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Enhancing Technology-Focused Entrepreneurship in Higher Education Institutions Ecosystem: Implementing Innovation Models in International Projects

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Abstract: Innovation models are key to fostering technology-focused entrepreneurship in higher education institutions (HEIs). These models create dynamic environments that encourage collaboration, creativity, and problem-solving skills among students and faculty. HEIs face several challenges in fostering entrepreneurship, including allocating sufficient financial and human resources, integrating entrepreneurship education across disciplines, and managing intellectual property. Overcoming these challenges requires HEIs to cultivate an entrepreneurial culture and establish strong partnerships with industry stakeholders. To achieve these goals, HEIs must adopt successful innovation models proven to work. This article presents an international case study highlighting such models and the factors contributing to their success. This study explores the implementation and impact of innovation models, specifically IDEATION and DEETECHTIVE, within HEIs to foster technology-focused entrepreneurship. By implementing numerous actions focusing on online education integration and the Quintuple Helix Innovation Model, these models support shifting engineering students' mindsets toward entrepreneurship. This research highlights the importance of academia–industry collaboration, international partnerships, and the integration of entrepreneurship education in technology-focused disciplines. This study presents two models. The first, IDEATION, focuses on open innovation and sharing economy aspects. This model underwent rigorous testing and refinement, evolving into the second model, DEETECHTIVE, which is more comprehensive and deep tech-focused. These models have been validated as effective frameworks for fostering entrepreneurship and innovation within HEIs. This study's findings underscore the potential of these models to enhance innovation capacity, foster an entrepreneurial culture, and create ecosystems rich in creativity and advancement. Practical implications include the establishment of open innovation-oriented structures and

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mechanisms, the development of specialized curriculum components, and the creation of enhanced collaboration platforms.

Keywords: entrepreneurship education; innovation training; academia-industry collaboration; technology entrepreneurship; incubators; international partnerships; problem-solving skills

1. Introduction

Innovation models are essential for fostering technology-focused entrepreneurship in universities. These models create dynamic environments that enhance student and faculty collaboration, creativity, and problem-solving skills. Integrating industry partnerships, incubators, and accelerators into university ecosystems provides essential resources, mentorship, and networking opportunities. These elements are crucial for transforming innovative concepts into successful enterprises. However, higher education institutions (HEIs) face multiple challenges in nurturing entrepreneurship. These challenges include allocating sufficient resources, integrating entrepreneurial education across various disciplines, effectively managing intellectual property, and developing a sustainable entrepreneurial culture. To address these issues, universities must adopt and develop new, effective models for supporting innovation. This involves strategic planning, engaging stakeholders, developing policies, and continuously evaluating and adapting entrepreneurship programs and initiatives.

The literature review supporting this study is divided into four main sections, as follows: Entrepreneurship Development at Higher Education Institutions, Open Innovation Paradigm in Education, Sharing Economy for HEIs, and the Role of the Quintuple Helix Innovation Model. Each section uniquely contributes to this study by providing theoretical frameworks, contemporary practices, and practical solutions that collectively enhance the understanding and implementation of technology-focused entrepreneurship within HEIs. These themes ensure a comprehensive review of the relevant literature, supporting the development of effective innovation models tailored for higher education institutions. The specific reasons for selecting the aforementioned topics are explained below. The role of entrepreneurship development in higher education is crucial for identifying gaps and opportunities in entrepreneurship education within HEIs, directly supporting this study's focus. Understanding entrepreneurship development helps illustrate how HEIs can contribute to economic growth and social development. Moreover, analyzing how entrepreneurial principles are integrated into various curricula, especially in engineering and science, aids in designing effective educational strategies. Open Innovation paradigms encourage collaboration and shared value creation, making them essential for fostering innovation in educational settings. Supported by the European Commission, these paradigms align with this study's goals of integrating external sources into internal innovation processes. The sharing economy model complements the Open Innovation paradigm. It helps HEIs optimize resources and reduce costs, addressing financial and human resource limitations. This model supports the development of collaborative networks, enhancing access to shared knowledge and infrastructure, as well as promoting sustainable practices within HEIs. Finally, the quintuple helix innovation model (QHIM) provides a holistic approach by integrating political, educational, economic, environmental, and social systems. This model emphasizes sustainable entrepreneurship, aligning with global trends toward eco-friendly and socially responsible business practices. The QHIM facilitates stronger connections between different sectors, enhancing the impact and reach of innovation initiatives within HEIs.

1.1. Background

1.1.1. Entrepreneurship Development at Higher Education Institutions

Innovation and entrepreneurship are pillars of social progress and national competitiveness in the global economy. Education serves as the primary arena for nurturing innovative and entrepreneurial talents. Higher education institutions (HEIs) promote innovation and entrepreneurship, significantly contributing to economic growth and social development [1,2]. Entrepreneurial education is essential for cultivating creativity and innovation. Studies show that institutional support mechanisms, such as business plan assistance and consultations with industry experts, are vital in influencing students' entrepreneurial activities and self-efficacy, shaping their entrepreneurial intentions [3,4]. Exposure to successful entrepreneurial models that attract students to business courses, and the approaches that offer tailored courses to non-business students, positively impact students' attitudes toward entrepreneurship, with a focus on social rather than financial benefits [5,6]. Over the past decades, there has been a notable gap in integrating entrepreneurship principles into engineering and science curricula; however, a significant improvement has recently been noticed [7,8]. Efficiently including entrepreneurship in engineering courses requires collaborative efforts across business and engineering schools and a multi-school approach to fully embed a robust entrepreneurial culture within HEIs. HEIs have been instrumental in shaping entrepreneurial mindsets among students, preparing them to succeed as entrepreneurs and managers. By integrating entrepreneurial principles into their curricula, HEIs equip students with the skills and knowledge to drive innovation and contribute to job creation and economic prosperity [9–11].

1.1.2. Open Innovation Paradigm in Education

Open Innovation (OI) and Open Innovation 2.0 (OI2) are increasingly popular paradigms that enhance the innovative capacities of institutions. OI leverages external sources to accelerate internal innovation and expand market opportunities [12]. A systematic literature review of over 50 articles revealed that open innovation and co-creation enable entrepreneurs to expand their knowledge and promote innovation despite challenges like resource scarcity and collaboration skills, highlighting the need for supportive programs and mechanisms [13]. OI2 further emphasizes collaboration, shared value creation, innovation ecosystems, exponential technologies, and rapid adoption. These paradigms enable universities to foster entrepreneurship, create viable business ventures, and equip students for success in the competitive global marketplace. Supported by the European Commission's Open Innovation Strategy and Policy Group (OISPG), these approaches are fundamental for higher education institutions aiming to lead global innovation and provide world-class experiences [14]. OI and OI2 facilitate innovation in education and support a shift toward more open and decentralized innovation models [15]. The growing importance of digital platforms as key venues for value creation aligns with these paradigms, offering new and experienced entrepreneurs opportunities to engage in expansive platform ecosystems [16]. Recent studies have focused on how OI and OI2 enhance collaboration networks between academia, business, and industry, fostering knowledge transfer, sustainability, and competitiveness [17]. These paradigms are central to Education 4.0, which promotes critical thinking skills through structured learning approaches like problem-based and project-based learning across various cognitive stages [18–21]. For technology-focused HEIs, OI and OI2 are essential in fostering a culture of innovation. They support new product development through "crowdsourcing and crowdfunding" [22,23] and enhance intergenerational collaboration among students and staff. Additionally, integrating business accelerators and incubators within HEIs strengthens these institutions by establishing extensive networks that bolster organizational sustainability and competitiveness [24–27].

1.1.3. Sharing Economy for HEIs

The sharing economy, a business model integral to Open Innovation, coordinates resource acquisition and distribution through online peer-to-peer activities, often for a

fee. This model minimizes waste, boosts efficiency, and drives bottom-up change [28,29]. Its global value, projected to increase from USD 14 billion in 2014 to USD 335 billion by 2025 [30], highlights its potential to significantly reduce costs, optimize resources, and create new revenue streams [30–33]. Increasingly adopted by Higher Education Institutions (HEIs) worldwide, the sharing economy enhances resource efficiency, lowers costs, and improves consumer welfare. Integrating this model into HEIs' innovation strategies promotes collaborative networks, broadens access to shared knowledge, and supports sustainable consumption practices. By leveraging the sharing economy, HEIs can meet operational and educational goals while enhancing efficiency, sustainability, and equity [34–36].

1.1.4. Role of the Quintuple Helix Innovation Model

The quintuple helix innovation model (QHIM) offers a comprehensive framework for HEIs promoting sustainable entrepreneurship. It integrates five critical dimensions, as follows: political, educational, economic, environmental, and social. This integration facilitates synergies that enhance the connections between the economy, society, and democracy, crucial for addressing the socio-economic challenges of the twenty-first century and fostering socio-ecological transitions [37–40]. By adopting the QHIM, HEIs can nurture an entrepreneurial culture that supports green entrepreneurs and drives sustainable-smart innovations. This approach enhances connectivity among various stakeholders, leading to a more robust and impactful innovation ecosystem. Ultimately, implementing the QHIM provides holistic solutions that advance innovation development, significantly contributing to economic growth and job creation [41–43].

1.2. Aims, Objectives, and Goals

In recent years, HEIs have moved from traditional educational methods to online learning, emphasizing practicality, flexibility, and accessibility [21,44,45]. This shift allows universities to develop innovative educational formats, particularly those that foster international cooperation and bridge the entrepreneurship gap [21,46,47].

Proposed Innovative Model Objectives:

- Enhance entrepreneurship education for engineering and science students by developing a comprehensive curriculum that integrates entrepreneurship principles with their technical expertise;
- Leverage online learning to broaden access and enhance student collaboration within the HEI ecosystem and across international partnerships;
- Expand the theoretical framework to contribute to the body of knowledge on designing and implementing effective innovation models that foster entrepreneurship among engineering and science students [10].

Our primary goals are the following:

- Increase the number of engineering and science student entrepreneurs and foster a culture of innovation within HEIs;
- Facilitate knowledge exchange and joint ventures among students from partnering HEIs to strengthen international collaborations and promote a globally minded entrepreneurial mindset;
- Contribute to the development of a new generation of innovative and entrepreneurial engineers and scientists by realizing these aims, objectives, and goals.

Our research was led by four main questions:

- What strategies can be implemented to increase the number of engineering and science student entrepreneurs in HEIs?
- What are the key components of an effective innovation model for enhancing entrepreneurship within HEIs?
- How can international collaborations foster a globally-minded entrepreneurial mindset among students?

- What initiatives can be undertaken to develop a new generation of innovative and entrepreneurial engineers and scientists within HEIs?

The hypotheses below focus on integrating and utilizing different cutting-edge teaching and training approaches to develop students' innovation and co-creation skills. Each one of these hypotheses was evaluated as a part of the different actions of the two projects presented below (we assign each hypothesis to the corresponding project's actions according to the following pattern: project's acronym, action's number, and name). Thus, we built our work by considering the four following hypotheses:

- Implementing mentorship programs and providing access to entrepreneurship resources increase the number of engineering and science student entrepreneurs in HEIs (IDEATION: A.1 Digital access to infrastructure; IDEATION: A.5 Pre-incubation program GROW-up TECH; DEETECHTIVE: A.1 Talent Hunter Space; DEETECHTIVE: A.5 Pre-Incubation Mentoring Program GROW-up TECH; DEETECHTIVE: A.6 Start-up booster);
- Incorporating online education and open innovation topics into the curriculum significantly improves students' entrepreneurial skills and outcomes (IDEATION: A.3 Crowd Innovation; IDEATION: A.4 Testing crowdfunding opportunities; IDEATION: A.6 International Open Innovation Training IDEA-up; DEETECHTIVE: A.3 International Open Innovation Training: IDEA-up DEEP TECH; DEETECHTIVE: A.4 Deep Tech innovation challenges).
- HEIs that actively engage in international collaborations will report higher levels of entrepreneurial activity and innovation among their students (IDEATION: A.1 Digital access to infrastructure; IDEATION: A.2 Knowledge Triangle Networks; DEETECHTIVE: A.2 Deep Tech Dates; DEETECHTIVE: A.7 Knowledge hotspot).
- Integrating practical, real-world projects into the curriculum contributes to developing a new generation of innovative and entrepreneurial engineers and scientists (IDEATION: A.1 Digital access to infrastructure; IDEATION: A.3 Crowd Innovation; IDEATION: A.6 International Open Innovation Training IDEA-up; DEETECHTIVE: A.3 International Open Innovation Training: IDEA-up DEEP TECH; DEETECHTIVE: A.4 Deep Tech innovation challenges).

By addressing these research questions and testing these hypotheses, this study aims to provide a comprehensive framework for fostering a culture of innovation and entrepreneurship within HEIs, ultimately contributing to the development of a new generation of innovative engineers and scientists. The first hypothesis is built on the premise that mentorship and resources are critical for fostering entrepreneurship. By offering continuous mentorship programs and comprehensive access to resources, students can receive the guidance and support necessary to transform their ideas into entrepreneurial ventures. The IDEATION and DEETECHTIVE projects included actions specifically aimed at supporting this hypothesis by providing the needed infrastructure and mentorship to cultivate student entrepreneurs. The second hypothesis is based on the idea that integrating online education and open innovation into the curriculum can enhance students' entrepreneurial capabilities by exposing them to a wider range of resources and perspectives. This approach fosters a deeper understanding of entrepreneurship. The IDEATION and DEETECHTIVE projects included actions designed to integrate these topics into the learning environment, thereby improving entrepreneurial outcomes. The third hypothesis is developed from the concept that international collaborations provide unique opportunities for cross-cultural learning and networking, which are essential for fostering a global entrepreneurial mindset. Engaging in international partnerships allows students to learn from diverse perspectives and engage in collaborative problem-solving. The projects facilitated cross-institutional workshops and networking events, aiming to strengthen international collaborations and promote entrepreneurial activities. The fourth hypothesis posits that hands-on, practical projects help students apply their knowledge in real-world scenarios, fostering innovation and an entrepreneurial mindset. By incorporating real-world projects into the curriculum, HEIs can bridge the gap between theoretical knowledge and practical application. The

IDEATION and DEETECHTIVE projects included actions focused on integrating practical projects and international open innovation training, demonstrating the importance of this approach in developing innovative and entrepreneurial skills.

In the subsequent sections, the methods section introduces the innovation models developed and the international case studies that facilitated their evaluation. The results section highlights key findings from the projects used as evaluation frameworks. The discussion section assesses the strengths and weaknesses of the models, offering perspectives for future enhancements. Finally, the conclusions recommends that HEIs implement successful innovation models and cultivate an ecosystem that drives sector-wide innovation.

2. Methods

In the following section, we are focusing on the need to define an actionable innovation model for entrepreneurial learning before presenting the IDEATION model for HEI Entrepreneurship and then its improvement as the DEETECHTIVE.

The development of the IDEATION model involved four HEI participants (Wroclaw University of Science and Technology (WUST) from Poland, the Holon Institute of Technology (HIT) from Israel, the University of La Laguna (ULL) from Spain, and the Institute for Industrial Management (FIR) from Germany), over 800 students of different degrees, and over 400 staff members, all trained (and mentored) to innovation and entrepreneurship from said four HEIs (duration 18 months: from July 2022 to December 2023).

The DEETECHTIVE model improving the previous one involved five HEIs (WUST, HIT, EPF School of Engineering (EPF) from France, Centria University of Applied Sciences (CENT) from Finland, and the University of Genova (UNIGE) from Italy). DEETECHTIVE had more than 350 students and nearly 200 staff participants involved in innovation training and mentoring from all five HEIs (duration: 8 months, from May 2023 to December 2023).

The reason for creating consortia composed of four HEIs and one business support organization (BSO) in IDEATION and five HEIs and one BSO in DEETECHTIVE was a compromise between geographical span, limited budget, common goals, and participation in EIT KICs (knowledge and innovation communities). Some of these restrictions were set by the funding institution—for example, the consortium should include more non-KIC organizations than organizations that are KIC members.

2.1. Needs Definition for an Actionable Innovation Model for Entrepreneurial Learning

Online education integration is essential for connecting students and educators across different geographic locations, facilitating international collaboration and the exchange of ideas, which are critical for multi-site innovation. It allows for the scalable and consistent delivery of educational content, ensuring that innovative practices and entrepreneurial training can be uniformly implemented and accessed by participants worldwide, thus supporting a unified approach to innovation across multiple sites. Conclusions resulting from the literature review show that the quintuple helix innovation model is vital, as it incorporates diverse sectors (political, educational, economic, environmental, and social), promoting inclusive and sustainable innovation practices that are applicable and beneficial in an international context. By fostering collaboration among various stakeholders globally, the QHIM enhances synergy and connectivity between international and multi-site institutions, driving impactful and cohesive innovation efforts across different regions. Therefore, to enhance entrepreneurship within universities, an effective innovation model must incorporate two key components:

- Online Education Integration: Reflecting recent shifts in the educational landscape, the model should offer all training and activities online. The curriculum should focus broadly on entrepreneurship, explicitly addressing Open Innovation topics such as crowdsourcing, crowdfunding, and Social Product Development (SPD). These elements are crucial in academic settings to help students understand the benefits of engaging in innovation challenges and to recognize alternative funding methods for their projects;

- Alignment with the Quintuple Helix Innovation Model: The model should incorporate the QHIM framework, involving academia, industry, society, public authorities, and the natural environment. This integration supports adopting the sharing economy concept, addressing common issues technology-focused HEIs face, such as costly underutilized research infrastructure. The model can offer extensive benefits by implementing infrastructure sharing among faculties, departments, and external entities like startups, small- and medium-sized enterprises (SMEs), and other HEIs. Faculties are encouraged to develop pre-incubation programs tailored explicitly for engineering students.

These considerations have shaped the development of a general model concept, which serves as the foundation for the research discussed in this paper. This concept represents the initial step in our proposed research methodology, depicted in Figure 1, STEP 0.

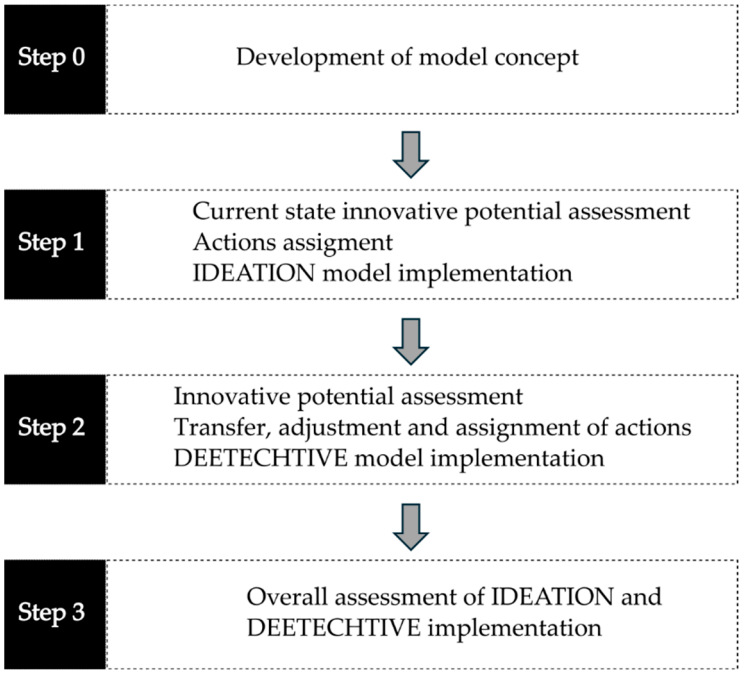

Figure 1. General scheme presenting research methodology.

Innovation Model Focus Areas:

- Sharing Economy: Promotes resource optimization and cost reduction;
- Open Innovation: Facilitates collaborative innovation across various sectors;
- Social Product Development: Encourages the creation of socially beneficial products and services.

This action-based model addresses significant shifts in work, innovation creation, and learning methods. It includes six specific actions that define the model's structure, each aligned with one of the three main paradigms. Figure 1 illustrates the complete research methodology and its structural outline.

The initial step in our research methodology involves assessing the innovative potential of Higher Education Institutions (HEIs), as depicted in Figure 1. This assessment is carried out using HEInnovate [48], a self-reflection tool designed specifically for HEIs. HEInnovate allows institutions to analyze their performance across eight key areas:

- Leadership and Governance: Evaluating the leadership strategies and governance structures in place;
- Organizational Capacity: Assessing the adequacy of funding, human resources, and incentive mechanisms;

- Entrepreneurial Teaching and Learning: Review the approaches and methodologies used to teach entrepreneurship;
- Preparing and Supporting Entrepreneurs: Examining the support systems available for budding entrepreneurs;
- Digital Transformation and Capability: Analyzing the institution's digital technologies and their integration into teaching and administrative processes;
- Knowledge Exchange and Collaboration: Looking at how effectively the institution engages with external entities and shares knowledge;
- The Internationalized Institution: Measuring the global engagement and impact of the institution.

Each HEI participating in an innovation project based on the models discussed is expected to perform this analysis individually to evaluate its current state and identify areas for improvement.

2.2. The IDEATION Model: 6 Actions for HEI Entrepreneurship

The IDEATION innovation model is designed to enhance entrepreneurial and innovation capacities within Higher Education Institutions (HEIs) and significantly impact their surrounding ecosystems. It incorporates six targeted actions to boost innovativeness and entrepreneurial skills intended for deployment within international partnerships (Figure 2).

Main Objectives of the IDEATION Model:

- Digital Resource Accessibility: Open digital resources to increase awareness and provide access to competencies, experiences, and infrastructure through a newly developed format of digital services;
- Strengthening Knowledge Partnerships: Enhance partnerships within the knowledge triangle by creating spaces for collaborative networks and fostering opportunities for new cooperation;
- Open Innovation Practices: Test and popularize Open Innovation-based approaches to directly accelerate the innovation process within HEIs and their broader ecosystems;
- Quality Enhancement in Innovation and Entrepreneurship Education: Establish a pre-incubation program and international open innovation training to improve the quality of innovation and support entrepreneurial education.

As detailed in Figure 2, the IDEATION model is built around these six actions to drive the entrepreneurial and innovative capabilities of HEIs.

2.2.1. Digital Access to Infrastructure

This action is designed to enhance the innovativeness and entrepreneurial capacity of HEIs and provide startups, SMEs, and research teams with direct access to advanced, high-tech research infrastructure under preferential terms. To facilitate this, each partner will create and maintain a digital database of available infrastructure on a dedicated digital platform. This initiative is rooted in the sharing economy model, aiming to optimize the use of existing resources.

The approach specifically addresses a prevalent issue in larger HEIs; there is often a lack of awareness about the range of equipment available across different labs. This unawareness can lead to unnecessary duplication of infrastructure and underutilization.

By making information about available resources easily accessible, the action aims to improve infrastructure utilization rates and foster a more collaborative environment within the HEI ecosystem.

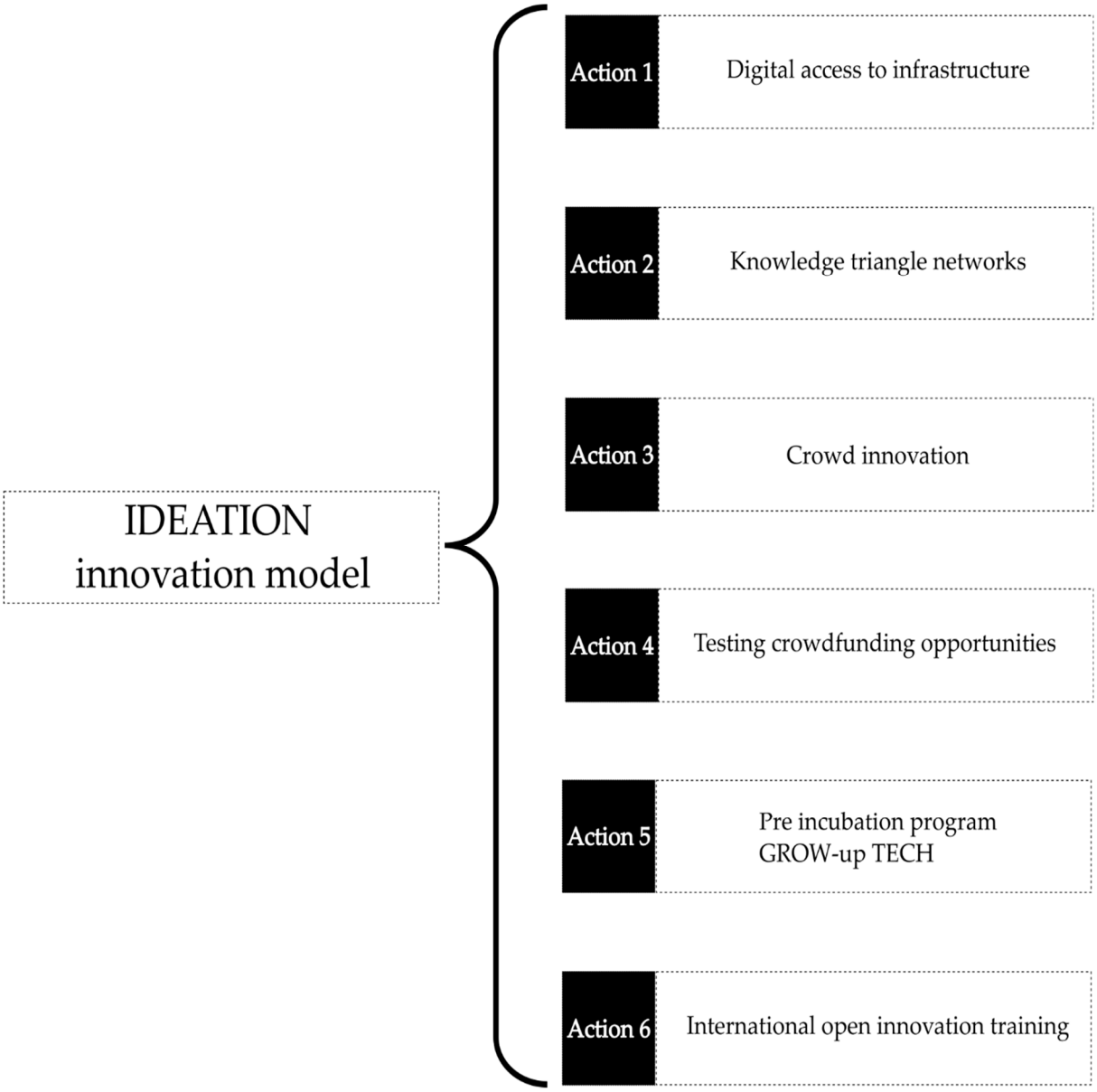

Figure 2. Actions included in the IDEATION innovation model.

2.2.2. Knowledge Triangle Networks

This action focuses on enhancing partnerships within the knowledge triangle by creating collaborative spaces and fostering new cooperations. It aims to integrate and engage more deeply with the innovation ecosystems of various partners through two main strategies:

- Data-Driven Cluster Formation: This approach utilizes data mining techniques to analyze real experiences. It identifies similarities among participants to form potential clusters. This method simplifies and accelerates the development of new partnerships and networks, making the process more efficient and targeted;
- Organization of Innovative Events: These events are designed to assemble representatives from different segments of the knowledge triangle. These gatherings facilitate the initiation of new collaborations by providing a platform for sharing experiences, challenges, and ideas. The events aim to foster a rich knowledge exchange and drive collective innovation efforts.

2.2.3. Crowd Innovation

This action is designed to test and promote Open Innovation 2.0-based approaches, specifically emphasizing crowdsourcing to accelerate the innovation process within Higher Education Institutions and their ecosystems. The primary goal is to create an environment conducive to innovation-driven research, ultimately enhancing the innovation capacity of HEIs, as follows:

- Implementation of Digital Platforms: A dedicated digital platform will be utilized to collate various crowdsourcing-based challenges. This platform will serve as a hub for generating a wide array of innovative solutions by tapping into the collective intelligence of a global network;
- International Collaboration: The initiative will be conducted internationally, involving participants from all partner countries. This global approach diversifies the range of innovative ideas, fosters cross-border collaborations, and enriches the research environment through international insights.

This action leverages digital tools and international cooperation to cultivate a dynamic and responsive innovation ecosystem within and across HEIs.

2.2.4. Testing Crowdfunding Opportunities

Crowdfunding, a key component of Open Innovation 2.0, will be actively promoted by initiating competitions for crowdfunding campaigns and organizing related workshops. These initiatives are designed to:

- Foster Innovative Crowdfunding Initiatives: These competitions and workshops aim to generate a diverse array of innovative crowdfunding projects by engaging students and researchers in practical activities;
- Develop Entrepreneurial Skills: This approach cultivates an entrepreneurial mindset among participants, providing them with hands-on experience in alternative financing mechanisms crucial for funding research and innovative ideas;
- Enhance Access to Funding: Through real-world application, participants will gain direct access to funding sources while simultaneously receiving immediate market feedback on their proposed solutions. This dual benefit accelerates the funding process and integrates valuable market insights into the development phase.

This structured approach to crowdfunding underpins the broader objectives of fostering a culture of innovation and practical financial acumen within the HEI ecosystem.

2.2.5. Pre-Incubation Program "GROW-Up TECH"

The GROW-up TECH pre-incubation program was established to foster innovation and strengthen entrepreneurial education. This program supports numerous startups through a comprehensive approach:

- Structured Support: Startups benefit from extensive training sessions, workshops, and expert supervision. EPIC [49] and KTH [50] assessments further enhance this structured environment, which provides critical evaluations and feedback to refine business strategies and technological developments;
- Mentoring for Students: Students participating in the program receive mentoring to develop their abilities to design innovative products or services. This hands-on guidance is crucial for nurturing practical skills and entrepreneurial thinking, empowering students to translate academic knowledge into market-ready innovations.

This action accelerates the development of new enterprises and embeds a strong entrepreneurial culture within the academic environment.

2.2.6. International Open Innovation Training IDEA-Up

We developed and implemented an International Open Innovation Training program to bolster entrepreneurial education and innovation quality. This program will focus on core concepts such as entrepreneurship, Open Innovation 1.0 and 2.0, and Social Product

Development. It will utilize online platforms to deliver state-of-the-art approaches, methods, and case studies, emphasizing Open Science and SPD. The training material will be compiled into a digital handbook with all related resources and instructional content. The assessment of the innovative potential of our partners is a critical first step in the action selection and assignment process.

According to our research methodology, the second step involves adapting and refining the most effective actions based on this assessment. This process led to the formation of a new consortium built on the foundations of initial evaluations. Each new partner will assess innovative potential, informing the assignment of specific actions in the revised model. This systematic approach ensures that our collaborative efforts are tailored to maximize the strengths and opportunities within the consortium.

2.3. The DEETECHTIVE Model: An Enhanced IDEATION Model

The DEETECHTIVE model builds upon the revised IDEATION framework, specifically focusing on Deep Tech and integrating previously mentioned enhancements.

Model Overview and Integration: Figure 3 illustrates the interactions between the IDEATION and DEETECHTIVE models concerning key paradigms such as the Sharing Economy, Open Innovation, entrepreneurship, Deep Tech, and Social Product Development. It details how specific actions from the IDEATION model (I1–I6) are adapted and transferred to the DEETECHTIVE model (I2 → D2, I3 → D4, I5 → D5, I6 → D3), ensuring continuity and evolution of the initial intents.

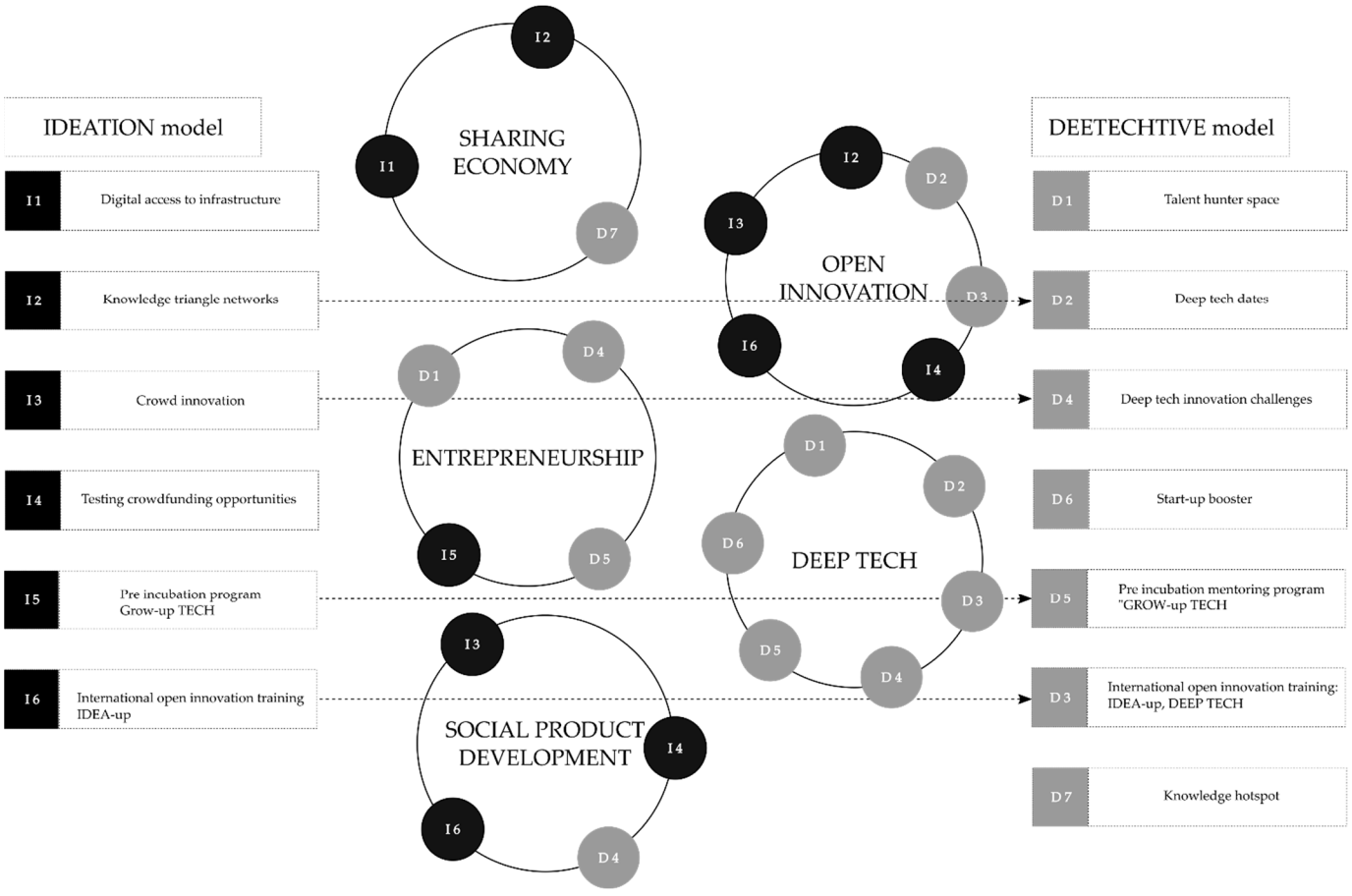

Figure 3. General scheme presenting innovation models enhancing entrepreneurship in HEI ecosystems.

Alignment with the Quintuple Helix Innovation Model: Both the IDEATION and DEETECHTIVE models align with the quintuple helix innovation model, which integrates universities, industry, government, society, and the environment, adhering to advanced

innovation frameworks. However, the DEETECHTIVE model shifts its focus slightly, emphasizing three main pillars:

Deep Tech: Enhancing capabilities in cutting-edge technologies.

Open Innovation and Open Science: Encouraging more transparent and collaborative innovation processes.

Social Product Development: Focusing on creating socially beneficial products.

Primary Objectives of the DEETECHTIVE Model: Developing the Talent Hunter Space: This pan-European platform aims to identify and cultivate deep tech talent within the student community, facilitating the growth of skilled innovators.

Figure 3 illustrates the interactions between the IDEATION and DEETECHTIVE models mentioned earlier.

Accelerating Innovation: It tests and promotes Open Innovation 2.0 methodologies, supporting deep tech startups within HEIs and their wider ecosystems. This initiative aims to speed up the innovation cycle and rapidly bring cutting-edge solutions to the market.

- Enhancing Educational Quality: The model enhances the quality of innovation and supports entrepreneurial education through initiatives like the International Open Innovation Training: IDEA-up DEEP TECH and the pre-incubation mentoring program: GROW UP TECH. These programs are designed to equip participants with the necessary skills and knowledge to succeed in high-tech entrepreneurial endeavors.
- Disseminating Knowledge: By collecting and sharing success stories and lessons learned, the model helps disseminate valuable insights across local and international ecosystems, enhancing cooperation and knowledge exchange.
- Vision and Focus of the DEETECHTIVE Model: The DEETECHTIVE model envisions a transformational path toward future advancements by enhancing the capacity for entrepreneurship and innovation through open innovation and open science. It specifically targets building innovative capacities in fields such as Advanced Manufacturing, aerospace, automotive, remote sensing, artificial intelligence, machine learning, big data, semantic web, robotics, and emerging Web 3.0 technologies, including the internet of things, blockchain, distributed ledgers, and non-fungible tokens (NFTs). The detailed actions encompassed by the DEETECHTIVE innovation model are outlined in Figure 4.

The DEETECHTIVE innovation model enhancing entrepreneurship in HEI ecosystems is based on 7 actions.

2.3.1. Talent Hunter Space

The DEETECHTIVE model's first action, Talent Hunter Space (THS), is designed as a pan-European talent and skills development platform. This platform aims to support participating HEIs in swiftly identifying, skilling, reskilling, and upskilling deep tech talents within the DEETECHTIVE student community. By facilitating international talent hunting, THS enhances the innovative capacity and entrepreneurial prowess of HEIs, precisely addressing the ecosystems' demands for student training in deep tech areas.

Implementation Details:

- Digital Database Creation: Each project partner will develop a digital database dedicated to deep tech, innovation, and entrepreneurship. This resource will boost awareness among partners and improve access to existing and new solutions alongside support programs at each HEI;
- Training for Implementation: Academic and non-academic staff will receive targeted training sessions to implement the THS effectively. These sessions will focus on enhancing competencies in career counseling and skills profiling for students, ensuring that the platform identifies and nurtures talent effectively.

This strategic initiative tackles a prevalent challenge in large HEIs by streamlining talent discovery and development, ensuring that students equipped with high-demand tech skills are prepared to meet the needs of modern industries.

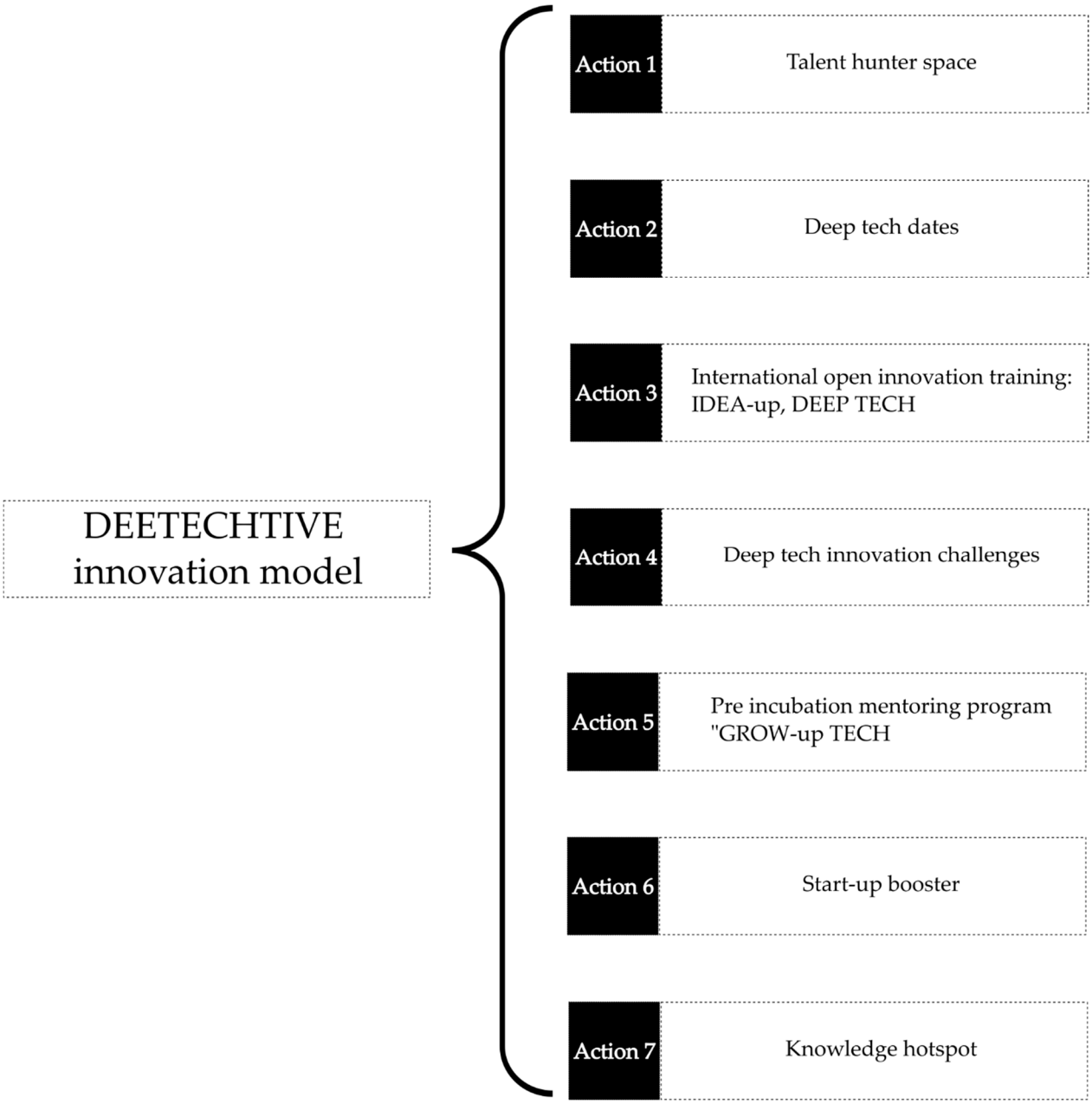

Figure 4. Actions included in the DEETECHTIVE innovation model.

2.3.2. Deep Tech Dates

Action 2 aims to fortify partnerships within the knowledge triangle through the innovative concept of "Deep Tech Dates". This new format is designed to build and enhance collaborative networks, facilitating stronger integration and engagement with partners' innovation ecosystems. The implementation of deep tech dates is as follows:

- Event Organization: Deep Tech Dates are a series of targeted events that convene representatives from various segments of the knowledge triangle—academia, industry, and government;
- Purpose and Activities: These gatherings are structured to allow participants to share experiences, discuss current challenges, exchange ideas, and forge new collaborations. The focus is creating a dynamic forum for open dialogue and partnership development that directly supports deep tech initiatives.

Goals of Action 2:

- Enhanced Collaboration: By introducing a structured yet flexible environment for interaction, deep tech dates aim to break down traditional barriers between different sectors and foster a seamless exchange of knowledge and resources;
- Innovation Ecosystem Integration: This action facilitates deeper engagement with existing innovation ecosystems and helps identify and leverage synergistic opportunities for all involved parties.

This approach ensures that all participants are better positioned to contribute to and benefit from shared innovation endeavors, ultimately leading to more robust and productive partnerships.

2.3.3. International Open Innovation Training: IDEA-Up DEEP TECH

Action 3 aims to elevate innovation quality and bolster entrepreneurial education through the development of the International Open Innovation Training: IDEA-up DEEP TECH. This initiative focuses on key areas such as Deep Tech, Open Innovation, and social product development.

Program Details:

- Comprehensive Curriculum: A 50 h lecture-based program will be implemented, designed to address the cutting-edge aspects of Deep Tech, Open Innovation, and social product development. The curriculum aims to design and promote high-tech solutions, enhancing participants' innovative capabilities;
- Educational Approach: The program will foster an entrepreneurial mindset among students by providing practical knowledge through an immersive learning experience. Students will be organized into international cross-disciplinary teams and engage in problem-based learning (PBL). This approach is intended to deepen their understanding and application of complex concepts by solving real-world problems [19,20,51].

Goals of Action 3:

- Strengthen Entrepreneurial Education: The program strengthens the entrepreneurial offerings at HEIs by integrating advanced technological and innovative teachings;
- Enhance Student Innovation Capacity: Through collaborative and problem-oriented education, students are equipped with the necessary skills to navigate and succeed in the competitive fields of technology and innovation.

This action ensures that HEIs enhance their educational impact by providing a robust framework for students to develop essential skills in innovation and entrepreneurship.

2.3.4. Deep Tech Innovation Challenges

This action is designed to expedite the innovation process within HEIs and their broader ecosystems by implementing and promoting Open Innovation 2.0-based strategies, specifically targeting support for deep tech (DT) startups. The goal is to create an environment that fosters innovation-driven research and enhances the overall innovation capacity of HEIs.

Implementation Strategies:

- Structural Development: This action involves setting up infrastructures and conditions optimal for innovation-driven research. This structure aims to support DT startups by providing the necessary tools and resources to thrive in a competitive ecosystem;
- Crowdsourcing Initiatives: A pivotal component of this action is using crowdsourcing to tackle DT-focused challenges. A digital platform will collect these challenges and facilitate the submission of innovative solutions from a global community;

- International Collaboration: This initiative will be rolled out internationally, involving participants from all consortium countries, to ensure a diverse range of insights and solutions, thereby enriching the innovation process.

This approach accelerates innovation within HEIs and cultivates a robust network of international collaborations, enhancing the global impact of the consortium's efforts.

2.3.5. Pre-Incubation Mentoring Program: GROW-Up TECH

Action 5 is designed to enhance and complement the initiatives outlined in Action 3 by establishing the pre-incubation mentoring program: GROW-up TECH. This program specifically targets mentoring students in creating and developing Deep Tech-focused businesses.

Program Details:

- Workshop Series: A series of targeted workshops will be organized to provide foundational support and guidance to students. These workshops are structured to help participants refine their business ideas and develop viable business models tailored to the unique demands of Deep Tech industries;
- International Collaboration: The program incorporates an international dimension to broaden the scope of learning and innovation. Students will be grouped into international teams, fostering cross-cultural collaboration and enabling them to leverage diverse perspectives and expertise in developing their business ideas.

This action not only supports students in navigating the complexities of Deep Tech entrepreneurship but also encourages a collaborative spirit across borders, enhancing the global reach and impact of their innovative ventures.

2.3.6. Start-Up Booster

The start-up booster action is designed to streamline and enhance the support infrastructure for Deep Tech (DT) start-ups within participating HEIs. This initiative focuses on consolidating and cataloging entrepreneurs' services and support mechanisms, including mentoring, legal advice, and intellectual property protection.

Implementation and Analysis:

- Service Cataloging: All participating HEIs will initially catalog the available support services to ensure startups have easy access to the necessary resources;
- Cross-Consortium Analysis: A thorough analysis across the consortium will be performed to align the specific needs of startups and scale-ups with the available HEI support. This ensures that the resources provided are precisely tailored to meet the demands of the startups;
- Targeted Support Program: The DEETECHTIVE initiative will offer two months of flexible and targeted support following the analysis. This support package includes specialized training sessions, supervisor assistance, and evaluations using EPIC and KTH assessment tools.

Direct Startup Support (outcome): As a result of these concerted efforts, several startups will receive direct, customized support that addresses their specific operational, technical, and developmental needs.

2.3.7. Knowledge Hotspot

The primary goal of Action 7 is to compile and share success stories and lessons learned from the activities implemented under the IDEATION and DEETECHTIVE models. This action is vital for enhancing knowledge and fostering continuous improvement within partner HEIs and their broader ecosystems.

Implementation and Impact:

- Knowledge Sharing: This initiative aims to distribute valuable information across partners' local ecosystems and cooperation networks by gathering insights from

all implemented actions. This dissemination helps replicate successful strategies and avoid past pitfalls, strengthening future endeavors;
- STEP 3—Comprehensive Evaluation: As the final step in our research methodology, STEP 3 thoroughly evaluates the overall implementation of the IDEATION and DEETECHTIVE models. This evaluation is conducted using dedicated Key Performance Indicators (KPIs), which are essential for measuring the effectiveness of each action and ensuring that the implementation is aligned with the intended outcomes;
- Transparent Monitoring and Evaluation (outcome): KPIs facilitate transparent and objective monitoring of the models' implementation, providing a clear benchmark for assessing progress and identifying areas for further enhancement.

2.4. IDEATION and DEETECHTIVE Models Effectiveness

The models' effectiveness was measured by considering the ratio (noted as the completion rate) between the expected number and the achieved number of predefined key performance indicators (KPIs), namely:

- Start-ups/scale-ups supported;
- Students trained with a view to innovation and entrepreneurship;
- Students mentored;
- Academic staff members trained with a view to innovation and entrepreneurship;
- Academic staff members mentored;
- Non-academic staff (e.g., professional staff, support staff) trained with a view to innovation and entrepreneurship;
- Non-academic staff mentored;
- Improved support structures and mechanisms (including successful infrastructure sharing, innovation challenges created, and crowdfunding campaigns submitted);
- New partnerships established;
- Start-ups created.

The KPIs were assigned to each action separately. The detailed breakdown of the planned KPIs per action can be found in Appendix A. Key performance indicators (KPIs) are segmented by actions.

3. Results

3.1. Innovative Potential Assessment

The research methodology outlined in Figure 1 was initiated by four HEIs: the Wroclaw University of Science and Technology (WUST), the Holon Institute of Technology (HIT), the University of La Laguna (ULL), and the Institute for Industrial Management (FIR). As part of the initial phase, these institutions utilized the HEInnovate self-reflection tool to assess their innovative potential. This assessment is essential for universities to strategically allocate resources and make informed decisions that enhance their competitiveness and innovation capabilities in a rapidly changing environment (Figure 1). By understanding their strengths and weaknesses in innovation, these institutions can prioritize initiatives, foster collaborations, and adapt to new trends, ensuring they remain adaptable and effective in meeting evolving societal challenges (Table 1).

Evaluating "Leadership and Governance" across institutions revealed that the Holon Institute of Technology (HIT) demonstrated strong leadership qualities characterized by effective strategic direction and decision-making capabilities. In contrast, Wroclaw University of Science and Technology (WUST) and the University of La Laguna (ULL) showed potential for enhancing their leadership initiatives to guide their strategic goals better. In "Organizational Capacity", HIT showcased a robust framework attributed to efficient resource allocation and well-structured incentive mechanisms. Conversely, WUST and ULL were identified as needing enhanced resources and incentives to bolster their organizational strength and support their institutional objectives. Regarding "Entrepreneurial Teaching and Learning", ULL excelled in creating an environment conducive to student innovation

and creativity. Meanwhile, both WUST and the Institute for Industrial Management (FIR) were recognized as having opportunities to improve their entrepreneurial education approaches to foster entrepreneurial spirit among students. For "Preparing and Supporting Entrepreneurs", HIT stood out with its comprehensive support programs and networks, serving as a potential model for WUST and FIR to emulate to enhance their systems for nurturing entrepreneurial ventures.

Table 1. IDEATION—Initial assessments.

Key Areas	WUST	HIT	ULL	FIR	Avg.
Leadership and Governance	2.0	4.6	2.0	3.0	2.9
Organizational Capacity: Funding, People, and Incentives	1.0	4.0	1.6	3.6	2.6
Entrepreneurial Teaching and Learning	2.0	2.8	1.8	3.0	2.4
Preparing and Supporting Entrepreneurs	2.0	3.0	1.8	1.8	2.2
Digital Transformation and Capability	2.4	2.8	3.8	3.0	3.0
Knowledge Exchange and Collaboration	1.6	2.0	2.8	4.0	2.6
The Internationalized Institution	1.6	3.2	2.0	1.8	2.2
Measuring Impact	1.5	1.3	1.2	1.6	1.4

In "Digital Transformation and Capability", ULL is proficient in leveraging technology to drive innovation. This suggests that WUST and FIR could benefit from strengthening their digital capabilities to keep pace with rapid technological advancements.

3.2. Actions Assignment and IDEATION Model Implementation

Following the innovative potential assessment results, a comprehensive plan for assigning specific actions within the IDEATION model was formulated. This strategic approach enabled the transformation of the model into a significant project under the European Institute of Innovation and Technology (EIT) Higher Education Institutions Initiative, titled "Innovation Capacity Building for Higher Education" [52]. Coordinated by EIT Raw Materials [53], this initiative bolsters innovation and entrepreneurship within academia. The project, named IDEATION: Innovation and Entrepreneurship Actions and Training for Higher Education, successfully secured funding of EUR 1.2 million from the knowledge and innovation communities (KICs) of EIT Manufacturing [54]. Officially launched in July 2022, the IDEATION project was scheduled to run until June 2024. It included a consortium of five partners from five different countries: the Wroclaw University of Science and Technology (WUST) in Poland as the lead partner, the Holon Institute of Technology (HIT) in Israel, the University of La Laguna (ULL) in Spain, the Institute for Industrial Management (FIR) in Germany, and CRIT Srl in Italy. This project was built upon the six key actions identified earlier. The innovative potential assessment, as detailed in Table 2, was instrumental in determining each partner's role and level of involvement in these actions, ensuring a tailored approach that leverages each institution's unique strengths and capabilities. Table 2 details the specific actions each partner was involved in and the extent of their participation.

The project activities were clearly defined and quantified, and they were structured into three phases, as follows: Phase 1, from July to December 2022; Phase 2A, from January to December 2023; and Phase 2B, from January to June 2024. The structure of the actions—their number and length—results from the call requirements. Table 3 details the specific breakdown of the key performance indicators (KPIs).

Table 2. Participation in the IDEATION actions.

	Participation in Particular Actions	WUST	HIT	ULL	FIR	CRIT
A.1	Digital access to infrastructure	✔	✔	✔	✔	✔
A.2	Knowledge Triangle Networks	✔	✔	✔	✔	✔
A.3	Crowd Innovation	✔	✔	✔	✔	✔
A.4	Testing crowdfunding opportunities	✔		✔	✔	
A.5	Pre-Incubation Program GROW-up TECH	✔		✔		✔
A.6	International Open Innovation Training IDEA-up	✔	✔	✔	✔	

Table 3. IDEATION—Planned KPIs.

IDEATION KPIs	Phase 1	Phase 2A	Phase 2B	Overall
Start-ups/scale-ups supported	3	3	3	9
Students trained with a view to innovation and entrepreneurship	260	375	165	800
Students mentored	22	30	14	66
Academic staff members trained with a view to innovation and entrepreneurship	60	75	35	170
Academic staff members mentored	8	8	0	16
Non-academic staff (e.g., professional staff, support staff) trained with a view to innovation and entrepreneurship	60	75	35	170
Non-academic staff mentored	8	8	0	16
Improved support structures and mechanism	19	33	10	62
New partnerships established	1	1	1	3
Start-ups created	0	0	4	4

Moreover, the IDEATION project has achieved significant results.

3.2.1. Research Infrastructure Sharing

During this project, the partners developed a model that allows remote access to technologically advanced laboratories worldwide, including robotic control. This model, supported by the SYNERGY meta-platform [55,56], facilitates digital resource sharing, raises awareness, and enhances access to competencies and infrastructure. It has been implemented and tested, enabling sharing between enterprises and universities.

3.2.2. Tech Dates Events

To create a community of interest, the IDEATION team established a new format of open seminars to strengthen partnerships within the knowledge triangle and foster new cooperative networks. These events, supported by the SYNERGY meta-platform, promote interaction and collaboration.

3.2.3. Innovation Support Model Validation

An innovation support model based on open innovation and the sharing economy was validated. This included developing a series of innovation challenges that utilized crowdsourcing and crowdfunding, primarily focusing on developing new technologically advanced products to accelerate innovation processes across enterprises, universities, and surrounding ecosystems.

3.2.4. IDEA-Up Platform and Training Model

The development of the IDEA-up platform [57] and an open online training model, International Open Innovation Training IDEA-up, which focused on entrepreneurship, innovation (especially Open Innovation), and Social Product Development in advanced manufacturing technologies, were crucial contributions of the project to the HEI community. The training consists of three main modules:

- Module 1: Innovation and Entrepreneurship (12 lectures);
- Module 2: Open Innovation (7 lectures);
- Module 3: Social Product Development (4 lectures).

3.2.5. From the IDEA-Up Platform to Deep Tech

The IDEA-up platform provided insights into deep tech and leading-edge approaches, helped to develop innovation and entrepreneurial skills, inspired startup creation, and offered access to lectures from international researchers. Participants also received a free certification.

3.2.6. The "GROW-Up TECH" Pre-Incubation Program

The training was enriched by the "GROW-up TECH" pre-incubation program model, which fosters innovation by supporting the establishment of startups in technologically advanced fields. GROW-up TECH and IDEA-up embody knowledge sharing, enhance innovation quality, and support entrepreneurial education. They also offer an alternative development path to a corporate career, creating conducive conditions for generating advanced innovations.

3.3. Enhancing the IDEATION Model with Knowledge Transfer and Continuous Adjustments: The DEETECHTIVE Model

During the successful implementation of the IDEATION project, the EIT's HEI Initiative: Innovation Capacity Building for Higher Education, released another call for proposals. Two IDEATION project partners, respectively, WUST and HIT, decided to continue their collaboration and apply for a new project. They aimed to validate further and develop the IDEATION innovation model and formed a new network of partners. Another assessment of innovative potential was conducted, showing an increase in innovativeness at both WUST and HIT. Three additional HEIs were invited to join the new consortium: the EPF School of Engineering (EPF) from France, Centria University of Applied Sciences (CENT) from Finland, and the University of Genova (UNIGE) from Italy.

This allowed for upgrading the IDEATION model to the new DEETECHTIVE one, which is built on the IDEATION model with several enhancements (as described in Section 2.3). It incorporates the most successful actions from the previous model and introduces new actions tailored to the needs of the new consortium.

The DEETECHTIVE project ("Deep Tech Talents—Innovation & Entrepreneurship Support"), funded with EUR 0.75 million from the KIC—EIT RAW Materials, started in May 2023 and ends by July 2024. All five HEIs utilized the HE Innovate self-reflection tool to assess their innovative potential. The results of this assessment are displayed in Table 4.

Table 4. DEETECHTIVE—Initial assessments.

Key Areas	WUST	HIT	UNIGE	EPF	CENT	Average
Leadership and Governance	2.2	4.8	1.2	3.8	3.0	3.0
Organizational Capacity: Funding, People, and Incentives	1.2	3.8	2.6	2.8	3.8	2.8
Entrepreneurial Teaching and Learning	2.2	3.8	2.0	3.6	4.2	3.2
Preparing and Supporting Entrepreneurs	2.3	4.5	2.7	3.0	3.5	3.2
Digital Transformation and Capability	2.2	4.0	2.8	4.0	4.0	3.4
Knowledge Exchange and Collaboration	1.8	4.6	3.2	4.0	4.0	3.5
The Internationalized Institution	1.6	4.4	4.6	3.4	4.0	3.6
Measuring Impact	1.5	3.7	2.5	3.0	2.5	2.6

3.3.1. DEETECHTIVE Model Implementation

HIT and EPF stood out in their initial assessments for their strong "leadership and governance", which enabled effective strategic direction and decision-making. Conversely, UNIGE and CENT had room for improvement, presenting opportunities to enhance their leadership initiatives.

In "Organizational Capacity", CENT excelled due to effective resource allocation and incentive structures, while WUST and UNIGE showed potential for improvement to boost their capacity.

CENT also led in "Entrepreneurial Teaching and Learning", creating environments that foster student innovation and creativity. WUST and UNIGE had the opportunity to refine their approaches to promote entrepreneurship further.

Regarding "Preparing and Supporting Entrepreneurs", HIT and EPF excelled with comprehensive support programs. WUST and UNIGE could benefit from strengthening their support systems for entrepreneurial ventures.

About "Digital Transformation and Capability", CENT showcased its expertise, utilizing technology to drive innovation. WUST and UNIGE, meanwhile, could enhance their digital capabilities to better adapt to evolving trends.

CENT also led in "Knowledge Exchange and Collaboration", indicating strong connections with industry and academia. WUST and UNIGE were encouraged to improve their collaborative efforts to leverage external expertise and resources more effectively.

Regarding "Internationalization", UNIGE and CENT displayed a strong international presence, fostering diverse perspectives and innovation opportunities. WUST and EPF were advised to expand their international collaborations to increase global impact.

Regarding "Measuring Impact", all HEIs needed to develop more robust evaluation frameworks to assess the effectiveness of their innovation initiatives.

Overall, WUST had the potential for broad improvements across several areas. HIT excelled in supporting entrepreneurship and showed strong leadership but could improve entrepreneurial teaching and impact measurement. UNIGE and EPF demonstrated capabilities in internationalization and supported entrepreneurs, although they could bolster their impact measurement and collaborative efforts. CENT performed well across multiple areas but had room to improve impact measurement.

The DEETECHTIVE project included seven key actions, with each partner involved in specific actions (Table 5) according to the results of the innovativeness potential assessment (Table 4).

Table 5. Participation in the DEETECHTIVE actions.

	Participation in Particular Actions	WUST	HIT	UNIGE	ITT	EPF	CENT
A.1	Talent Hunter Space	✔	✔	✔	✔	✔	✔
A.2	Deep Tech Dates	✔	✔	✔	✔	✔	✔
A.3	International Open Innovation Training: IDEA-up DEEP TECH	✔	✔	✔		✔	✔
A.4	Deep Tech innovation challenges	✔	✔	✔	✔	✔	✔
A.5	Pre-Incubation Mentoring Program "GROW UP TECH"		✔		✔	✔	
A.6	Start-up booster				✔		✔
A.7	Knowledge hotspot	✔	✔	✔	✔	✔	✔

All project activities are precisely defined and quantified, organized into two phases: Phase 1, from May to December 2023, and Phase 2, from January to July 2024. The structure of the actions—their number and length—results from the call requirements. The detailed breakdown of the KPIs is disclosed below (Table 6).

Some key results of the DEETECHTIVE implementation are supporting these KPIs.

Table 6. DEETECHTIVE—Planned KPIs.

IDEATION KPIs	Phase 1	Phase 2	Overall
Start-ups/scale-ups supported	2	3	5
Students trained with a view to innovation and entrepreneurship	360	365	725
Students mentored	36	39	75
Academic staff members trained with a view to innovation and entrepreneurship	60	72	132
Academic staff members mentored	18	21	39
Non-academic staff (e.g., professional staff, support staff) trained with a view to innovation and entrepreneurship	60	72	132
Non-academic staff mentored	18	21	39
Improved support structures and mechanism	7	10	17
New partnerships established	1	2	3
Start-ups created	0	1	1

3.3.2. Talent Hunter Space

Developed as a pan-European platform, Talent Hunter Space (THS) identified hidden talents among Deep Tech students. It allowed companies to register their Deep Tech needs and enabled academic teachers to recommend talented students to university units like career offices or business incubators. This process could integrate with the Moodle platform or function directly through THS, ensuring talents were matched with appropriate opportunities.

3.3.3. Deep Tech Dates Events

These new events were designed to strengthen partnerships within the knowledge triangle and create new networks focused on Deep Tech.

3.3.4. Open Innovation Training IDEA-Up DEEP TECH

This comprehensive online training program consisted of eight modules aimed at enhancing skills in entrepreneurship, innovation, and specific Deep Tech areas:

- Module 1: Entrepreneurship from the Deep Tech Point of View (three lectures);
- Module 2: Innovation and Entrepreneurship Capacity Building (eight lectures);
- Module 3: Business Models (two lectures);
- Module 4: Start-up Perspective (four lectures);
- Module 5: Deep Tech: Artificial Intelligence Insights (six lectures);
- Module 6: Deep Tech: Robotics (nine lectures);
- Module 7: Deep Tech: Additive Manufacturing (three lectures);
- Module 8: Deep Tech in Higher Education (two lectures).

3.3.5. GROW-Up TECH Pre-Incubation Program

Similarly to the implementation of this pre-incubation program in IDEATION (Section 3.2.6), which was complemented by the IDEA-up DEEP TECH training, GROW-up TECH supported the creation of start-ups in Deep Tech fields. It offered a practical alternative to traditional corporate careers.

3.3.6. Innovation Challenges and Start-Up Booster

Validated the innovation support model from the SYNERGY and IDEATION projects through innovation challenges based on crowdsourcing, accelerating the creation of new products. The new start-up booster model also supported Deep Tech start-ups by developing a dedicated transformation plan and a range of services.

These components of the DEETECHTIVE project implementation collectively aimed to improve innovation capabilities, foster entrepreneurship, and enhance the development of Deep Tech sectors across multiple institutions and networks.

3.4. Overall Assessment of IDEATION and DEETECHTIVE Implementation

This analysis of Phase 1 (July 2022–December 2022) and Phase 2A (January 2023–December 2023) for Project IDEATION revealed a resounding success in achieving key performance indicators (KPIs). Table 7 showcases not only the fulfillment but, in some instances, the surpassing of established performance goals. This achievement signifies a robust implementation of the project's IDEATION and DEETECHTIVE frameworks.

Table 7. IDEATION—reached KPIs in Phase 1 and Phase 2A.

IDEATION KPIs	Phase 1 Planned	Phase 1 Reached	Completion Rate (%)	Phase 2A Planned	Phase 2A Reached	Completion Rate (%)
Start-ups/scale-ups supported	3	3	100	3	3	100
Students trained with a view to innovation and entrepreneurship	260	313	120	375	494	132
Students mentored	22	39	177	30	33	110
Academic staff members trained with a view to innovation and entrepreneurship	60	76	127	75	152	203
Academic staff members mentored	8	8	100	8	17	213
Non-academic staff (e.g., professional staff, support staff) trained with a view to innovation and entrepreneurship	60	67	112	75	135	180
Non-academic staff mentored	8	9	113	8	16	200
Improved support structures and mechanism	19	19	100	33	34	103
New partnerships established	1	4	400	1	6	600
Start-ups created		0	0		1	25

The IDEATION project witnessed a remarkable display of collaborative efforts and innovation. Therefore, a breakdown of the key actions implemented is critical to understanding how the challenges were handled correctly.

The "Digital Access to Infrastructure" action involved all the project partners in establishing a successful mechanism for infrastructure sharing. This involved registering numerous infrastructures (101) and facilitating knowledge dissemination through presentations (5) on the sharing economy model. Furthermore, project efforts led to the creation of successful matches (4) between entities seeking and offering infrastructure access.

A cornerstone of IDEATION relied on the action "Knowledge Triangle Networks" aimed to foster new partnerships and strengthen existing collaborations. This was achieved by organizing well-attended Open Seminars (5) for 116 participants. A dedicated platform was also established, registering many entities (79) to foster ongoing collaboration.

Moreover, "Crowd Innovation" aimed to unleash student entrepreneurial and innovation potential. The project actively encouraged students to tackle real-world challenges by developing innovative solutions. This resulted in the creation of five compelling Innovation Challenges, which subsequently received student submissions (15) showcasing their ingenuity.

Then, by "Testing Crowdfunding Opportunities", IDEATION teams (WUST, ULL, and FIR) tried to unveil crowdfunding's capabilities, focusing on educating participants (students and staff) on the exciting world of crowdfunding and crowd-investing. Three comprehensive training courses were organized, reaching 90 participants. This newfound knowledge was translated into action with the development of 10 crowdfunding campaigns poised to unlock new funding opportunities.

As an additional substantial action of IDEATION, the "pre-incubation program" implemented by WUST, ULL, and CRIT aimed to nurture the next generation of startups. Thus, this action provided crucial support for budding entrepreneurs. Through 15 workshops, 36 participants received valuable guidance. Notably, the program successfully supported the launch of three promising startups.

Furthermore, as an international project, the "International Open Innovation Training IDEA-up", implemented by WUST, HIT, ULL, and FIR, was particularly impactful, attracting 381 registrants interested in delving into the world of open innovation. By the program's conclusion in December 2022, a significant portion (185) had successfully completed the training, signifying a strong commitment to innovation on a global scale.

As summarized in Table 8, KPIs established for Phase 1 were not only met but, in some cases, surpassed. This initial success lays a strong foundation for the project's continued progress.

Table 8. DEETECHTIVE—Planned and reached KPIs in Phase 1.

DEETECHTIVE KPIs	Phase 1 Planned	Phase 1 Reached	Completion Rate (%)
Start-ups/scale-ups supported	2	2	100
Students trained with a view to innovation and entrepreneurship	360	364	101
Students mentored	36	39	108
Academic staff members trained with a view to innovation and entrepreneurship	60	106	177
Academic staff members mentored	18	24	133
Non-academic staff (e.g., professional staff, support staff) trained with a view to innovation and entrepreneurship	60	89	148
Non-academic staff mentored	18	19	106
Improved support structures and mechanism	7	11	157
New partnerships established	1	2	200
Start-ups created	0	0	0

The various actions implemented within the project and their related achievements focus on nurturing deep tech talent, fostering innovation, and establishing collaborations.

By looking at the "Talent Hunter Space" action, in which all the partners were involved, a prototype IT solution was developed to help academic and non-academic staff identify innovative and entrepreneurship-oriented students (also called "talented students" herein). Six training sessions were organized to enhance the efficiency of the identified talented students. Mentoring was provided to 19 non-academic and 24 academic staff members. Additionally, 26 deep tech needs were registered, and 54 talents were identified.

Moreover, the main objective of the "Deep Tech Dates" was to facilitate collaboration by organizing six events (473 participants) and establishing a dedicated platform for ongoing interactions (50 entities registered). Additionally, training sessions enhanced skills for 149 participants (70 non-academic, 79 academic staff).

The "International Open Innovation Training: IDEA-up DEEP TECH" attracted a significant international audience (390 registrants) for deep tech open innovation training, and 364 (93.3%) participants successfully completed the program, showcasing a strong commitment to innovation.

To ignite student creativity, the project organized 10 "Deep Tech Innovation Challenges". These challenges inspired students, as evidenced by the 16 innovative solutions they submitted.

The "Pre-Incubation Mentoring Program GROW-up TECH" was established to nurture future deep tech leaders and support 39 aspiring deep tech entrepreneurs. Implemented by

ITT, EPF, and CENT, this program provided valuable guidance through nine workshops and dedicated mentoring.

A fruitful collaboration between ITT and CENT, entitled "Start-up Booster", empowered two promising deep tech startups. This program provided individualized incubation plans and dedicated services, giving them the tools they need to thrive.

The IDEATION and DEETECHTIVE projects were implemented in multiple phases, with IDEATION divided into three phases (Phase 1, 2A, 2B) and DEETECHTIVE into two (Phase 1 and 2). The division into phases resulted from the call requirements. This paper addresses the results of the three completed phases: IDEATION Phase 1, IDEATION Phase 2A, and DEETECHTIVE Phase 1. Additionally, it is worth noting that IDEATION was designed as a two-year project, while DEETECHTIVE was only a 15-month project with a significantly lower budget, which made DEETECHTIVE's implementation much more ambitious and challenging. In the completed phases of IDEATION, significant success was achieved in meeting the key performance indicators. The project consistently supported the target number of start-ups and scale-ups, with three supported in each phase. Thesummary of the KPIs achieved can be seen in Table 9. Student training exceeded targets, with 807 students trained in total in Phase 1 and 2A. Student mentorship also surpassed goals, with 72 students mentored in Phases 1 and 2A. Additionally, academic staff training achieved 127% of the target in Phase 1 and 203% in Phase 2A, while non-academic staff training exceeded targets, reaching 180% in Phase 2A. The project far surpassed targets for new partnerships, establishing 10 new partnerships in both finalized phases. DEETECHTIVE Phase 1, building on the IDEATION model, also showed promising results. It met the target for supporting start-ups and scale-ups, trained 364 students, and mentored 108% of the target number of students (39). Academic staff training achieved a completion rate of 177%, while non-academic staff training reached 148% of the target. The project established new partnerships at twice the targeted rate. Overall, the successful implementation of both IDEATION and DEETECHTIVE models highlights their effectiveness in fostering innovative environments within participating HEIs and the broader business community. In total, 1171 students and 655 HEI staff members have been trained so far, and 64 support structures and mechanisms have been established, including innovation challenges, successful infrastructure sharing, and crowdfunding campaigns. These initiatives increased entrepreneurial activity, enhanced training and mentorship, and strengthened international collaboration through numerous new partnerships. The IDEATION and DEETECHTIVE projects have laid a strong foundation for continued growth and impact in future phases.

Table 9. IDEATION and DEETECHTIVE—summary of the KPIs achieved.

KPIs	DEETECHTIVE Completion Rate (%)	IDEATION Completion Rate (%)	Total No. of KPIs Achieved
Startups/scale-ups supported	100	100	8
Students trained with a view to innovation and entrepreneurship	101	127	1171
Students mentored	108	138	111
Academic staff members trained with a view to innovation and entrepreneurship	177	169	334
Academic staff members mentored	133	156	49
Non-academic staff (e.g., professional staff, support staff) trained with a view to innovation and entrepreneurship	148	150	291
Non-academic staff mentored	106	156	44
Improved support structures and mechanism	157	102	64
New partnerships established	200	500	12
Startups created	n/a	25	1

4. Discussion

4.1. Main Findings

The IDEATION and DEETECHTIVE models have successfully fostered more innovative environments within local ecosystems, benefiting the participating HEIs and the broader business community. A literature review indicates a lack of existing infrastructure-sharing solutions aligned with the sharing economy's principles. IDEATION's Action 1, "Digital Access to Infrastructure", addressed this gap, which utilized the SYNERGY platform to facilitate infrastructure sharing. The implementation of both models confirms their effectiveness in promoting innovation within local ecosystems. It suggests that many actions could apply to various stakeholders, including SMEs and startups.

4.2. Strength and Limitations

The showcased projects exhibited notable strengths, particularly in strong international collaboration and multidisciplinary partnerships. Diverse perspectives from various cultural backgrounds facilitated rich cross-cultural exchanges that significantly enhanced the innovation process. The integration of unique ideas and approaches from these collaborations led to more innovative and comprehensive solutions. For instance, cross-cultural teams are more likely to generate creative outcomes due to the diversity of thought and problem-solving strategies they bring to the table. Similarly, the involvement of experts from different academic disciplines stimulated creativity by combining various methodologies and expertise, ensuring a holistic approach to addressing complex problems and making solutions more robust and well-rounded [58]. Thus, multidisciplinary teams are better equipped to tackle complex issues because they draw on a broader range of knowledge and techniques [59].

Moreover, the comprehensive problem-solving achieved through the involved consortia and their participants demonstrated that teams with diverse academic backgrounds produce more innovative solutions compared to homogenous teams. These strengths underscore the importance of fostering international and multidisciplinary collaborations in driving innovation and addressing complex global challenges effectively [60].

The IDEATION and DEETECHTIVE projects faced several limitations that impacted their effectiveness and posed significant challenges to achieving their goals. One of the primary issues was the traditional departmental structures within institutions. These structures often created organizational silos, which hindered collaboration by restricting the flow of ideas and resources across different fields. As a result, interdisciplinary cooperation was significantly impeded, making it difficult to leverage the full potential of diverse expertise and viewpoints.

Additionally, the necessity of coordinating efforts across various time zones and aligning the schedules of international partners required meticulous planning and robust management strategies. This posed substantial management challenges, as it was essential to ensure that all parties remained on track and that project timelines were adhered to. The complexity of managing such widespread collaboration often led to delays and inefficiencies, highlighting the need for more agile and adaptive management practices.

Another significant limitation was the disparity in innovation culture among the collaborating entities. Different organizations and teams had varying approaches and attitudes toward innovation, which necessitated considerable efforts to align these differences. Harmonizing expectations and working styles was crucial to fostering a cohesive working environment, but it also required time and resources that could otherwise have been spent directly on innovation activities.

Logistical and communicative challenges further compounded these issues. Misaligned academic calendars across different countries made it difficult to synchronize project milestones and deadlines. This lack of synchronization often resulted in periods of inactivity or misalignment in project phases, which could delay progress and reduce overall efficiency. Furthermore, language barriers presented additional obstacles to effective communication. The need for translation and interpretation services to ensure clear and ac-

curate exchanges of ideas and information added another layer of complexity to the projects. These language barriers sometimes led to misunderstandings and miscommunications, which could further hinder collaboration and slow down project advancements.

In summary, while the projects had the potential to benefit significantly from international and interdisciplinary collaboration, they were also challenged by traditional departmental structures, the complexities of managing across time zones, disparities in innovation culture, and various logistical and communicative barriers. Addressing these limitations required strategic planning, adaptive management, and concerted efforts to align diverse teams and resources.

In summary, while the projects capitalized on the strengths of international collaboration and multidisciplinary partnerships to drive innovation and comprehensive problem-solving, they also had to address significant limitations related to structural, managerial, cultural, and logistical challenges [58,61,62].

4.3. Future Perspectives

Given the strengths and weaknesses observed, several strategies could enhance future projects:

- Enhanced Cross-Institutional Collaboration: Future initiatives should focus on developing standardized collaboration frameworks that facilitate knowledge sharing and resource pooling across institutions and disciplines;
- Streamlined Infrastructure Sharing Solutions: Building on the successful implementation of Digital Access to Infrastructure, future projects could develop more sophisticated platforms that leverage technologies like blockchain for efficient and secure resource sharing;
- Cultural Integration and Inclusivity Initiatives: Addressing cultural and language barriers is crucial. Future projects include language exchange programs and cultural sensitivity training to foster effective international collaboration;
- Flexible Time Management Strategies: Implementing flexible and dynamic project management frameworks could accommodate varying institutional schedules, enhancing project coherence and effectiveness;
- Improving the inclusion of all stakeholders to increase innovation interest by adding end-users and developers, as illustrated for innovation for persons with disabilities [63];
- Continued Emphasis on Multidisciplinary Collaboration: Future projects should continue to encourage collaboration across diverse fields, using approaches like interdisciplinary research programs and collaborative innovation hubs to address complex challenges holistically, such as the One Digital Health framework [64]. By breaking down silos and promoting cross-pollination of ideas, future initiatives can unlock new opportunities for innovation and create positive impact across various sectors and domains.

To sum up, the IDEATION and DEETECHTIVE projects have showcased the potential for innovative models to enhance the capabilities of higher education institutions significantly and set a benchmark for future collaborative efforts across various ecosystems. By addressing the key challenges and building on the strengths identified through these projects, future initiatives can be better designed to foster an inclusive, collaborative, and technologically advanced environment. Embracing these strategies will enhance the impact of innovation projects and ensure they are resilient and adaptable to the changing demands of global education and business landscapes. The journey of continuous improvement and adaptation in higher education innovation practices promises to unlock profound transformations, paving the way for a future in which academia and industry collaboratively thrive on creativity and technological advancement. The IDEATION and DEETECHTIVE models have shown their potential in transforming higher education institutions into hubs of entrepreneurial and innovative activity. Future research and practical applications could be significantly advanced by aligning with the Deep Tech Talent Initiative, a flagship under the New European Innovation Agenda, driven by the EIT, aiming to train 1 million peo-

ple in deep tech areas. Future research directions will focus on how the IDEATION and DEETECHTIVE models can be adapted to integrate training modules from the Deep Tech Talent Initiative, including developing specialized curriculum components for advanced topics like artificial intelligence and blockchain technology. Studies could evaluate the impact of these integrated models on local and regional innovation ecosystems, using metrics such as the number of startups created, industry-academia collaboration levels, and local economic impact. Research could also explore the scalability of these models across different European regions and their transferability to other global contexts, assessing their adaptability to various educational and cultural environments. Practical applications could involve establishing deep tech hubs that serve as incubators for high-tech startups, building on the foundation laid by IDEATION and DEETECHTIVE. Enhanced collaboration platforms could be developed to facilitate better communication and resource sharing among stakeholders in the deep tech ecosystem, leveraging advanced technologies for improved security and efficiency. Institutions could also develop and offer customized training programs aligned with the goals of the Deep Tech Talent Initiative, ensuring that students and professionals are equipped with the skills needed to thrive in a rapidly evolving technological landscape. By integrating the IDEATION and DEETECHTIVE models with the objectives of the Deep Tech Talent Initiative, future research and practice can significantly contribute to positioning Europe as a leader in deep tech innovation. This alignment supports training a new generation of skilled professionals and fosters a robust, collaborative, and inclusive innovation ecosystem.

5. Conclusions

We developed and validated the IDEATION and DEETECHTIVE models within real-world contexts to transform higher education institutions (HEIs) into entrepreneurial and innovative activity hubs, significantly enhancing their impact on surrounding ecosystems. These models incorporate entrepreneurship, deep tech, open innovation, the sharing economy, and social product development. They respond to the dynamic shifts in work styles, innovation paradigms, and educational landscapes driven by Industry 4.0/5.0, the pervasive influence of social media, and the ongoing impacts of the COVID-19 pandemic. This study aimed to create an innovative model that promotes entrepreneurship among engineering and science students, emphasizing global collaboration.

During the IDEATION and DEETECHTIVE projects, we reached our goals and answered our research questions by validating our hypotheses. Thus, the strategies we have developed and implemented to increase the number of engineering and science student entrepreneurs inside HEIs mainly involve the development of continuous mentorship programs that provide large access to entrepreneurship resources. By doing so, students can receive guidance and support in turning their ideas into entrepreneurial ventures. In addition, incorporating online education and open innovation topics into the curriculum significantly improves students' entrepreneurial skills and outcomes. This approach allows students to engage with a wider range of resources and perspectives, fostering a deeper understanding of entrepreneurship. Our findings support the hypothesis that online education and open innovation are crucial components of an effective innovation model for enhancing entrepreneurship within HEIs. The integration of these elements helps in creating a more flexible and accessible learning environment, which is essential for nurturing innovative ideas and entrepreneurial skills.

Furthermore, international collaborations have been shown to foster a globally-minded entrepreneurial mindset among students and HEIs staff members. HEIs that actively engage in international collaborations report higher levels of entrepreneurial activity and innovation among their students. These collaborations provide students with unique opportunities to learn from diverse perspectives, engage in cross-cultural problem-solving, and develop a global network. Our research supports the hypothesis that international collaborations are crucial in promoting entrepreneurship and innovation within HEIs. By facilitating regular cross-institutional workshops and networking events, we have strength-

ened international collaborations and fostered a more globally-minded entrepreneurial mindset among students. Initiatives that can be undertaken to develop a new generation of innovative and entrepreneurial engineers and scientists within HEIs include integrating practical, real-world projects into the curriculum. This approach enables students to apply their knowledge and skills to real-life scenarios, fostering innovation and an entrepreneurial mindset. In conclusion, the IDEATION and DEETECHTIVE projects have demonstrated the effectiveness of these strategies and initiatives in fostering entrepreneurship within HEIs. By implementing these approaches, HEIs can significantly enhance their students' entrepreneurial skills, foster innovation, and contribute to the development of a new generation of innovative and entrepreneurial engineers and scientists.

The IDEATION model underwent thorough testing, evaluation, and refinement, evolving into the more comprehensive DEETECHTIVE model. This progression has significantly enriched academic discourse by enhancing theoretical foundations for crafting student-centric innovation models that foster entrepreneurship within these fields. Additionally, this study explores the models' transferability, illustrating how other HEIs, companies, and business support organizations might adopt these innovative approaches. Despite various challenges, the IDEATION and DEETECHTIVE models have effectively accelerated innovation at participating HEIs, achieving ambitious objectives swiftly. This research introduces a new, validated framework that empowers HEIs to cultivate a culture of entrepreneurship and innovation, thereby nurturing ecosystems rich in creativity and advancement.

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Abbreviations

CENT	Centria University of Applied Sciences
EIT	European Institute of Innovation and Technology
EPF	EPF School of Engineering
HEI	Higher Education Institution
HIT	Holon Institute of Technology, Israel
FIR	Institute for Industrial Management, Germany
KIC	Knowledge and Innovation Community
KPI	Key performance indicator
OI	Open Innovation
OI2	Open Innovation 2.0
QHIM	Quintuple Helix Innovation Model
SPD	Social Product Development
THS	Talent Hunter Space
ULL	University of La Laguna, Spain
UNIGE	University of Genova
WUST	Wroclaw University of Science and Technology

Appendix A. Key Performance Indicators (KPIs) Segmented by Actions

Table A1. IDEATION—planned KPIs segmented by actions.

KPIs per Action in IDEATION: Phase 1	A.1	A.2	A.3	A.4	A.5	A.6	Sum of KPIs
Improved support structures and mechanism	5		5	9			19
Academic staff members trained with a view to innovation and entrepreneurship		25		15		20	60
Academic staff members mentored						8	8
Non-academic staff (e.g., professional staff, support staff) trained with a view to innovation and entrepreneurship		25		15		20	60
Non-academic staff mentored						8	8
Startups/scale-ups supported					3		3
Students trained with a view to innovation and entrepreneurship				30	30	200	260
Students mentored					6	16	22
New partnerships established		1					1
KPIs per Action in IDEATION: Phase 2A	A.1	A.2	A.3	A.4	A.5	A.6	Sum of KPIs
Improved support structures and mechanism	5		10	18			33
Academic staff members trained with a view to innovation and entrepreneurship	15	25		15		20	75
Academic staff members mentored						10	10
Non-academic staff (e.g., professional staff, support staff) trained with a view to innovation and entrepreneurship	15	25		15		20	75
Non-academic staff mentored						10	10
Startups/scale-ups supported					3		3

Table A1. *Cont.*

KPIs per Action in IDEATION: Phase 2A	A.1	A.2	A.3	A.4	A.5	A.6	Sum of KPIs
Students trained with a view to innovation and entrepreneurship	35			30	30	280	375
Students mentored					6	24	30
New partnerships established		1					1
KPIs per Action in IDEATION: Phase 2B	A.1	A.2	A.3	A.4	A.5	A.6	Sum of KPIs
Improved support structures and mechanism	5		5				10
Academic staff members trained with a view to innovation and entrepreneurship	10	25					35
Academic staff members mentored							0
Non-academic staff (e.g., professional staff, support staff) trained with a view to innovation and entrepreneurship	10	25					35
Non-academic staff mentored							0
Startups/scale-ups supported					3		3
Students trained with a view to innovation and entrepreneurship	15				30	120	165
Students mentored					6	8	14
New partnerships established		1					1
Startups created							0

Table A2. DEETECHTIVE—planned KPIs segmented by actions.

Planned KPIs per Action in DEETECHTIVE: Phase 1	**A.1**	**A.2**	**A.3**	**A.4**	**A.5**	**A.6**	**Sum of KPIs**
Improved support structures and mechanism	1			6			7
Academic staff members trained with a view to innovation and entrepreneurship	30	30					60
Academic staff members mentored	6	12					18
Non-academic staff (e.g., professional staff, support staff) trained with a view to innovation and entrepreneurship	30	30					60
Non-academic staff mentored	6	12					18
Start-ups/scale-ups supported						2	2
Students trained with a view to innovation and entrepreneurship			360				360
Students mentored					36		36
New partnerships established		1					1
Planned KPIs per Action in DEETECHTIVE: Phase 2	A.1	A.2	A.3	A.4	A.5	A.6	Sum of KPIs
Improved support structures and mechanism	1			9			10
Academic staff members trained with a view to innovation and entrepreneurship	36	36					72
Academic staff members mentored	9	12					21
Non-academic staff (e.g., professional staff, support staff) trained with a view to innovation and entrepreneurship	36	36					72

Table A2. *Cont.*

Planned KPIs per Action in DEETECHTIVE: Phase 2	A.1	A.2	A.3	A.4	A.5	A.6	Sum of KPIs
Non-academic staff mentored	9	12					21
Startups/scale-ups supported						3	3
Students trained with a view to innovation and entrepreneurship			365				365
Students mentored					39		39
New partnerships established		2					2
Startups created						1	1

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