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Science to Business Transfer Training Program—The Involvement of Universities †

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Abstract: The successful commercialization of the results of research works, R&D projects and inventions, as well as the cooperation between research centres, industry and business, is becoming commonplace and crucial in regional development. Regardless of the scientific level of the research results, the utility of these results and the adopted business model for their implementation are the key factors determining the market success. Currently, the recognized skills and competencies of academic staff at Eastern and Southeastern European universities in the field of the implementation and commercialization of scientific research results do not seem sufficient. This article presents the methodology, development and results of the tailor-made Science to Business transfer program implemented within the TrainESEEv.2 'Training the trainers in East and Southeast Europe' project, with a focus on the Raw Materials sector needs.

Keywords: raw materials education; science to business; lifelong learning; student empowerment; ESEE region; commercialization of research results

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1. Introduction

Fundamental research discoveries are essential to increasing innovation and productivity in an economy. However, despite the sustained increase in scientific knowledge, recent productivity growth in most advanced economies has stagnated [1,2]. At the same time, firms are funding less basic research internally and are instead relying more heavily on scientific knowledge generated at universities [3,4].

The EU Report titled Science, Research and Innovation performance of the EU 2022 [5] analyses the EU's innovation performance in a global context and provides insights into how research and innovation policies can help build an inclusive, sustainable, competitive and resilient Europe by leveraging the essential role of research and innovation as a source of prosperity [6] and as a catalyst for change (see, e.g., Horizon Europe strategic plan 2025–2027 analysis [7]). Knowledge sharing between different types of organizations, in this case the university–industry relation, faces barriers related to the differentiation of structure and purpose for each organization [8].

To create value from research at universities, they must understand the process of transferring the knowledge. While science is a quest for general knowledge, business is an effort to provide a particular product or service. Recognizing these fundamental differences between the worlds of business and science is critical to building a strong bridge between them.

EU countries should give further attention to research and innovation in material sciences, geosciences and metallurgy to remain internationally competitive. According to the Report 'Critical Raw Materials for Strategic Technologies and Sectors in the EU', diversification strategies, skills and innovation are a core ingredient to realize environmentally, economically and socially efficient material and successful knowledge transfer [9].

The TrainESEEv.2 *'Training the trainers in East and Southeast Europe'* project was implemented as a building-capacity project for the raw materials sector from 1 January 2020 to 31 December 2021, with 12 consortium partners from 10 countries, within Learning and Education activities of EIT RawMaterials (EIT RM) https://trainesee2.eu/ (accessed on 10 October 2023). The project concept and development were based mainly on crucial EIT RM challenges in the Eastern and Southeastern European (ESEE) Region: a shortage of cross-interdisciplinary skilled staff in the future RM sector; the use of unique RM potential in the ESEE Region enhances the attractiveness of ESEE universities and creates the growth environment for future professionals in the sector. The other goal of this project was related to capacity building for either universities or businesses in order to successfully adapt to and implement innovation, enhance and enable effective university–business cooperation and help local universities to become 'Entrepreneur University' [9].

2. Methods

The TrainESEEv.2 project was coordinated by the University of Zagreb—Faculty of Mining, Geology and Petroleum Engineering. The consortium consisted of 8 "Trainers" institutions: Aalto University, Fundación Tecnalia Research & Innovation, KGHM Cuprum Ltd. Research & Development Centre, AGH University of Science and Technology, University of Miskolc, Vienna University of Technology, Montanuniversität Leoben, National Technical University of Athens and 6 "Trainees" universities: AGH University of Science and Technology, National Technical University of Athens, Technical University of Košice, University of Miskolc, Dnipro University of Technology, University of Mining and Geology "St. Ivan Rilski". The universities prepared SWOT analyses and activity drafting, and they provided external participants for the 2021 workshops, expressing willingness to implement TrainESEE accelerating programmes (Figure 1).

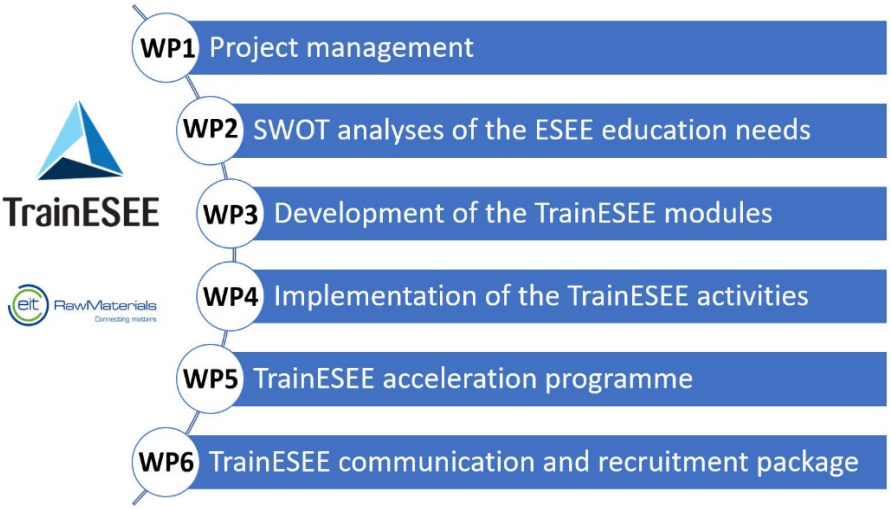

Figure 1. The basic structure of the TrainESEEv.2 project.

The goals of the TrainESEEv.2 project were subsequently adjusted to the needs and formulated as follows: to enhance the didactical skills of the teaching staff, to develop tailor-made educational techniques based on didactical methods, to strengthen online teaching techniques by introducing advanced digital resources in didactics, to enhance evaluation and assessment skills as well as efficient supervision, to help higher education institutions towards a sustainable and competitive position through capacity building modules and to create and develop tailor-made acceleration programs.

The generic skills chosen as topics of the TrainESEE training activities were as follows: teaching methodology improvement, project development and management skills, innovation and entrepreneurial related skills and science-to-business competencies [10,11].

The specific needs were identified via a Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis of the ESEE education needs, which was the key preparatory project work (WP2).

WP3 included the analysis of the market and technology needs, Teaching methodology module development, Project development and management module development, Innovation and entrepreneurial module development and Science to Business module development (Figure 2). The process also involved several industry partners as advisors, with a role to provide feedback on the teaching materials.

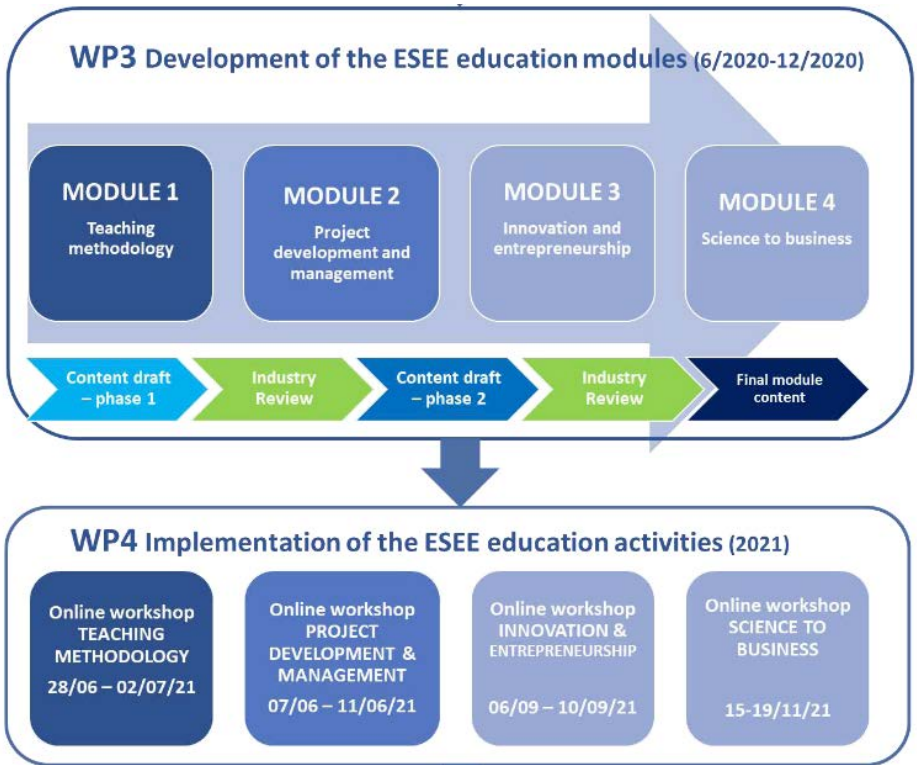

Figure 2. TrainESSE modules' content and implementation of the educational activities.

WP4 involved implementing the TrainESEE educational activities through four online (due to COVID restrictions) workshops, conducted from July to November 2021 (Figure 2).

Based on all the module implementation results, TrainESEE is establishing self-sustainable acceleration programmes at each of the 6 participating universities, which will run till at least 2024. The process of developing the content of the four TrainESEE modules was implemented through activity drafting and final content development. The key elements that need to be defined for a specific module have also been set, like, e.g., on the module level, monitoring the teaching quality and evaluation procedures.

A total of 21 participants from 6 universities attended the science-to-business workshop, including professors, assistants, junior researchers and PhD students. The skills acquired during the workshop were assessed through the use of an evaluation form consisting of 25 multiple-choice questions with one correct answer. The form was compiled by all the trainers.

The workshop provided participants with opportunity and contributed to better understanding of technological positioning and valuation, improved knowledge and skills for understanding different commercialisation options and methods, mapping of technology, and improved knowledge of the concepts of IP legal protection. Participants gained skills on how to use the Innovation Due Diligence method and how to create a business model using the Canvas Model and the Magic Quadrant for the technology idea.

The aim of the Science to Business module (responsible partner: KGHM CUPRUM Ltd. Research & Development Centre) was to enable the attendees to identify key factors

for successful innovation, recognize business opportunities by assessing market needs, describe the technology in problem–solution terms and find viable applications for the technology. The participants were also expected to learn about market positioning, reaching out to potential business clients, gathering feedback, choosing best-suited IP protection options and funding schemes.

The main module assumptions were as follows:

- the Science to Business module focuses on idea holders—researchers, including docs, post-docs and younger academic staff possessing a tech idea—in order to provide them with the practical knowledge of business creation and the process of bringing technology to market;
- tech ideas or research results possessed by participants should be characterised by commercialisation potential or the possibility of near-industry application (technology readiness level TRL 3-5: idea, basic research, technology formulation or needs valuation);
- concentration on actions and issues within the 3 tech readiness levels: idea readiness, business readiness and market exploitation readiness;
- types of teaching activities: lectures, case studies, best-case examples, exercises, teamwork.

3. Results and Discussion

The work performed within WP2 primarily resulted in delivering education-based SWOT analyses of the six universities (RM-focused) from six RIS ESEE countries. These analyses served as an input for developing tailor-made training activities in WP3 and helped in recognising most important educational needs at the universities. After the SWOT analyses were finalised, the academic needs were mapped and identified accordingly in the activity drafting process to develop the content of the Science to Business module.

The following most important needs of the Science to Business module development were identified and highlighted:

- Knowledge of academics about technology transfer mechanisms and intellectual property protection rules;
- Knowledge gaps of ways and steps of technology transfer processes;
- Unsatisfactory use of the potential of projects financed by the EU programmes;
- Insufficient awareness of funding options for research and ideas;
- Lack of communication in forming university—business cooperation;
- need for support and promotion of innovation;
- Knowledge gaps of basics of product development, including obtaining licenses;
- Lack of training on research dissemination—marketing and project results' promotion;
- Need for filling the gap between academic research and business applications;
- Leading academic research to be able to develop potential market products;
- Lack of understanding regarding contemporary management tools and idea assessment, including the implementation of the Lean Canvas approach;
- Prioritising business ideas and creating proper business strategies.

The Science to Business module was implemented as a one-week online course for 21 participants from 6 ESEE universities from 15 to 19 November of 2021.

The process of the development and implementation of the module developed a basic ability for the business model creation and practice. The module gave idea holders (innovators, researchers, other staff related to the creation and exploitation of scientific innovations) an understanding of the key concepts relevant for technology transfer and commercialisation and the ability to implement related tools in their day-to-day work with innovations.

Based on the training course and results of the competency assessment test, the following key skills and competencies, which were the most expected, were gained:

- Ability to make a quick assessment and develop a plan for a research-based business case;
- Comprehension on ways and steps of technology transfer processes;
- Ability to create a basic business strategy;

- Ability to assess innovations using TRL, IRL and CRL;
- Capacity to prioritize business ideas;
- Ability to create a proper business model for a technology;
- Understanding how firms create, communicate and deliver value to customers;
- Ability to prepare for discussions with investors and provide an elevator pitch;
- Understanding the mechanisms of research marketing and promotion;
- Knowledge of the procedure for applying for and granting of patents;
- Ability to value and prioritise innovation and business ideas, including primary market validation;
- Capacity to recognise the ways and steps of a technology transfer model and stages;
- Understanding the differences between start-up and spin-off/spin-out as well as their operational models;
- Ability to create a business model for a technology using the Canvas Model;
- Knowledge to assess and compare licensing, sales and start-up as commercialisation routes for research-based innovations;
- Ability to summarise key aspects of an invention in a way that is used, e.g., by technology transfer offices (TTOs).

The structure of the Science to Business module consisted of four sections plus a follow-up module (Figures 3–6). The sections are summarised in the figures for the reader to comprehend the overall structure of the module.

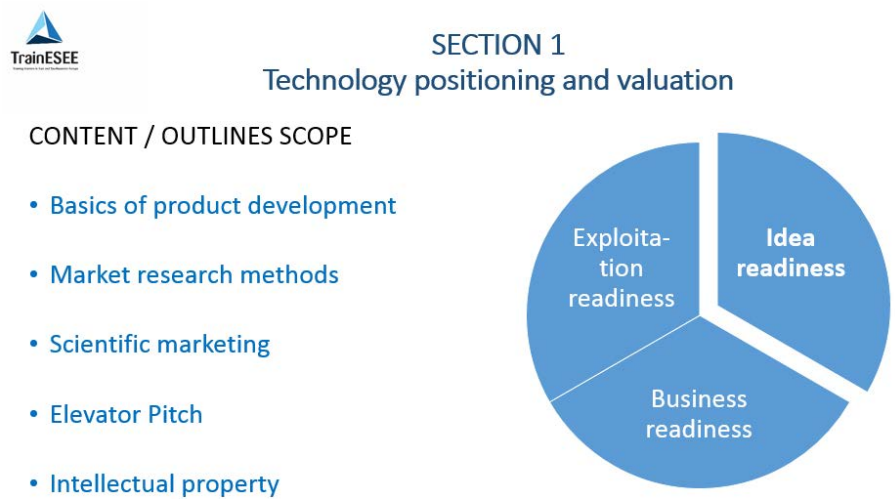

Figure 3. Section 1 (Technology positioning and valuation) scope.

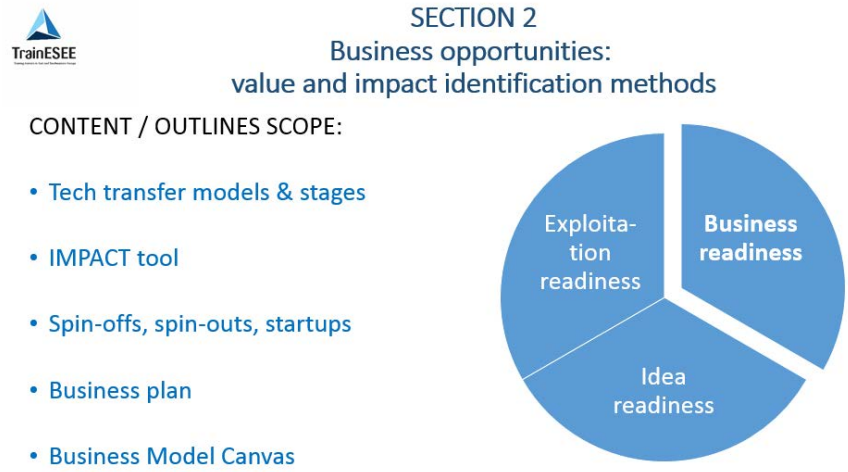

Figure 4. Section 2 (Business opportunities: value and impact identification methods) scope.

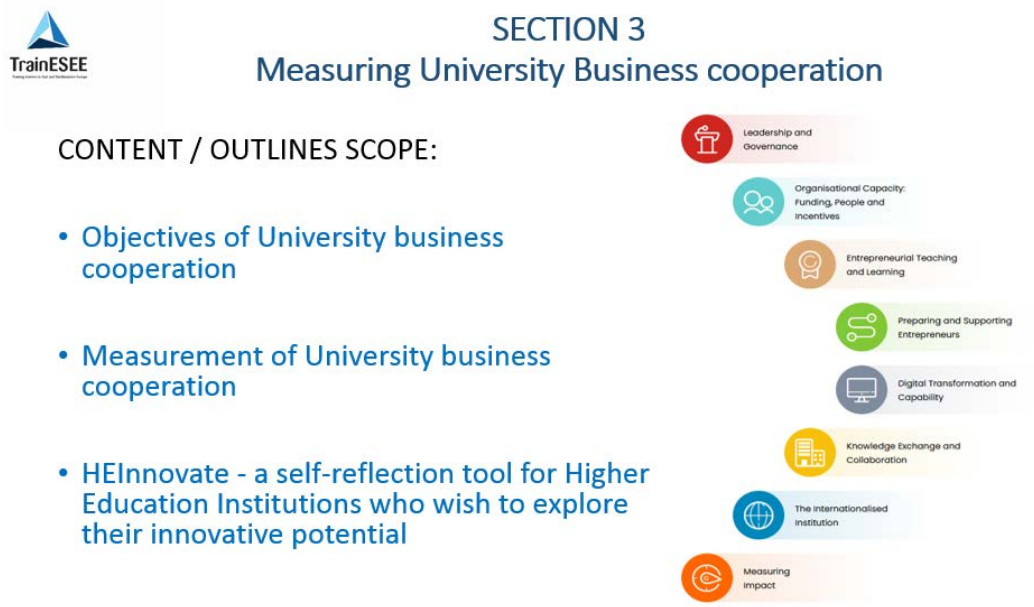

Figure 5. Section 3 (Measuring university–business cooperation) scope.

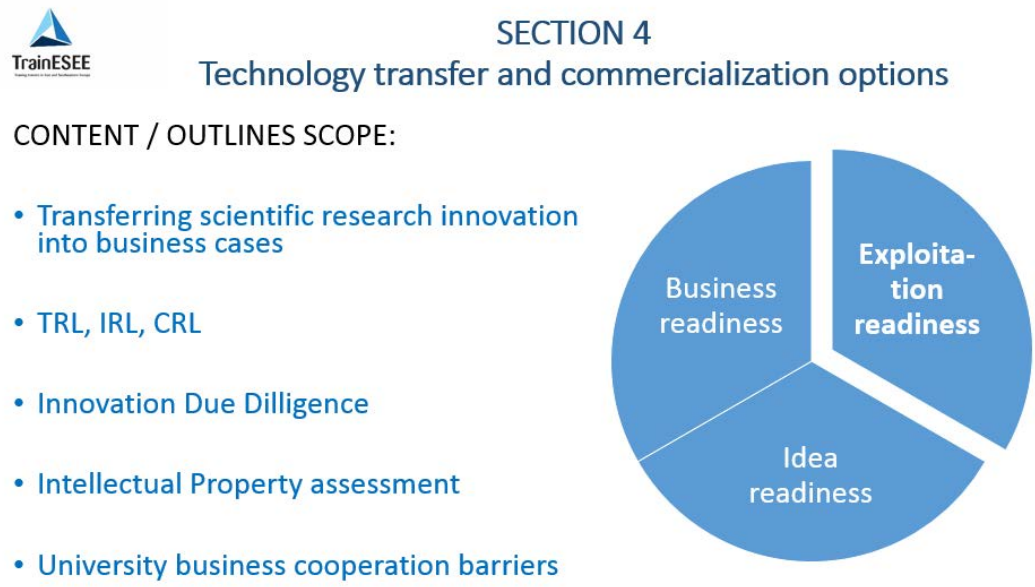

Figure 6. Section 4 (Technology transfer and commercialization options) scope.

4. Conclusions

Nowadays, many research organizations and universities have dedicated staff for the administration and management of intellectual property (IP) and commercialization processes at technology transfer offices (TTOs) and university research administration. However, the successful commercialisation of technological and academic innovations is greatly facilitated by the active participation and support of the developers of the innovations, and the described Science to Business module will provide them with the required information and tools. The idea holders can only advance the exploitation of their innovations and IP in cases where they can identify the opportunities and have the capacity and skills to act to advance their further development and commercialisation.

The Science to Business program, developed and implemented within the TrainE-SEEv.2 project, dedicated to academic staff in the raw materials sector at Eastern and Southeastern European universities provides a wider opportunity to practically recognise and understand different perspectives on technology transfer and commercialisation of

scientific innovations, leading to the ability to defend and develop own capacities for transferring the R&D project results to market.

The successful commercialisation of the results of scientific works, R&D and inventions as well as cooperation between research centres, industry and business is becoming common place and crucial for regional development. In the modern world of science, it is not an invention but innovation (its implementation and profit from it) that determines the market success.

The main aspects related to technology transfer discovered by this research study were the need for professionalisation and training, as well as the need to protect the intellectual property generated at universities. The university needs to be entrepreneurial in order to foster the innovation culture, creating internal policies in the innovation area and mapping transfer processes.

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