Call: HORIZON-WIDERA-2021-ACCESS-03/Twinning

Project SustDesignTex (GA No. 101079009), title: „Sustainable Industrial Design of Textile Structures for Composites" funded by the European Union

Deliverable Report

SUSTainable industrial DESIGN of TEXtile structures for composites (SustDesignTex)

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Deliverable Title	**D5.3: Educational course for PhD students**
Deliverable Lead:	*Lodz University of Technology*
Related Work Package:	*WP5: Design and realization of dedicated composite reinforcements taking into account the aspects of sustainable development.*
Author(s):	*Tsegaye Lemmi & Marcin Barburski*
Dissemination Level:	*Public*
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Abstract:	*This deliverable report summarizes the educational courses given for PhD students at Lodz University of Technology as part of SustDesignTex project realization. The courses were given by various experts from project partner institutions.*

Contents

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1. Introduction

This deliverable presents a comprehensive overview of the educational courses delivered for the PhD Students of various disciplines at Lodz University of Technology during the realization of the SustDesignTex project. A series of targeted short-term educational courses were developed and delivered to support the training and development of early-stage researchers (ESRs), primarily PhD students. These courses were designed to address key competencies identified as critical for high-quality doctoral education in line with the curriculum of Interdisciplinary Doctoral School of Lodz University of Technology.

The short-term courses aimed to enhance both domain-specific expertise and transferable skills, such as research methodologies, project writing, innovation, responsible research and innovation (RRI), and interdisciplinary collaboration. In line with the project, the courses covered a range of topics in sustainable composite manufacturing for various applications and the patenting system. These activities aimed to build research capacity, foster interdisciplinary knowledge, and support career development in line with the project's overall objectives.

By offering flexible, intensive learning opportunities, the project responded to the diverse needs of PhD candidates across disciplines, backgrounds, and levels of research experience. The courses were delivered by professors from project partner universities and industry in the form of visiting professor in both physical and virtual formats

2. Objectives

The main objective of this deliverable was to:

- Expose PhD students to global academic and professional practices.
- Foster cross-disciplinary collaboration and mobility of PhD students
- Provide exposure to industry-relevant and transferable skills
- Encourage institutional collaboration between partner universities.
- Enhance the academic portfolio of the host institution through guest-led modules.
- Build a foundation for future joint teaching initiatives between project partner institutions.
- Promote best practices in responsible research and innovation (RRI)

3. Course Selection and Development

The courses delivered were selected in collaboration with Interdisciplinary Doctoral School (IDS) of Lodz University of Technology and international partners, SustDesignTex project goals, emerging academic trends in the area of the SustDesignTex project, and the expertise of the partner institutions. The courses were delivered in a way that ensured coherence with the IDS of Lodz University of Technology's curriculum, alignment with the academic level, and the objectives of the SustDesignTex project.

4. Course details

The list of courses delivered is presented in the following table, and on average, over 15 PhD students were able to participate in each course.

Course title	**Partner University**	**Lead Instructor**	**Dates**	**Mode of delivery**
Resource effective textile processes for functional textiles and smart textiles	University of Borås	Vincent A. Nierstrasz	14.09.2023	Online via MS. Teams
Composite Materials: Raw Materials, Properties, Manufacturing Processes, Design, Analysis and Applications	University of Zaragoza	David Ranz and Jesus Cuartero	09.10.2023 – 27.10.2023 Total of 30 hours	Online via MS. Teams
Project Management	Lodz University of Technology	TUL's project office	07.05.2024 Total of 5 hours	Face-to-Face
Guidance on Personal Development	Lodz University of Technology	TUL's Career office	08.05.2024 Total of 5 hours	Face-to-Face
Practical skills in the field of international patent protection	ITA of RWTH Aachen University	Susanne Ruffert, Kristin Jirka, and Rebecca Emmerich	09.05.2024 Total of 3 hours	Hybrid
Bio-composite – Concept Possibilities and Challenges.	University of Borås	Mikael Skrifvars	13.05.2024 – 14.05.2024 Total of 10 hours	Face-to-Face
Circular Economy Strategies for Polymer Materials				

The use and challenges of composite materials in aviation and aerospace industries	Wadamekum	Tomasz Balcerzak, and Pawel Lubecki	15.05.2024 Total of 3 hours	Face-to-Face

4.1 Resource effective textile processes for functional textiles and smart textiles

On the 14th of September 2023, Professor Vincent A. Nierstrasz from the University of Borås delivered a hot-topic course for early stage researchers including PhD students of Lodz University of Technology. Prof. Nierstrasz delivered an enlightening session specifically tailored to the realm of textiles where he shared insights Resource effective textile processes for functional textiles and smart textiles. Professor Nierstrasz also generously shared the wealth of experience gained at University of Borås, shedding light on the art of writing and administering successful research project proposals. As a testament to the University of Borås's commitment to cutting-edge research, he elaborated on the ongoing projects, providing valuable insights into effective practices crucial for their realization.

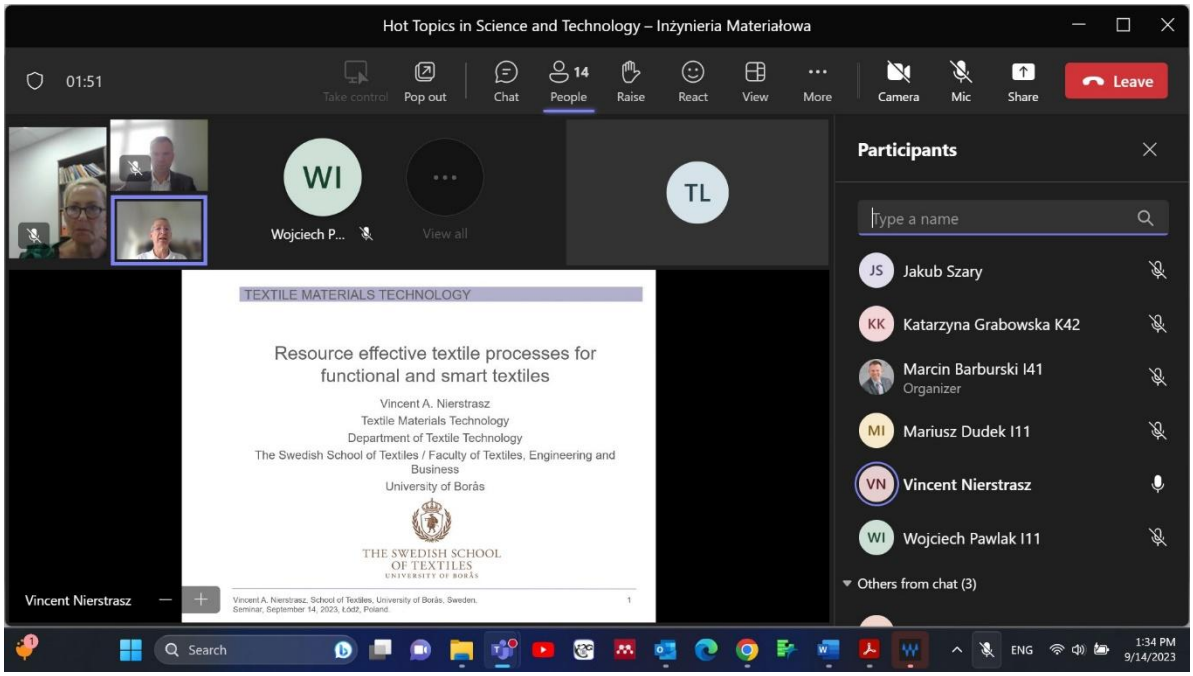

Figure 1. Pictures taken during the lecture session of Prof. Nierstrasz.

4.2 Composite Materials: Raw Materials, Properties, Manufacturing Processes, Design, Analysis and Applications

The course delivered by experts from the University of Zaragoza was in the form of lectures and virtual laboratory exercises. The lectures included introductions about composite materials, raw materials used for composite manufacturing, a range of reinforcement and matrix types were presented, various composite manufacturing techniques and composite property analysis methods were also thoroughly presented during series of lecture sessions. During the virtual laboratory sessions, the experts have shown how to produce composite materials.

Figure 2. Pictures taken during the lecture delivered by UNIZAR expert.

4.3 Project Management

The International Project Office at Lodz University of Technology (TUL) successfully delivered a Project Management course tailored for PhD students. The initiative aimed to equip participants with essential skills for planning, executing, and managing research and academic projects effectively.

Figure 3. Pictures taken during the PM lecture.

4.4 Guidance on Personal Development

The Career Office at Lodz University of Technology (TUL) conducted a Personal Development Guidance session specifically designed for PhD students. The session aimed to support early-stage researchers in identifying their strengths, planning their professional growth, and preparing for diverse career paths within and beyond academia. Participants gained practical tools for self-assessment, goal setting, and strategic career planning. The initiative was well-received and is part of a broader effort to enhance career readiness among doctoral candidates.

4.5 Practical skills in the field of international patent protection

Experts from RWTH Aachen University also delivered a lecture in hybrid form, detailing the patent system, including an introduction to Intellectual Property Rights (IPR), how protection works, how to obtain patent protection, requirements of patentability, and many more related cases were delivered meticulously by the experts. In this course, MSc., PhD., And other early stage researchers were participated.

Figure 4. Pictures taken during the lecture course delivered by ITA experts.

4.6 The use and challenges of composite materials in aviation and aerospace industries

As part of an industry-academia engagement initiative, experts from leading Wademekum company delivered a session to PhD students on the use and challenges of composite materials in the aviation and aerospace sectors. The session aimed to bridge the gap between research and industrial practice, highlighting both the strategic advantages and current limitations of composites in real-world applications.

Figure 5. Pictures taken during the lecture session.

4.7 Bio-composite – Concept Possibilities and Challenges, and Circular Economy Strategies for Polymer Materials

The course was delivered in the form of a lecture by Professor Mikael Skrifvars from the University of Boras during his visit to Lodz University of Technology. Professor Skrifvars has shared with Lodz University of Technology PhD and MSc. students his deep understanding and experience in the areas of bio-based composite materials, circular economy strategies, and real-world challenges for polymer materials.

Figure 6. Picture taken during Prof. Mikael Skrifvars lecture at TUL.

5. Outcomes and impact

The PhD students:

- Learned to identify transferable skills and how to leverage them in academic and non-academic environments.
- Gained insights into how academic research aligns with industrial needs and challenges
- Built initial connections for potential internships, joint projects, or industrial PhD pathways
- The students gained practical and cutting-edge knowledge in specialized topics.
- Increased awareness of career-related issues, such as IP protection.
- Students built international academic connections and engaged with diverse teaching styles.

6. Conclusion

The short-term courses provided PhD students with valuable insights into project management, personal development, and the practical application of advanced materials in industry. By combining academic learning with real-world perspectives from institutional and industry experts, the initiative supported students in developing essential skills for both research and professional careers. Continued engagement in such interdisciplinary and cross-sector activities will further enhance their readiness for future challenges and opportunities in academia and beyond.