may be preferable to develop efforts within the institution that are outside the purview of the courses in order to educate these I&E topics.
Research	To develop a wider knowledge transmission capacity without sacrificing excellence in teaching and fundamental scientific research there should be created specific courses and initiatives accessible to all students but not demanded. The knowledge associated to each field is important to create good professionals.

3. The interaction between science and industry is an important aspect of the ecology of innovation. How can universities become engines of innovation in their local ecosystems?

Research + Industry	There should be more hands-on courses and projects within industry, with industry partners, as a start, not only thesis but throughout the student's journey. For research groups there should always be sessions with industry partners to know their reality and needs, even within other countries, so one can understand the present context and try to "pitch sell" new ideas to those markets.
Academia + Industry	In the past, universities have built knowledge looking first to themselves, but the world has advanced and now on certain fields companies are ahead of universities. In order to become competitive again, the academia must understand which are the problems that the academia should be solving solve (that the companies want solved and don't want to solve by themselves) rather than duplicating work as we often see in the industry or just solving a problem no one is looking to solve.
Research	Throughout technology transfer strategies.
Industry	By being open to receive challenges from industry, and industry should be willing to invest / pay for research. One of the problems in universities is the lag between when the research is done and when those will be effectly used. Some breakthroughs are made today and only used 10 years in the future, while there are equally challenging topics to explore that can have a more immediate impact and better financed
Research + Academia	It is necessary to bring together skills and dedicated teams, creating research institutions that we call the interface (type INESC ETC, INEGI, IPATIMUP,

	and the like) that are institutions already a little bit next to the university And that can recruit people who can create multidisciplinary teams who know the theoretical side, yes, but who have the capabilities to move to the experimental side and create something effectively.
Research + Academia	To innovate we can go to the market and get money to make innovation. Portugal, here in Porto and in the north (University of Porto inclusive) today has a number of startups that I would say almost incomparable in southern Europe. Certainly and even in northern Europe there are not many environments that are producing such good knowledge and so good ability to convert startups into companies already of some size.
Research + Academia	By creating technology parks or creating incubators it also allows the early-stage to be promoted and empowered, more easily and creates more favorable conditions for growth.
Research + Academia	The relationship between industry and higher education will always be ambiguous. In my opinion, it would be of value to include in the teaching staff with practical knowledge that they can witness with concrete examples what they are exposing to students, showing them the real applicability of the topics.
Industry	The interaction between science and industry is a very important aspect here to give sustainability to innovation. There are many roles that universities can take on there. More classic and more transactional forms of knowledge transfer, licensing technology
Research + Academia	One of the most obvious ways in which universities can be the instigators of innovation is the power they have to create start-ups, and in addition, they also promote follow-up structures for them as business incubators. Basically, universities are giving this knowledge to people who later decide to take it to the market, maintaining contact and follow-up in the early days.
Industry	Other ways for universities to be machines in local development and instigators of local innovation are to cultivate and bring closer the relationship with society, contributing with initiatives for it, as well as providing services to companies and creating laboratories in partnership with the industry. This will bring the University closer to a more entrepreneurial context and promote the ecology of innovation.
Industry	By providing supportive environmental conditions that foster strong relationships with companies and community.
Research	The creation, promotion and support to business incubators is fundamental. Many companies come directly from the faculties.
Research + Academia	The universities have been doing synergies with companies and other public institutions in order to dynamize activities with students.
Research	Invest more in business creation, or at least provide support.

4. How can universities better prepare their students to become innovators?

Research + Industry	like mentioned, more projects, courses, internships and other activities within the new innovation concepts, with partnerships with industry should be a good start, but mainly, first, explain the concept of innovation and research, since most of the students associate R&D with theoretical work only
Academia + Industry	Universities should prepare the students to build small things and test them easily on the market, even if it is just with our group of friends or family. It will help students to embrace the importance of having a client or customer and building for them, instead of building something that no one wants.
Research	It's beneficial for the Universities and their students to have entrepreneurial Professores that know how to do technology transfer
Industry	By approximating industrial challenges with the given courses
Research + Academia	We have to create more space in the curricula with some specialized training focused on this area. There is a lot of expertise and it is a relatively sophisticated work and therefore we are able to help students cover a lot of ground in terms of preparation and in terms of training to do this work with systematized knowledge is is and then we have to create opportunities for students to expose themselves to challenges.
Research + Academia	We don't all have to be entrepreneurs... but those who want to be must have access to the means and tools to do so.
Research + Academia	Engineering training enhances entrepreneurship
Research + Academia	It is not clear that a computer engineer (for example) has to finish the course and schedule throughout his professional career. There are more options, and it is important for students to know that they can follow other paths.
Industry	In the first year of Computer Engineering there were disciplines such as business management, accounting, analysis of investment projects, logistics, operational research... There's only operational research these days. I wonder if they still actually graduate into entrepreneurs. The importance of these skills must be recognised for those who want to do so.
Research + Academia	It is important to have, first of all, rich and adequate scientific training, hence the importance of the role of higher education in promoting innovation and undertaken. Second, for a start-up, initial monitoring is essential for it to grow and develop, and the structures that some universities provide for this purpose, such as business incubators, are essential to provide this support. These structures allow entrepreneurs to evolve in a more comfortable environment, surrounded by a series of support mechanisms, so that they can get to know each other and evolve.
Industry	One of the best methodologies is to provide disciplines dedicated to practical projects, in which students can be divided into teams (this helps to create team spirit, learn to deal with other people, and everything else) and then work on real problems, to assign solutions, stimulating critical thinking and creativity, and of course all this is directly linked to innovation and entrepreneurship.

Industry	Organize activities within I&E topics together with companies.
Research	Explain better the context of research centers. Many people don't see research as a career because associate it with more theoretical activities, but it doesn't work like that. Research centres are providers of innovation, and many entrepreneurs ascend from there.
Research + Academia	Organize activities within I&E topics together with companies.
Research	More challenge-bases and hands-on activites.

5. Despite efforts to support investment in R&D, education, and innovation there is still little progress in the transition to a knowledge-based economy. Is it because the areas have always been addressed separately?

Research + Industry	yes, over the years clusters have been formed in each area, which makes the integration harder
Academia + Industry	I think there is a lot to improve. Universities need to work hand in hand with companies and build spin-offs and/or competence centres when needed. Merit in the universities is often measured in papers or presentations on summits (which favours endogamy) and that can be relevant, but even more relevant (for the country's economy and for the sustainable business of the university) are having discoveries working on the market and patents. Having said that, I think we are miles away from an open and healthy ecosystem; thus I would say that we could start with baby steps like having the right metrics (as I said earlier, not papers and presentation) and opening the universities to the world.
Research	There are no incentives
Industry	I believe mostly innovation is treated separately (at least in Europe) from R&D and Education. Even R&D and education are close but only in universities, not in technical universities in Portugal. The transition to a knowledge-based economy is a controversial topic. There are many financial factors and interests to avoid having a knowledge-based economy, given that is might not be as profitable as the one we are now. Thus, maybe this is not because the areas have been addressed separately.
Research + Academia	I believe that some money should be invested in purer, more fundamental, more social, more cultural research, disconnected from a company.
Research + Academia	In recent times the dissertations (master's degree) are so focused on the business environment, that we have fewer and fewer people interested both at the level of students and in terms of those of the supervisors themselves in guiding and situations in which both purely academic.
Research + Academia	Investment usually comes from the outside, the country isn't ready to support these initiatives.
Research + Academia	The concept of the "knowledge-based" society isn't well defined yet, at least from what I understand. To turn this into an economical matter, it will be even harder.

Industry	I don't think that's the reason. There's been more and more patents to secure intellectual property in the past few years, so I believe we are going in a good direction.
Research + Academia	The universities and especially the research centres (which are the ones more dedicated to creating innovation) should bet more on licensing intellectual property. This is another subject that education should cover!
Industry	I don't think these areas have been accessed separately.
Industry	The commercialization of knowledge has been more addressed in the past years. Many companies have been licensing innovation.
Research	Universities need to work with companies and build spin-offs and/or competence centres when needed.
Research + Academia	I don't think so. Innovation is directly linked to R&D and R&D is directly linked to education. The connection between Innovation and education is the weakest, but I believe it can be solved through the research centres.
Research	The efforts on the investment come mainly from Europe or private entities. A good step to achieve this knowledge-based economy should be receiving support from the government.

6. The knowledge triangle approach stresses that research output should be integrated into education. Innovations also help the education system to ameliorate both its content and improve the learning environment. How does the knowledge triangle concept put emphasis on the role of education in fostering innovation?

Research + Industry	Education has the role of developing and the needed skills for individuals that work within business and R&D, so it is clear in this approach the importance of education as the basis for fostering innovation
Academia + Industry	Looks a good start but I would add some of the things I said earlier and I would define inputs and outputs from each part (so that this is not so abstract).
Research	3 Mission of Universities
Industry	As seen in the triangle, only skills (I'm assuming hard skills) are being considered for innovation, and others such as creativity, inclusion, and other soft skills are important as well. Having only technical people or people with very little soft skills in charge of companies or being innovators, normally leads to ethical and inclusiveness problems, only focusing on technological progress. As seen in the latest innovations in AI, a more diverse and inclusive team / mindset can develop less biased products. This is not reflected (explicitly) in the triangle, and perhaps a new dimension might be required, such as Social Impact.
Research + Academia	Yes, universities have already realized that, in addition to the pillar of education and the pillar of research, that having a pillar of how to give value to society in other ways and therefore yes and science and technology parks and incubation systems are important and the interface they generate gives after the result of research.

Research + Academia	I can't agree more with the concept of this triangle, let's say I think it's the only way we can really change this entirely
Research + Academia	That concept makes total sense, but I would add something: people. Right in the middle! People are the booster for all the activities, so we should work on their competences and mindsets.
Research + Academia	The knowledge triangle emphasises the role of education by fostering it's connection with both innovation providers: companies and research centres.
Industry	The role of education in fostering innovation starts by fostering innovators. Well prepared students are the first step to become successful professionals.
Research + Academia	University-Industry labs can bridge the gap between university and innovation.
Industry	The synergies schematized in the knowledge triangle are real and we see that in the partnerships we do in the development of projects. Most of the consortia are composed of companies, academia and research centres.
Industry	The scheme shows that education is directly linked with both companies and research centres as it provides professionals fos both and usually is involved in the creation of the research centres but can also be linked to the creation of companies.
Research	The role of education is fundamental in any case, as it provides the basis for every context.
Research + Academia	The academia can also benefit from innovation, by providing more recent tools to students, professors and other related.
Research	The synergies presented in this model are real, dynamic and very important. All the vertices can learn from each other, the partnering up is good to share practices. Education is the basis of all.

7. How does the interaction of industry and research help to create innovation?

    - Promote R&D activities that provide partnerships between academia and industry
    - Bring academia staff to the R&D laboratories to work together
    - Projects that include local companies
    - Promote activities in academia that involve students and companies
    - Organise internships in the companies to show the reality to the students

8. What are the biggest barriers in academia (higher education) that hinder the promotion and sustainability of the innovative process?

Research + Industry	very few or inexistent research careers, and a lot of bureaucratic processes that don't allow the continuity of people for more than x years, or being allocated to multiple innovation projects...
Academia + Industry	Not having (or being evaluated by) the right metrics
Research	Incentives and recognition

Industry	European mindset of investment; Not be willing to fail, or failing is not an option; There's not a university follow-up on new interesting developments that might come out of master thesis and courses' projects.
Research + Academia	I think universities have a problem. In Europe, and particularly in Portugal, I think that universities at the bottom are not well prepared for innovation because they are prepared to do research, which produces knowledge that is converted and published in articles or sold in patents or published and then sold. The units can produce knowledge to convert to value, but this is not innovation. Innovation is when we take this and do something more market-oriented or satisfaction-oriented.
Research + Academia	In the United States there is not as much risk aversion as there is in Portugal. Here, we have a harder time saying that we failed... but in reality there is no problem in failing. In the end, when we look back, we have to learn from the options we choose. If today didn't work out here, tomorrow it can take place elsewhere and the focus should not just be on money, but innovation.
Research + Academia	Research career precariousness and fear of failure.
Research + Academia	Research career precariousness and lack of resources.
Industry	Not enough financing solutions, because of the risk of failure.
Research + Academia	Fear of neglecting basic training concepts when adding transversal competences.
Industry	Still quite theoretical view of the competencies
Industry	Still quite theoretical view of the competencies
Research	Research career precariousness.
Research + Academia	Fear of neglecting basic training concepts when adding transversal competences.
Research	Research career precariousness.

Annexe 2: Survey results

1.

Study Field	**What is INNOVATION?**
Electronics Engineering	It is the ability to think and put to practice something new.
Mechanical Engineering	The ability to do what everyone does, but better
IT	Innovation brings something new or a new way to do something
Engineering	New solutions to old problems
Engineering	To create new solution for relevant problems, to think outside the box.
Electrical engenaring	Development of new technologies (better ones)
Engenharia de materiais	Inovação é criar algo novo, ou fazer algo que já existe mas de forma diferente
Informatics	New ways to do tasks. Often allied with using new technologies.
Engenharia Mecânica	A inovação é a criação de produtos ou serviços que não existiam antes ou a melhoria dos já existentes, podendo ser ou não um fator distintivo
Mechanical Engineering	Development of an improvement to a currently used system
Ciência da Informação	Uma inovação é um produto ou processo novo ou melhorado (ou combinação dos mesmos) que difere significativamente dos produtos ou processos anteriores da unidade e que foi disponibilizado a potenciais utilizadores (produto) ou posto em uso pela unidade. (Oslo Manual 2018)
Engineering	Create something that has never been done before
Mechanical Engineering	Innovation can be seen as "out of the box" thinking, something new, or something old but using a different approach/point-of-view
Engenharia de Materiais	Innovation is the creation, development and implementation of a new product, process or service, with the aim of improving efficiency, effectiveness or competitive advantage
Software Engineering	Any action or concept that has not been thought of before or done in the exact same manner but is able or has the capability to lead to useful outcomes.
Urban Planning	Something different of what came before. But in neoliberal academia "innovation" generally means a "invention" that can be monetized.
Engenharia e Gestão Industrial	Inovação é a criação de algo novo, diferente do que já existe. Pode ainda ser visto como o melhoramento ou otimização de algo já existente

Master in Electronic and Computer Engineering	The use/creation/implementation of something new
Computer Science	Innovation is a change for the better.
Engenharia Mecânica	Procura de algo novo ou o melhoramento de algo existente

2.

Study Field	**What is ENTREPRENEURSHIP?**
Electronics Engineering	It is the capacity of putting to practice and monetizing the ideas of someone.
Mechanical Engineering	The capacity to solve world's problems
IT	Is a lifestyle, is someone who risks and tries new business ideas
Engineering	Solving problems for other people and in doing so becoming independent
Engineering	To develop these solutions, manage resources and assets to achieve that
Electrical engenaring	Creating value for one's self (with or without other people)
Engenharia de materiais	É a criação de uma empresa que produz um produto ou presta um serviço
Informatics	Active involvement in creating new products or companies
Engenharia Mecânica	Empreendedorismo é procurar criar valor para a sociedade
Mechanical Engineering	Forming a business around your ideas on a product or topic
Ciência da Informação	O empreendedorismo é a capacidade criativa de um indivíduo, independentemente ou dentro de uma organização, para identificar uma oportunidade e persegui-la, a fim de produzir um novo valor ou sucesso económico. (Green Book of Entrepreneurship in Europe 2003)
Engineering	Setting up a business at your own costs with the prospect of profit in the future
Mechanical Engineering	Entrepreneurship is presenting to the public something that can change their life
Engenharia de Materiais	What is your definition of entrepreneurship? An entrepreneur is an individual who creates a new business, bearing most of the risks and enjoying most of the rewards. The process of setting up a business is known as entrepreneurship. The entrepreneur is commonly seen as an innovator, a source of new ideas, goods, services, and business/or procedures.
Software Engineering	To create and lead an organization or company.
Urban Planning	This terminology is often used to blur work-capital relations by transforming the social individual into a "company-individual". It

	is a means to transfer the responsibilities and burdens of the capitalists to the workers, but keeping all the benefits of capitalism. In this scenery the worker is an independent individual without rights commonly attributed to the working class. But he stills works, indirectly, for the same companies that holds the means of production.
Engenharia e Gestão Industrial	Empreendedorismo é a proatividade/iniciativa de alguém criar algo novo.
Master in Electronic and Computer Engineering	Creating something by yourself/without the help of any company
Computer Science	Management for success.
Engenharia Mecânica	Capacidade de conjugar gestão de informação, skills sociais e promover novas abordagens a problemas

3.

Study Field	**How are the INNOVATION and ENTREPRENEURSHIP related?**
Electronics Engineering	An enterpreneur will, in general, have more success if its product or service is innovative.
Mechanical Engineering	In order to solve problems, one has to think outside the box and do things differently
IT	In order to get a new business idea you have to innovate, this is why they are related
Engineering	A good way to start a business is offering solutions that other people can't provide
Engineering	Entrepeneurship depends on innovation to some extent to achieve success. Innovatiotion with any good entrepeneurship is wasted
Electrical engenaring	Indirectly New technologies make you unique and that makes it easier to make money in a open market and there for makes it easier to create self value
Engenharia de materiais	A inovação pode levar a um empreendimento
Informatics	Entrepreneurs use new technologies or techniques to create new products that offer value to the market
Engenharia Mecânica	A inovação parte da vontade de fazer as coisas melhor ou de forma diferente, algo que o empreendedorismo procura e sem o qual não teria sucesso
Mechanical Engineering	To be a succesful entrepreneur, you need a valid innovation
Ciência da Informação	Têm uma relação de interdependência uma vez que o empreendedorismo alimentação da inovação e esta é potenciada pelo empreendedorismo.
Engineering	Innovation requires some form of entrepreneurial behavior

Mechanical Engineering	Entrepreneurship requires innovation, and innovation drives entrepreneurship, so they are both interconnected. A given entrepreneurship normally only achieves success if the presents and introduces innovation
Engenharia de Materiais	Over time, entrepreneurship has become associated with creativity, the ability to develop something original, particularly an idea or a representation of an idea. Innovation requires creativity, but innovation is more specifically the application of creativity
Software Engineering	Usually the best and most successful entrepreneurship ventures bring some sort of innovation to the space they are trying to occupy.
Urban Planning	Both terms are extensively employed in neoliberal media and academia.
Engenharia e Gestão Industrial	Na minha opinião o empreendedorismo e a inovação são equivalentes, isto é, um implica o outro.
Master in Electronic and Computer Engineering	Sometimes entrepreneurship requires inovation, sometimes it doesn't
Computer Science	Most often than not, good entrepreneurship involved innovation.
Engenharia Mecânica	São skills simbióticas

4.

Study Field	**Do you consider that Higher Education, in its multiple areas of study, sufficiently addresses Innovation?**
Electronics Engineering	Yes
Mechanical Engineering	Yes
IT	Can't say
Engineering	Can't say
Engineering	No
Electrical engenaring	Yes
Engenharia de materiais	No
Informatics	Yes
Engenharia Mecânica	No
Mechanical Engineering	No
Ciência da Informação	Yes
Engineering	No

Mechanical Engineering	No
Engenharia de Materiais	No
Software Engineering	Can't say
Urban Planning	Can't say
Engenharia e Gestão Industrial	No
Master in Electronic and Computer Engineering	Yes
Computer Science	Can't say
Engenharia Mecânica	No

5.

Study Field	**Do you consider that higher education, in its multiple areas of study, sufficiently addresses Entrepreneurship?**
Electronics Engineering	No
Mechanical Engineering	Yes
IT	Yes
Engineering	No
Engineering	No
Electrical engenaring	No
Engenharia de materiais	Yes
Informatics	No
Engenharia Mecânica	No
Mechanical Engineering	No
Ciência da Informação	Yes
Engineering	No
Mechanical Engineering	No
Engenharia de Materiais	No
Software Engineering	Can't say
Urban Planning	Can't say

Engenharia e Gestão Industrial	No
Master in Electronic and Computer Engineering	No
Computer Science	Can't say
Engenharia Mecânica	No

6.

Study Field	**Do you consider it essential that Innovation and Entrepreneurship are included in the study plans?**
Electronics Engineering	Yes
Mechanical Engineering	Yes
IT	Yes
Engineering	No
Engineering	Yes
Electrical engenaring	Can't say
Engenharia de materiais	No
Informatics	Yes
Engenharia Mecânica	Yes
Mechanical Engineering	Yes
Ciência da Informação	Yes
Engineering	Yes
Mechanical Engineering	Yes
Engenharia de Materiais	Yes
Software Engineering	Yes
Urban Planning	No
Engenharia e Gestão Industrial	Yes
Master in Electronic and Computer Engineering	Yes
Computer Science	Yes

Engenharia Mecânica	Yes

7.

Study Field	**Is there, in your opinion, enough accessible information for those who want to move forward with a business idea?**
Electronics Engineering	No
Mechanical Engineering	No
IT	Yes
Engineering	Yes
Engineering	No
Electrical engenaring	Yes
Engenharia de materiais	Yes
Informatics	No
Engenharia Mecânica	No
Mechanical Engineering	No
Ciência da Informação	Yes
Engineering	Yes
Mechanical Engineering	Can't say
Engenharia de Materiais	Can't say
Software Engineering	Can't say
Urban Planning	No
Engenharia e Gestão Industrial	No
Master in Electronic and Computer Engineering	No
Computer Science	Can't say
Engenharia Mecânica	Yes

8.

Study Field	**What mechanisms do you consider most effective to promote Innovation?**

Electronics Engineering	Course units included in the study cycles, Seminars / Lectures, Workshops, Keynotes from professionals
Mechanical Engineering	Course units included in the study cycles, Seminars / Lectures, Workshops, Interships
IT	Course units included in the study cycles, Seminars / Lectures, Workshops, Challenges, Interships
Engineering	Challenges
Engineering	Seminars / Lectures, Workshops, Challenges, Interships
Electrical engenaring	Course units included in the study cycles, Seminars / Lectures, Workshops, Interships
Engenharia de materiais	Challenges, Keynotes from professionals
Informatics	Seminars / Lectures, Workshops, Keynotes from professionals
Engenharia Mecânica	Course units included in the study cycles, Seminars / Lectures, Interships
Mechanical Engineering	Course units included in the study cycles, Seminars / Lectures, Workshops, Interships
Ciência da Informação	Course units included in the study cycles, Seminars / Lectures, Workshops, Challenges
Engineering	Seminars / Lectures, Interships
Mechanical Engineering	Workshops, Challenges, Keynotes from professionals
Engenharia de Materiais	Course units included in the study cycles, Seminars / Lectures, Workshops, Challenges, Interships, Keynotes from professionals
Software Engineering	Workshops, Challenges, Interships
Urban Planning	Challenges
Engenharia e Gestão Industrial	Seminars / Lectures, Workshops, Keynotes from professionals
Master in Electronic and Computer Engineering	Course units included in the study cycles, Seminars / Lectures, Keynotes from professionals
Computer Science	Course units included in the study cycles, Workshops, Interships
Engenharia Mecânica	Course units included in the study cycles, Seminars / Lectures, Workshops, Challenges, Interships

9.

Study Field	**What mechanisms do you consider most effective to promote Entrepreneurship?**
Electronics Engineering	Course units included in the study cycles, Seminars/Lectures, Workshops, Interships

Mechanical Engineering	Course units included in the study cycles, Seminars/Lectures, Workshops, Interships
IT	Course units included in the study cycles, Seminars/Lectures, Workshops, Challenges, Interships, Keynotes from professionals
Engineering	Interships
Engineering	Course units included in the study cycles, Seminars/Lectures, Workshops, Keynotes from professionals
Electrical engenaring	Workshops, Challenges
Engenharia de materiais	Course units included in the study cycles, Seminars/Lectures
Informatics	Seminars/Lectures, Workshops, Interships, Keynotes from professionals
Engenharia Mecânica	Seminars/Lectures, Challenges, Keynotes from professionals
Mechanical Engineering	Course units included in the study cycles, Seminars/Lectures, Keynotes from professionals
Ciência da Informação	Course units included in the study cycles, Seminars/Lectures, Workshops, Challenges
Engineering	Workshops, Challenges
Mechanical Engineering	Seminars/Lectures, Interships, Keynotes from professionals
Engenharia de Materiais	Course units included in the study cycles, Seminars/Lectures, Workshops, Challenges, Interships, Keynotes from professionals
Software Engineering	Workshops, Challenges, Interships
Urban Planning	Propaganda
Engenharia e Gestão Industrial	Course units included in the study cycles, Seminars/Lectures, Interships
Master in Electronic and Computer Engineering	Workshops, Challenges, Interships, Keynotes from professionals
Computer Science	Workshops, Interships
Engenharia Mecânica	Workshops, Challenges, Interships

10.

Study Field	**How can universities become engines of innovation in their local ecosystems?**
Electronics Engineering	This can be done by promoting classes about innovative and state-of-the-art technologies and ways of thinking, just as it is now with the basic theories and technologies.

Mechanical Engineering	Creating a favorable environment to promote creativity
IT	By giving scholarships for students to go forward with their ideas
Engineering	They should incentivise lateral thinking
Engineering	By rewarding good innovation iniciatives.
Electrical engenaring	Opening more spots and better ones at the institutes of innovation associated with them selfs
Engenharia de materiais	Sim, se forem capazes de estimular os seus estudantes a fazê lo
Informatics	Further partner students with local companies to promote the creation of new ideas
Engenharia Mecânica	Para além de lecionar os conteúdos do programa que são relativamente estáticos, deve haver uma porção dedicada ao futuro dessa área e sobre os desenvolvimentos que estão a ocorrer, com foco na investigação e ciência
Mechanical Engineering	Promoting innovative ideas with collaboration of industry partners
Ciência da Informação	Dotando os seus estudantes de ferramentas e modelos de desenvolvimento de projetos de inovação.
Engineering	Cooperation between them and companies in multiple areas
Mechanical Engineering	Promotion of investigation close to the interests of their local ecosystems
Engenharia de Materiais	Mirroring the “real-world,” innovative universities go outside the boundaries of their institution to conduct research, perform service and participate in other types of collaboration internationally, thus preparing students for their future in a global community and proving themselves as valuable resources
Software Engineering	Partnering with local and non-profit organizations where students can help solve problems with adequate compensation for their work, be that through the university or organization.
Urban Planning	The expansion of academic innovationism seems to be working well.
Engenharia e Gestão Industrial	Abrindo cursos mais direcionados para a inovação e empreendedorismo.
Master in Electronic and Computer Engineering	Having more outsiders participating in the courses. Being in forms of lectures, workshops or some sort of way.
Computer Science	Provide the means for students learn about innovation and good entrepreneurship.
Engenharia Mecânica	Promover atividades internas às cadeira tanto com extra curriculares que têm em vista a resolução de problemas gerais do dia-à-dia e não só específicos de engenharia

11.

Study Field	**How can the interaction between Higher Education, Industry and Research further promote the creation of Innovation?**
Electronics Engineering	Promote R&D activities that provide partnerships between Education, Research and Industry;, Bring the business team to the R&D labs to work together;, Promote activities at the academy, which bring together students and companies;
Mechanical Engineering	Promote activities at the academy, which bring together students and companies;, Organize internships in companies to show students the professional reality;
IT	Promote R&D activities that provide partnerships between Education, Research and Industry;, Projects that include companies from the University ecosystem;, Organize internships in companies to show students the professional reality;
Engineering	Organize internships in companies to show students the professional reality;
Engineering	Bring the business team to the R&D labs to work together;, Projects that include companies from the University ecosystem;, Promote activities at the academy, which bring together students and companies;
Electrical engenaring	Promote R&D activities that provide partnerships between Education, Research and Industry;, Bring the business team to the R&D labs to work together;, Organize internships in companies to show students the professional reality;
Engenharia de materiais	Promote R&D activities that provide partnerships between Education, Research and Industry;, Projects that include companies from the University ecosystem;, Promote activities at the academy, which bring together students and companies;
Informatics	Promote R&D activities that provide partnerships between Education, Research and Industry;, Bring the business team to the R&D labs to work together;, Projects that include companies from the University ecosystem;, Promote activities at the academy, which bring together students and companies;, Organize internships in companies to show students the professional reality;
Engenharia Mecânica	Promote R&D activities that provide partnerships between Education, Research and Industry;, Promote activities at the academy, which bring together students and companies;, Organize internships in companies to show students the professional reality;
Mechanical Engineering	Promote R&D activities that provide partnerships between Education, Research and Industry;, Bring the business team to the R&D labs to work together;, Projects that include companies from the University ecosystem;
Ciência da Informação	Promote R&D activities that provide partnerships between Education, Research and Industry;, Bring the business team to the R&D labs to work together;, Projects that include companies from the University ecosystem;, Promote activities at the academy,

	which bring together students and companies;, Organize internships in companies to show students the professional reality;
Engineering	Projects that include companies from the University ecosystem;, Promote activities at the academy, which bring together students and companies;
Mechanical Engineering	Promote R&D activities that provide partnerships between Education, Research and Industry;, Promote activities at the academy, which bring together students and companies;, Organize internships in companies to show students the professional reality;
Engenharia de Materiais	Promote R&D activities that provide partnerships between Education, Research and Industry;, Bring the business team to the R&D labs to work together;, Projects that include companies from the University ecosystem;, Promote activities at the academy, which bring together students and companies;, Organize internships in companies to show students the professional reality;
Software Engineering	Bring the business team to the R&D labs to work together;, Organize internships in companies to show students the professional reality;
Urban Planning	Bring the business team to the R&D labs to work together;, Projects that include companies from the University ecosystem;, Promote activities at the academy, which bring together students and companies;, Organize internships in companies to show students the professional reality;
Engenharia e Gestão Industrial	Promote R&D activities that provide partnerships between Education, Research and Industry;, Projects that include companies from the University ecosystem;, Promote activities at the academy, which bring together students and companies;
Master in Electronic and Computer Engineering	Promote activities at the academy, which bring together students and companies;, Organize internships in companies to show students the professional reality;
Computer Science	Projects that include companies from the University ecosystem;, Promote activities at the academy, which bring together students and companies;, Organize internships in companies to show students the professional reality;
Engenharia Mecânica	Promote R&D activities that provide partnerships between Education, Research and Industry;, Bring the business team to the R&D labs to work together;, Projects that include companies from the University ecosystem;, Promote activities at the academy, which bring together students and companies;

12.

Study Field	**Do you consider that there are barriers in the promotion of Innovation and Entrepreneurship in Higher Education? If yes, which ones?**
Electronics Engineering	The only barriers are the unwillingness to do so from the interested parts.

Mechanical Engineering	Higher Education, most of the times, still is organized to pass tests and not exactly solve actual problems
IT	Usually the professors and students don't have the innovation and entrepreneurship mindset (normal in our country) which means there's no good optimization of the ideas.
Engineering	Entrepreneurship is antithetical to the model of "education", as we know it today
Engineering	HE is not representative enough of real world business
Electrical engenaring	Lack of knowledge for students Lack of incentives from the college
Engenharia de materiais	Não
Informatics	Lack of basic business knowledge; Courses sometimes too theoretical and not grounded on practial applications.
Engenharia Mecânica	Barreira financeira (inovação requer investimentos) Quantidade de alunos muito elevada em todos os cursos, o que não permite um grau de atenção e colaboração tão grande
Mechanical Engineering	No
Ciência da Informação	Sim. O receio pelos estudantes em arriscarem num projeto de inovação/empreendedorismo.
Engineering	No
Mechanical Engineering	There isn't a real physical barrier nowadays, just some inertia to put it on practice
Engenharia de Materiais	Managing Finances; Human Resource Problem; Non-strategic Planning; Political Barriers; Not Having the Right Team.
Software Engineering	Can't think of any right now.
Urban Planning	Neoliberalism is an ideology hunger for destruction and eventually society will lose its capacity to feed the monster. Many gurus and coachs already preach to their sectum that the university is pointless. I the end the biggest treat to this ideology is itself managing to work.
Engenharia e Gestão Industrial	Sim, falta de informação e informação não objetiva/explícita.
Master in Electronic and Computer Engineering	Lack of real word examples from the first 3 years. Although that I agree undergraduate should be more scientific it should be given some real world application in order to create a desire in the students to develop real world applications.
Computer Science	Yes. We're all evaluated as if there's an hierarchy, which most of the time isn't true. At the same time, most teachers don't seem to want to provide an insightful learning experience and would rather

	us just come and go as soon as possible, teaching the same things the exact same way.
Engenharia Mecânica	Custo (eventualmente, mas pouco significativo)

13.

Study Field	**What other types of content would you like to have in your study plan?**
Electronics Engineering	I would like to have newer content like new technologies and classes on how to approach a problem or how to build a company from scratch for example.
Mechanical Engineering	These topics would be great, but also things related to Humanities as Psichology or Economics
IT	I can’t think of any
Engineering	Maybe some contact with entrepreneurs. Probably the professors at the university aren't the right people to teach us about entrepreneurship
Engineering	Work with real world relevant technologies, eg
Electrical engenaring	RnD classes that make us pass trough the researching process by ur selfs and teach the how to avoid the big traps in RnD
Engenharia de materiais	Não
Informatics	Further real-word applications of the knowledge learned throughout the semesters
Engenharia Mecânica	Formação sobre como criar empresas em Portugal e como pôr um negócio em andamento numa situação real e tudo o que é necessário ter em consideração, quer em termos de leis ou burocracias necessárias cumprir
Mechanical Engineering	Instead of thesis, there could be senior projects coupled with industry partners
Ciência da Informação	Linguagens de programação
Engineering	More internship programs
Mechanical Engineering	I don't really have an opinion regarding this subject (I know more contents that I wouldn't have in my study plan than the opposite)
Engenharia de Materiais	Innovation/Creativity; Entrepreneurship/Create a company/brand; How to do adult chores (pay IRS, house payments, how taxes work in our country, public investment).
Software Engineering	Volunteer work.
Urban Planning	I think we should be stimulated to make our communities better.
Engenharia e Gestão Industrial	Não sei

Master in Electronic and Computer Engineering	Ethics
Computer Science	Something other than exams, really.
Engenharia Mecânica	Aulas abertas e com temas diferentes de aula para aula

14.

Study Field	**Do you have any additional comments regarding Innovation and Entrepreneurship in Portugal?**
Electronics Engineering	It is a growing area.
Mechanical Engineering	No
IT	Since Portugal is a very conservative country failing is not seen with good eyes so coming up with new ideas and pursuing them is always a big pressure which makes people afraid of being entrepreneurs
Engineering	There is a lot of opportunity
Engineering	Lackluster.
Electrical engenaring	No
Engenharia de materiais	Não
Informatics	Further efforts are required to help make a better integration of these topics in the country's economic system.
Engenharia Mecânica	Devia ser um dos assuntos mais importantes em Portugal, dada a situação económica do país. Por outro lado, é necessário criar condições para que empreender seja rápido e fácil.
Mechanical Engineering	No
Ciência da Informação	Existe um Sistema Nacional de Inovação que está bem definido e cabe às instituições de ensino superior aproximar os estudante desse sistema.
Engineering	No
Mechanical Engineering	No
Engenharia de Materiais	Give more incentives to young people to create independently. Not having so many bureaucracies, paperwork and fees to open a company, create a brand when you are young.
Software Engineering	No.
Urban Planning	When it comes to use innovationism as tool to develop further a country, geography is more important than scientific policies. Without changing our economic system the portuguese

	universities are doomed to perpetually investing time and money in cheap and qualified workforce for the northern countries. We are all just playing a rigged game.
Engenharia e Gestão Industrial	Não
Master in Electronic and Computer Engineering	Nop
Computer Science	Not really!
Engenharia Mecânica	Não.

Annexe 3: INVENTHEI actions

- **Talks and Lectures**

Alumni I&E success stories (UPCE)

- Presentation and discussion of Alumni regarding their Innovation and Entrepreneurship success stories.

Partner:

University of Pardubice

Activity name:

Alumnis Innovation and Entrepreneurship Success Stories

Activity description:

Presentations and discussions of Alumnis (Faculty of Transport Engineering) Innovation and Entrepreneurship Success Stories. This activity will be organized by the Faculty of Transport Engineering of UPCE. (T3.1)

Participants/Stakeholders:

Students, academic staff, external partners, alumnies

Pedagogical approaches:

Presentation, discussion, brain-storming, interview.

Learning outcomes:

Will be defined.

Assessment methods:

Will be defined.

Timeline:

Will be defined.

Building an innovation culture (VUT)

- Seminar on the topic.

Innovative Entrepreneurship (VUT)

- Seminar on the topic.

Innovation and Eco-Innovation (VUT)

- Seminar on the topic.

Partner:

Valahia University of Targoviste

Activity name:

Students training

Activity description:

Students' selection – April 2022.
Activities/lecturers/workshops in innovation and entrepreneurship:
1. Green energy for a sustainable environment (round table) – May 2022
2. Innovation and eco-innovation (workshop) – May 2022
3. Risk assessment and climate change (workshop) – May 2022
4. Innovative entrepreneurship (workshop) – June 2022
5. Social economy – management and innovation (workshop) – June 2022

Participants/Stakeholders:

Bachelor students (from Environmental Engineering, Montanology, Geography, Geography of Tourism, etc)

Pedagogical approaches:

Offline: round table, seminars, workshops, with different ways (lecture, conversation, problematization, comparison, case studies, etc).

Learning outcomes:

Competences in innovation and entrepreneurship:
collaboration, anticipation, critical thinking, self-awareness, problem solving

Assessment methods:

tests

Timeline: First session - april, may, june

April, May, June

1

3D print and scan day (UPCE)

- Discussion of 3D print and scan with industry partners.

Partner:

University of Pardubice

Activity name:

3D Print and Scan Day

Activity description:

Potential of 3D print and scan will be presented and discussed with industry partners. Case as well as success studies of innovative companies will be presented. Discussion and brainstorming within all participants (students, academic staff, external partners) will identify oportunities for inovations and entrepreneurship in the field. This Activity will be organized by the Faculty of Transport Engineering of UPCE. (T3.1)

Participants/Stakeholders:

Students, academic staff, external partners

Pedagogical approaches:

Case studies, success studies, brain-storming.

Innovation Day (VUT)

- Talks about innovation faculty wide.

Partner:

Valahia University of Targoviste

Activity name:

Students training

Activity description:

Students' selection – April 2022.
Activities/lecturers/workshops in innovation and entrepreneurship:
1. Green energy for a sustainable environment (round table) – May 2022
2. Innovation and eco-innovation (workshop) – May 2022
3. Risk assessment and climate change (workshop) – May 2022
4. Innovative entrepreneurship (workshop) – June 2022
5. Social economy – management and innovation (workshop) – June 2022

Participants/Stakeholders:

Bachelor students (from Environmental Engineering, Montanology, Geography, Geography of Tourism, etc)

Pedagogical approaches:

Offline: round table, seminars, workshops, with different ways (lecture, conversation, problematization, comparison, case studies, etc).

Learning outcomes:

Competences in innovation and entrepreneurship:
collaboration, anticipation, critical thinking, self-awareness, problem solving

Assessment methods:

tests

Timeline: First session - april, may, june

April, May, June

1

Entrepreneurship Inspiration Day (TTK)

- Theoretical introduction to entrepreneurship competencies, expectations from the labour market linked to presentations held by companies, group discussions, participants' self-reflections and conclusions by the end of the day.

Partner:

Valahia University of Targoviste

Activity name:

Students training

Activity description:

Students' selection – April 2022.
Activities/lecturers/workshops in innovation and entrepreneurship:
1. Green energy for a sustainable environment (round table) – May 2022
2. Innovation and eco-innovation (workshop) – May 2022
3. Risk assessment and climate change (workshop) – May 2022
4. Innovative entrepreneurship (workshop) – June 2022
5. Social economy – management and innovation (workshop) – June 2022

Participants/Stakeholders:

Bachelor students (from Environmental Engineering, Montanology, Geography, Geography of Tourism, etc)

Pedagogical approaches:

Offline: round table, seminars, workshops, with different ways (lecture, conversation, problematization, comparison, case studies, etc).

Learning outcomes:

Competences in innovation and entrepreneurship:
collaboration, anticipation, critical thinking, self-awareness, problem solving

Assessment methods:

tests

Timeline: First session - april, may, june

April, May, June

1

- **Lean Start-up Camps**

LGP - Linking Great Partners (U. Porto)

- Challenge-based multidisciplinary learning and innovation-driven research course.

Partner:

UPORTO

Activity name:

LGP – Linking Great Partners

Activity pillar:

Learning and Mentoring

Activity description:

UPORTO is developing a challenged based multidisciplinary learning and innovation driven research course offered to master students (approximately 250 students) from 4 different master courses from FEUP and open to students from other faculties.

- This 6 ECTS course takes place in the second semester (February-May) and students will explore concepts and practices related to innovation and entrepreneurship while developing software-based solutions to societal problems. Students organised in medium-size multidisciplinary teams develop and validate a software-based product or service andthe corresponding business model. This course involves not only teaching and learning of I&E topics but also participation of mentors and external partners that will support students during the process.

Participants/Stakeholders:

Students, Academic Staff

Pedagogical approaches:

Project based pedagogical approach: problem/challenge based, project-based learning

Learning outcomes:

- **E&I Departments**

USFD

- Created an office for entrepreneurship that focuses on developing students' entrepreneurship skills.

Centre of I&E (TTK)

- They have a centre for innovation & entrepreneurship which should develop connections with companies and other stakeholders, as well as improve their student's and academic staff's capability for innovation and entrepreneurship.

- **Courses and degrees In E&I**

Gerontological I&E for teaching and research (USC)

- Course for teaching and research staff to familiarize with the concepts of innovation and entrepreneurship in the context of higher education, reflect on the needs of innovation and social entrepreneurship in an ageing society and acquire basic teaching skills to promote innovation and entrepreneurship skills in students of different degrees.

Partner:

University of Santiago de Compostela

Activity name:

GERONTOLOGICAL INNOVATION AND ENTREPRENEURSHIP FOR TEACHING AND RESEARCH (ATIP course).

Activity Type:

Learning and mentoring (education pilar).

Activity description:

Education in social innovation is based on practice supported by theories of critical learning, transformational learning, and epistemological development. In addition, it is proposed a pedagogical practice area for education in social innovation that could support learning design on a more critical view plane. Social innovation education enhances the academic curriculum through a focus on creative social problem solving and the development of skills and behaviors related to change, suggesting that the students have a more critical learning experience which will lead them to social innovators in the future.

Population aging, defined as the increase in the average age of the population due to increasing life expectancy, is an achievement of our society but also a critical sociodemographic issue. It is a multifactorial phenomenon that presents direct biomedical and economic implications, as well as psychological and social challenges. Gerontological innovation in long-lived society is necessary and relevant to this sector of the population, the society in general and the worldwide economy, even although it is a recent, barely known and developed approach.

A teacher training proposal has been developed that seeks to develop a space for reflection and debate on the importance of innovation in this context of longevity, and to support the development of teaching skills related to social innovation and social entrepreneurship. The proposal will be included in the USC Academic Training and Innovation Program (ATIP).The ATIP aims to establish a better training to acquire skills and improve teaching, research and management necessary for professional practice at the USC. To try to answer this purpose, the program provides training on: Information and communication applied to teaching; Teaching-

learning strategies; Educative assessment; Mentoring and guidance; Professional development: Research, management, languages (https://www.usc.gal/en/servizos/pfid/index.html).

Course objectives:
- Familiarize with the concepts of innovation and entrepreneurship in the context of higher education.
- Reflect on the needs of innovation and social entrepreneurship in an aging society.
- Acquire basic teaching skills to promote innovation and entrepreneurship skills in students of different degrees.

Course contents:
Session 1. Innovation and entrepreneurship in the context of longevity.
Session 2. The aging process, innovations in gerontological intervention.
Session 3. Teaching-student didactic actions for innovation and entrepreneurship.
Session 4. Examples of didactic actions in the gerontological field.

Participants/Stakeholders:

USC teaching and research staff

Pedagogical approaches:

Action-training strategy, through the exposition of contents, debate on the central ideas presented by the teachers, carrying out classroom exercises in small groups, and implementation of a case of didactic application in a subject. Learning by doing and Social learning will be used as teaching methodologies:

- Learning by doing is a methodology that it consists in learning through the experimentation and practice (Schank et al., 1999).
- Social learning is a methodology based on teamwork and learning from the social processes that take place internally. This type of learning encourages the development of competencies as teamwork, communication, self-management, cooperation, etc. (Moulaert et al., 2013).

Learning outcomes:

Following EntreComp learning outcomes, the following competences will be systematically assessed:

- Ideas and Opportunities:
  - Spotting Opportunities.
  - Creativity.
- Resources:
  - Self-awareness and Self-efficacy.
  - Motivation and Perseverance.
- Into Action:
  - Working with Others.
  - Planning and Management.
  - Taking the Initiative.

Assessment methods:

The main assessment method will be direct observation conducted by the two course directors. The evidence will be documented through observational records and field notes. Observations will be considered if observers reach a high degree of agreement in their records of specific behaviors related to each competence.

Additionally, the competences achieved by the teaching and research staff will be observed through the development of an example of didactic application in a specific subject, to be carried out autonomously by each participant based on the practical experiences of session 4.

Finally, an online questionnaire will be implemented assessing the knowledge about social innovation, social entrepreneurship and innovation didactics in longevity acquired by the participants.

Computer Vision for Innovation in Business (UPCE)

- A course to introduce computer vision hardware (industrial cameras, RGB-D cameras, laser scanners, various lenses and lights, processing units, etc.) and software tools for practical implementation of computer vision tasks.

Following EntreComp learning outcomes, the following competences will be systematically assessed:

- Ideas and Opportunities:
  - Spotting Opportunities.
  - Creativity.
- Resources:
  - Self-awareness and Self-efficacy.
  - Motivation and Perseverance.
- Into Action:
  - Working with Others.
  - Planning and Management.
  - Taking the Initiative.

Assessment methods:

The main assessment method will be direct observation conducted by the two course directors. The evidence will be documented through observational records and field notes. Observations will be considered if observers reach a high degree of agreement in their records of specific behaviors related to each competence.

Additionally, the competences achieved by the teaching and research staff will be observed through the development of an example of didactic application in a specific subject, to be carried out autonomously by each participant based on the practical experiences of session 4.

Finally, an online questionnaire will be implemented assessing the knowledge about social innovation, social entrepreneurship and innovation didactics in longevity acquired by the participants.

Machine Learning for Innovation in Business (UPCE)

- A course to introduce machine learning tools and models for practical purposes. Specifically, the students find out, what machine learning is, how to transform business and industrial problems into machine learning use cases, how to verify those use cases considering feasibility and impact, and how to carry a machine learning project through its various phases from the primal idea into practical implementation, and how to implement machine learning and artificial intelligence responsibly.

Partner:

University of Pardubice

Activity name:

Machine Learning for Innovation in Business

Activity description:

The aim of the course is to introduce machine learning tools and models for practical purposes. Specifically, the students find out, what machine learning is, how to transform business and industrial problems into machine learning use cases, how to verify those use cases considering feasibility and impact, how to carry a machine learning project through its various phases from the primal idea into a practical implementation, and how to implement machine learning and artificial intelligence responsibly. The course will be organized by the Faculty of Electrical Engineering and Informatics of UPCE. (T3.1).

Participants/Stakeholders:

The course is intended for Master's and Ph.D. students.

Pedagogical approaches:

Demonstration, Laboratory work, Stimulating activities

Learning outcomes:

Students will be able to transform the knowledge and skills they acquire in theoretical subjects during their studies into innovative activities. Based on this transformation, students will be able to start their own business based on machine learning.

Assessment methods:

Group discussions throughout the course, Systematic monitoring, Self project defence.

Timeline:

autumn 2022

Service Learning (USC)

- A course that combines processes of community service and learning in a single well-articulated project, in which participants learn while working on the real needs of the surroundings to improve them.

Partner:

University of Santiago de Compostela

Activity name:

(Senior) Service – Learning

Activity Type:

Learning and teaching structures (innovation pilar).

Activity description:

Service-Learning is an educational proposal that combines processes of community service and learning in a single well-articulated project, in which participants learn while working on real needs of the surroundings in order to improve them. That is, they learn by performing a service to the community through academic activities formally included in the curriculum (Santos Rego & Lorenzo, 2018 http://dx.doi.org/10.15304/op.2018.1165)

We have two realities oriented either towards students' service (volunteering) or towards their learning (practicum/internships), which, therefore, cannot be confused with Service-Learning. The structuring of projects aimed at strengthening the link between academic service and learning is the essential of Service-Learning, establishing a reciprocal relationship between the two components: academic learning will affect the provision of a quality service to the community, and on the contrary, the service will allow strengthening and endowing students' learning with more time and meaning. The goal is not to add service to learning, as a parallel piece, but an integration process. The service activities have to be compatible and integrated in the academic objectives and the learning tasks of the subject of the curriculum.

According to Santos Rego & Lorenzo (2018), Service-Learning is a solid educational innovation that allows HEIs to harmonize its traditional mission of providing the students with an integral training with its present mission, which is to be able to respond to the needs of its environment. As a pedagogical methodology, Service-Learning shares with innovation and entreneurship models the aim of turning HEIs into a key partner in the civic and intellectual development of communities, attempting to respond to social, civic, economic and ethical challenges.

In the University of Santiago de Compostela, the instituzionalization of the Service-Learning was did mobilizing resources and infrastructures around various services already existing in the institution, including the Learning Technology Center (CeTA), service that offers the university's teaching staff training in Service-Learning as part of its ATIP plan, and the University Participation and Integration Service (SEPIU), that contributes with its know-how in matters of volunteer work, management and social participation of the student body, along with its extensive knowledge of the community context.

Participants/Stakeholders:

Students of the subjects that take part of the Learning-Service program

Pedagogical approaches:

The combination of learning and a service to the community turns it into a methodology that multiplies the possibilities of learning. Accordingly, it must be correctly planned by establishing specific learning objectives. Academically proven strategies should be anticipated in order to assess learning in the community. The differences between students' roles in the community and in the classroom should be

minimized. The classrooms and the community are configured as highly differentiated learning environments. The role taken on in both environments should be similar, in an attempt of bringing the classroom (more passive) and community (more active) contexts closer together. In this regard, the role of the professor should be rethought, as a consequence of a more active role of students. It is no longer exclusively about transferring information, but about acting as a guide in students' learning.

The phases that we must follow for the development of a project of this type are:

INITIATION
1. Establish a starting point (new project, reformulate, adapt, improve etc.), defining objectives and purposes.
2. Detect needs.
3. Search for support (community partners, other professors, services etc.).
4. Schedule and organize the service to be performed.
5. Anticipate the learning contents that we want students to develop.
6. Promote students' involvement and mobilization.

DEVELOPMENT
7. Design and implementation of the SL project.
8. Establish follow-up sessions and explicit connection with the contents learned.
9. Apply process follow-up tools (portfolio, rubrics, etc.).

CLOSING
10. Reflect on the experience.
11. Celebrate the results, dissemination.
12. Improve the project.

Learning outcomes:

According to Santos Rego & Lorenzo (2018), Service-Learning projects allow professional and ethical decisions to be put into practice. This implies reflection and argumentation, analysis of assessments, norms, and habits of the different communities. It combines an strict academic orientation, with a close relationship of the service with the study program, and the service to the community. This entails obtaining academic learning, formally included in the curriculum, as well as transversal learning.

Assessment methods:

According to Santos Rego & Lorenzo (2018), the assessment has to be a central element of the SL program from its very beginnings. The data obtained through assessment processes will allow the improvement and strengthening of the program and, as such, guarantee its survival. It should include:

- Indicators about the program's success, including the objectives expected from the students, the community and the university.
- Initial assessment involving students, professors in charge and partners. In order to do this, various instruments are available, including the Questionnaire on University Students' Civic and Social Competences, and Self-efficacy (CUCOCSA), structured interview with the teaching staff and structured interview with the organizations.
- Adequate supervision of the students taking part in the projects, and in their turn, the professors involved must monitor the development of the service and the degree of satisfaction of both the students and the community. It should include the preparation of the student portfolio, and periodict meetings with the teaching staff.
  Student portfolio should include a description of the project and the description of the organization; a diary of sessions where they include their feelings, experiences, anecdotes, photographs, physical material,...; a section with lessons learned in relation to the subject, the degree and the skills for life; and a final section of critical assessment and conclusions.
- At the end of the implementation, we must proceed to evaluate the results or the product. It is the most complex assessment, because it implies using different tools directed to all the parties involved. Among them, we can use the CUCOCSA questionnaire,gGroup interview with the students participating in the project, structured interview with the community partners, and teaching staff self-evaluation rubric.
  A rubric to evaluate SL projects at university level should include 10 dimensions: learning approach, participation level, most developed competences, academic follow-up in the organization, transdisciplinarity, impact and social projection, networking, professional field, academic institutionalization, and assessment.
- Finally, a follow-up or impact evaluation must be designed, based on indicators like, among others, the continuation of the project in the next academic year, the teaching staff's and the students' demand for training, the interest of the partners, or the institutional assessment of the professor involved.

Timeline:

One (Senior) Service-Learning project is currently being implemented in the second semester of the 2021-2022 academic course in the USC. "Interdixitais" (Interdigital) is a intergenerational experience in the training of USC students and older people from the Fontiñas neighborhood in Santiago de Compostela, focused in the development of digital skills. The 1st and 4th year students of the Pedagogy Degree coordinate to create learning teams despite having different levels of knowledge, and they develop a

space to relate personally and professionally with the group of older people. Conducted in collaboration with the NGO Acción Solidaria de Galicia (ASDEGAL) in the Sociocultural Center of Fontiñas, twelve 1st grade students, eight 4th grade students and eight older people are involved in the program. For students in the 1st year of the degree, this is a voluntary activity, in which their participation will validate the delivery of an internship report. In the students of 4º of degree of pedagogy, with greater implication in the didactic programming, it is a complementary activity, through the delivery of a portfolio with the programmed activities and its contextualization. In addition to curriculum competencies, life skills are critically addressed including communicative skills, teamwork, self-critical attitudes, and attitudes about working with older adults.

At least two Service-Learning projects are expected to be implemented in the 2022-2023 academic course.

USC would be able to provide support to those partners developing Service-Learning projects in the 2022-2023 academic course, with special emphasis in those related with longevitiy (intergenerational experiences, development of innovations for senior organizations, ...).

Master's program in I&E (U. Porto)

- A master's program that promotes an integrated training of managers and entrepreneurs through practical training (hands-on approach). It is based on solid theoretical concepts and on permanent and professional supervision, which enable the development of skills and knowledge to produce efficient knowledge and innovation management in new businesses.

- **Business Model Competitions**

Start-up Entrepreneurship ABC (TTK)

- Training that provides participants with basic knowledge (start-up) about starting a business as well as initial experience of developing an idea through various exercises.

Partner:

TTK UAS

Activity name:

Startup entepreneurship ABC

Activity description:

The aim of the training is to provide participants with basic knowledge (start-up) about starting a business as well as initial experience of developing an idea through various exercises. The training is structured in the form of active learning, where there is a lot of independent or group work for the best acquisition of the learner.

Participants/Stakeholders:

Students, academic and nonacademic staff

Pedagogical approaches:

Group working, workshop, mentoring, reflection

Learning outcomes:

- Participants understand and are able to evaluate the entrepreneurial potential of different idea and choose between them;
- Participants know different methods for validating ideas and are able to apply at least one of them;
- Participants understand the Business Model Canvas and are able to complete it independently;
- Participants are aware of the Lean thinking method and can apply it;
- Participants know the theory needed to present ideas and how to present their ideas in an engaging way;
- Participants are aware of the different opportunities of the Estonian start-up community.

Assessment methods:

Idea demo/pitch, reflection

Senior Innovation Lab (USC)

- A challenge-based learning approach where different real-life obstacles were analysed to develop solutions.

Partner:

University of Santiago de Compostela

Activity name:

Senior Innovation Lab -2nd Edition

Activity Type:

Learning and mentoring (education pilar), with the final session with the companies (Senior Innovation Workshop) in the Innovation pilar.

Activity description:

It is a fact that older people in 2021 are completely different than older people from 20 years ago, in terms of social relationships, professional profiles and even family ties. Nowadays, society profile is changing, and we have a larger segment of population than ever with 65 years old or more. This fact leads us to a long-lived society and to rethink the model of social innovation to adapt it to the challenge of longevity.

Innovation has to considerate demographic change and to involve the adaptations provoked by it, including age-related changes, as well as innovative activities developed by long-lived population, business and service innovations that could meet recently identified needs, and resulting innovations from shared objectives between different generations. Therefore, it is necessary to develop common methodologies between HEI's and social innovators in order to close this gap.

The main objectives are:

- Promote the knowledge and awareness of USC students about the opportunities and challenges posed by the culture of Innovation and Social Entrepreneurship.
- Encourage the acquisition and development of entrepreneurial skills of the participants in a context of innovation, in which the sustainability of the project is understood from a triple bottom line approach (environmental, economic and social).
- Facilitate the alliance between USC and participating organizations in the elderly sector in order to promote knowledge transfer and enhance research and innovation capacity.

In its first edition, Senior Innovation Lab was conceived from a challenge-based learning approach. The researchers conducted four online meetings with relevant stakeholders. Nine challenges were discussed in this meetings, and the organizations gave feedback on which were the most relevant challenges in an unstructured way, through conversation. Once the meetings have been completed and all the data have been collected, the most repeated topics were pooled, grouped by similarity and synthesized into three main challenges:

- New technologies and aging: How can be incorporated technology in long-term care centres to improve the care processes? How can organizations in the sector be digitally transformed in order to offer quality care?
- Ageism and a change in the way we look at aging: How can the population be made aware of the need to change the way older people are viewed? How can age-related stereotypes be broken?
- New models of care: How to provide truly personalized gerontological attention? How to go from effective care to meaningful care?

Activity 1: Person-centered social innovation

Face-to-face session aimed at motivating cooperation and collaboration among participants to seek solutions to specific challenges. The competencies to be strengthened through the first session belong to two areas:

- Ideas and Opportunities
  - Spotting Opportunities: identification of opportunities to create value, problems that need to be addressed and establish new connections in order to create opportunities to create value.
- Into Action
  - Working with Others: ability to teamwork and cooperation with others in order to achieve the main goal.

For this, participants were divided into groups according to the challenge of their choice and trained to implement the qualitative interview. This was presented as a technique to understand the needs of the people for whom a solution is designed. It was explained how to apply it:
Phase 1: Interview preparation.
• Determine for whom we are designing a solution
• Brainstorm possible questions of interest.
• Identify and group issues.

• Select key questions.
Phase 2: Interview to empathize.
• Ask why
• Encourage stories
• Ask neutral questions (do not suggest answers).
• Document.
Phase 3: Share and extract learnings
• Synthesize the main learnings in the panel (use post-its).

At the end of the activity, they were asked to complete two tasks for the following seminar: (1) find a successful case of successful Innovation or Social Entrepreneurship in our sector, per team; (2) for the teams that wish to do so, they can continue interviewing people in order to extract more lessons learned. in order to extract further learning about the challenge we want to solve.

Seminar 2: Team-centered social innovation

The competencies to be strengthened through the second session belong to three areas:

- Ideas and Opportunities
  - Creativity: centered on the development of new ideas or better ideas to existing and new needs, experiences with innovative approaches and the combination of knowledge and resources to create value.
- Resources
  - Self-awareness and Self-efficacy: based on the strengths and weaknesses identification of the self and the group, and at the same time the belief that they have the abilities to achieve the aim.
- Into Action
  - Taking the Initiative: based on the capacity to begin to create value and embrace challenges by working independently to fulfill aims.

Design thinking methodology was used, based on generating innovative ideas through the understanding of problems and providing solutions, needs and real challenges of people, groups, organizations, etc. Two resources were implemented:

- Empathy map, a tool to understand the people for whom we want to design the solution. This tool is a guide for the entrepreneur to define what their problems, needs, concerns and desires are through an empathetic position. The participants answered the questions that appear on Figure 3 from the target customer perspective. The phases that follow this scheme are (a)

definition of the ideal user person, (b) completion of the empathy map, and (c) reformulation of the challenge based on learning.

Figure 3. Empathy map. Modified from https://www.designthinking.es/inicio/herramienta.php?id=35&fase=define

- Walt Disney method, a simple and agile technique for the creation and generation of new ideas and solutions. It is divided into three stages: a first stage in which extravagant, dreamlike or impossible ideas are proposed; a second stage, in which it is considered how the solutions proposed in the previous stage can be carried out, adopting a more realistic vision; and a last stage, in which it is sought to identify which of these solutions best suits the needs and finally select one of them. For the latter, the judgment panel is used. It is a tool that allows us to identify its pros, cons, deficiencies and obstacles. The activity sought that the participants show their ability to see both the positive and negative qualities of the ideas and apply them or discard them in favor of another that may have better development possibilities.

Seminar 3: Results-centered social innovation

The competencies to be strengthened through the third session belong to two areas:

- Resources
  - Motivation and Perseverance: are centered in being persistent to make become ideas into products, services or actions and achieve our goals by being resilient and patient.

This speech is characterized by:
- Surprise the interlocutor.
- Present the problem.
- Put people at the center.
- Present a unique value proposition.
- Be an attractive solution, awakening the interest of the interlocutor.
- Present the team.
- Presence of non-verbal communication.
- Have an appropriate finishing touch.

Participants develop their Elevator Pitch following the above characteristics and considering the following guidelines:
- Use of a "hook" to attract attention in the presentation of the idea.
- Exposure of the problem and the needs identified, as well as the people for whom the solution is designed.
- Define the solution, giving specific data and highlighting why it is different.
- Explain the business model and what is needed to implement it.
- Explain the impact that will be achieved with our idea.
- Make a powerful closing that invites participation in our project.

Mentoring session 1

It was held online to accompany the three teams participating in the project in the development of the Elevator Pitch of the proposal worked on during the previous sessions for the participants. The aim was to achieve a solid speech for the presentation of the projects in front of the workshop attendees. The competencies to be strengthened through the first mentoring session belong to two areas:

- Resources
  - Self-awareness and Self-efficacy: based on the strengths and weaknesses identification of the self and the group, and at the same time the belief that they have the abilities to achieve the aim.
- Into Action
  - Working with Others: based on the ability to teamwork and cooperation with others in order to achieve the main goal.

The methodology used during the session consisted of learning through practice (Learning by doing) and social learning through small groups in which the Elevator Pitch communication technique was worked on.

The procedure began with a first phase, in which each team met in different online rooms to prepare their speech. The mentor entered each of these small sessions to resolve doubts and make small proposals for improvement in order to encourage reflection in each work team. Then, each representative was invited to rehearse their speech in the general room in front of the rest of the participants. The mentor provided individualized feedback, pointing out the strengths of each intervention as well as areas for improvement. The rest of the participants also shared their reflections with each team, acknowledging the work carried out by their colleagues and suggesting changes and improvements.

Mentoring sessions 2

These sessions were on demand, intended for participants who wanted to advance specific solutions under development. The competencies to be strengthened involved one area:

- Into Action
  - Working with Others: based on the ability to teamwork and cooperation with others in order to achieve the main goal.
  - Planning and Management: centered on the definition of priorities, action plans, goals and the fact of being able to adapt to unexpected changes or problems.

The methodology used was based on learning through action and reflection (Learning by doing). It was sought to improve and develop the potential of the participants based on their own knowledge. Prior to the session, the mentees took a questionnaire provided by the mentor, with the aim of reflecting on their projects and its degree of progress. Based on these responses, the needs and goals of the session were determined for each group.

The procedure began with a first phase, in which the mentees presented the project to the mentor, identifying those issues on which they would like to work and continue advancing. The mentor then gave them feedback on strengths, areas for improvement, and next steps to take through a process of feedback and reflection-oriented questions. Finally, various Innovation and Entrepreneurship tools were provided so the teams could conduct a thoughtful analysis of their project and begin to address a business plan to commercialize it.

Senior Innovation Workshop

This session is open to the participation of students, academic and non-academic staff, and professionals. The proposal consisted of a day of collaborative work between actors from the university environment and organizations belonging to the local ecosystem. The main objective was that those attending the seminars could present the ideas developed and receive feedback from a panel of experts made up of representatives of these organizations. The competencies to be strengthened involved:

- Resources
  - Self-awareness and Self-efficacy: based on the strengths and weaknesses identification of the self and the group, and at the same time the belief that they have the abilities to achieve the aim.
  - Motivation and Perseverance: centered in being persistent to make become ideas into products, services or actions and achieve our goals by being resilient and patient.

The event was structured in four parts:

1. Welcome lecture. Lecture on social innovation and aging, from a motivation and empowerment perspective. In the first edition of the Senior Innovation Workshop, the session started with a presentation by Elisio Costa from the University of Porto/Porto4Aging, entitled "Improving innovation through collaborative work" and was focused on how the phenomenon of longevity challenges innovation considering the ecosystem and stakeholders involved.

2. Idea's fair. A representative of each of the work teams formed during the seminars made their elevator speech in front of the audience. They had 5 to 10 minutes to do it. The objective of this dynamic was to provide the opportunity to put into practice the skills the skills put into practice during the seminars.

3. INVENTHEI Café. This was a dynamic of participatory debate. The worktables were organized according to the challenges posed. The attendees were assigned to each group according to the answers provided through the workshop registration form, which inquired about their interests. Once the worktables were formed, different questions were raised about each of the challenges. The person designated as the "host" moderated the discussion and collected the main ideas that emerged.
   Representatives of the different companies participated in the working groups as as judges of the work carried out, and provided the first feedback to the participants in the seminars, before opening a discussion with the entire audience.

- **Networking Events**

Managing Directors Clubs (USFD)

- An event where they bring in regional businesses to have dinner and speakers talking about innovation culture.