Trainee program scheme for HE with VET hands-on principles

TECONAUT

USING DEEP TECH TO FACILITATE THE ECO TRANSITION IN THE NAUTICAL SECTOR

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Executive summary

This document outlines the framework for the TEcoNaut trainee program, designed to integrate Higher Education (HE) students into the eco-boatbuilding sector. The program bridges the gap between academic theory and practical application by embedding Vocational Education and Training (VET) principles and adhering to CEDEFOP apprenticeship guidelines. The core objective is to equip students with practical competencies in sustainable composites, natural fibers, and bio-based resins, culminating in a verifiable, hands-on production output.

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1 Introduction

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Introduction

The transition towards a more sustainable and circular maritime industry requires professionals who combine strong academic knowledge with practical experience in innovative manufacturing processes. While Higher Education programmes provide the theoretical foundations in engineering, materials science, and sustainability, there is an increasing need to strengthen students' practical competences through structured workplace learning.

Within this context, the TECoNaut project aims to bridge the gap between Higher Education and industry by promoting traineeships that integrate Vocational Education and Training (VET) principles into university education. Through collaboration between Higher Education Institutions, host companies, and the TECoNaut consortium, students gain hands-on experience in sustainable boatbuilding while developing the technical, environmental, and professional skills required by the sector.

This deliverable presents the TECoNaut Trainee Programme Scheme, defining the structure of the traineeship, its learning objectives, practical activities, expected learning outcomes, assessment framework, and the roles of the participating organisations. The proposed model is intended to provide a flexible framework that can be adapted by different universities and companies while ensuring a common quality standard across all TECoNaut partners.

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Program Objectives and Target Groups

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2. Program Objectives and Target Groups

The transition toward a circular marine economy requires a workforce proficient in both the engineering theory of sustainable materials and their practical shop-floor application.

Target Academic Profiles

- Naval Architecture and Marine Engineering
- Materials Science and Composites Engineering
- Chemical Engineering (Focus on Polymer Science)
- Sustainability and Environmental Engineering

Identified Competency Gaps

Based on the analysis of current study programs, HE students require targeted development in the physical handling of sustainable composites. Critical gaps include practical lamination techniques, the distinct behavioral properties of natural and alternative fibers during resin infusion, and the operational documentation required for environmental assessments on the shop floor.

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Roles of the Participating Organisations

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Roles of the Participating Organisations

The TECoNaut traineeship programme is based on close cooperation between Higher Education Institutions, host companies, and the TECoNaut consortium. Each partner contributes specific expertise and responsibilities to ensure that trainees acquire both academic knowledge and practical skills while maintaining a consistent quality framework across all participating organisations. The following section outlines the main roles and responsibilities of each stakeholder.

Higher Education Institutions (HEIs): Universities are responsible for recruiting and selecting suitable students, monitoring the progress of the traineeship from an academic perspective, maintaining communication with the host company, evaluating the student's performance based on the final report and the feedback received from the host company and provide constant academic assistance/supervision. Where applicable, they award the corresponding academic recognition (ECTS).

Host Companies: Host companies provide the facilities and working environment where the traineeship takes place. They implement the traineeship scheme according to their production processes, expertise, and workplace conditions, while ensuring that the agreed learning objectives are achieved. Company mentors guide the trainee throughout the placement, provide practical training and monitor their performance, subsequently giving feedback to the university.

TECoNaut Consortium[1]: The TECoNaut consortium coordinates the overall traineeship framework, provides common guidelines and assessment tools, collects the outputs and feedback generated during the traineeships, analyses the results, and uses the evidence gathered to support the project's deliverables, recommendations, and dissemination activities .

[1] The consortium of the TEcoNaut project includes the following partners: Sea Teach, Greenboats, Innovation Yachts, Astondoa, ANEN, PolBoat, EBI, Gölcük Vocational and Technical Anatolian High School, SOIB, NTUA, Politechnika Gdanska. Find more information about the partners and project on the website: https://teconaut.eu/en/partners/

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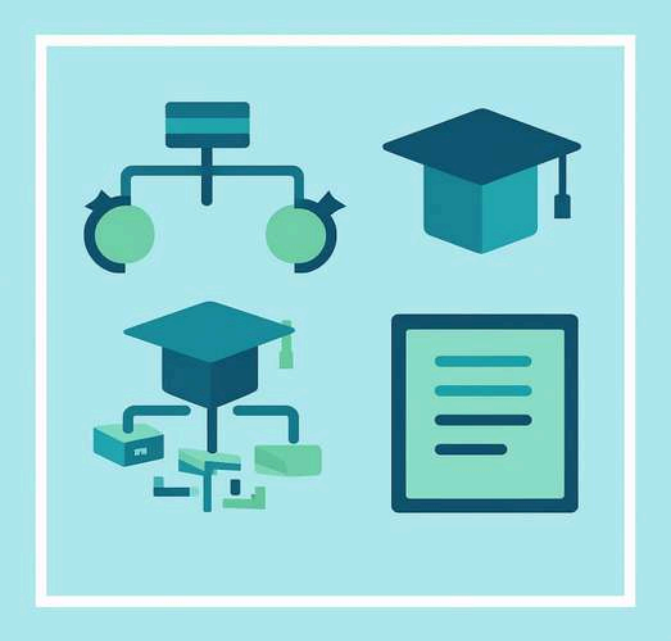
Program Structure and ECTS Integration



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Program Structure and ECTS Integration

The trainee program is structured to align with the **ECTS**, ensuring formal academic recognition for the participating universities.

Module Phase	Description of Activities	Workload
Preparation Phase	Health, safety, and environmental (HSE) induction, theoretical review of eco-materials, and project scoping. Provide safety and risk prevention measures.	**1 - 2 ECTS**
Practical Implementation	Supervised shop-floor fabrication, tooling preparation, and composite manufacturing (VET hands-on execution).	**6 - 10 ECTS**
Documentation and Analysis	Compilation of the Bill of Materials (BOM), process reporting, and final evaluation documentation.	**3 - 5 ECTS**
Total Workload	Complete Traineeship Program	**10 - 17 ECTS**

Program duration: The time frame is about 240h, 6 Weeks (40h/Week).

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Master Hands-on Activity List

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Master Hands-on Activity List

To fulfill the **CEDEFOP** apprenticeship principles, trainees must actively participate in standard boatbuilding processes, adapted for sustainable materials. The following activities incorporate specific hands-on expertise from consortium partners (including Innovation Yachts, Astondoa, and Greenboats) and form the mandatory core of the traineeship.

Activity Category	Specific Hands-On Tasks
Workplace Preparation	Setup of the lamination area; application of appropriate Personal Protective Equipment (PPE); distinguishing specific HSE protocols for bio-resins versus traditional synthetics.
Tooling and Molds	Cleaning, sealing, and applying eco-friendly release agents to molds; preparation of vacuum bagging consumables for complex geometries.
Material Handling (Natural & Alternative Fibers)	Cutting, kitting, and managing the specific drape characteristics of natural fibers (e.g., flax, hemp) and alternative recyclable fibers (e.g., basalt).
Resin & Matrix Processing	Storage, mixing, and handling of bio-based thermoset resin systems and alternative/recyclable matrices; monitoring exothermic reactions.
Core Material Processing	Trimming, shaping, and fitting sustainable core materials (e.g., recycled PET, balsa, sustainable woods, or cork) into complex mold structures.
Manufacturing Processes	Execution of wet lay-up processes; setup and monitoring of Vacuum Infusion; actively managing resin flow rates, which differ significantly when wetting out natural fibers vs. traditional glass.
Post-Production & Eco-Finishing	Demolding of cured components; edge trimming; executing eco-friendly surface finishing and painting processes (integrating high-quality finish standards).
Environmental Documentation	Weighing all raw materials prior to use; weighing generated waste; calculating exact fiber-to-resin ratios to establish baseline data for the Bill of Materials (BOM).

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Learning Outcomes Library

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Learning Outcomes Library

Completion of the master activity list corresponds directly to the following formalized learning outcomes, mapping both HE analytical goals and VET practical skills. These will be used for the final academic and host company evaluation.

Competence Area	Expected Learning Outcome
Health and Safety	The trainee safely navigates a composite manufacturing environment and complies with all hazard protocols specific to novel materials.
Material Competence	The trainee demonstrates a physical understanding of the specific drape, wet-out, and curing properties of alternative fibers (flax, basalt) and bio-resins compared to conventional materials.
Process Execution	The trainee successfully participates in a complete composite manufacturing cycle from mold preparation to demolding and finishing (e.g., sanding, eco-friendly painting).
Data Collection & BOM	The trainee accurately records material inputs, energy usage, and waste outputs required for life cycle calculations. The trainee is able to produce a full BOM of their manufactured part, generating a win/win data output for the host company.
Quality Control & Remediation	The trainee identifies common manufacturing defects (e.g., dry spots, voids, print-through) and understands practical, shop-floor remediation techniques.
Circularity & End-of-Life	The trainee applies principles of circular economy by separating waste streams and utilizing non-common or recyclable fiber matrices.

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Traineeship Output: Dinghy Construction

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Traineeship Output: Dinghy Construction

To synthesize the learning outcomes and provide a measurable deliverable, the traineeship will utilize an output project. The primary practical output is the construction of an dinghy. This specific project allows trainees to engage with the complete production cycle on a manageable scale while applying the diverse material expertise of the consortium.

Component 1: Hull Construction

Trainees will fabricate the primary hull using natural fibers (such as flax) combined with a bio-based resin system. This phase emphasizes vacuum infusion techniques and highlights the differences in resin absorption, structural draping, and flow dynamics compared to traditional glass fibers.

Component 2: Bulkheads and Internal Structures

The internal structural components and reinforcements will be manufactured utilizing pure mineral fibers and other unconventional, recyclable, or reclaimed fiber matrices. This phase specifically highlights circular economy principles and alternative material integration for structural rigidity.

Component 3: Surface Finishing

Trainees will execute the post-production phase, focusing on eco-friendly surface preparation, fairing, and painting. This component bridges the gap between raw composite manufacturing and the high-quality aesthetic finishes required in the broader marine and luxury yachting sectors.

Component 4: Bill of Materials (BOM) and Impact Tracking

While complete Life Cycle Assessments (LCA) demand specialized software often unavailable to Small and Medium-sized Enterprises, the absolute foundation of any LCA is an accurate Bill of Materials. Trainees are required to compile a rigorous BOM for the dinghy, executing the following:

- Documenting the exact weight of structural materials (fibers, core, resin).
- Tracking the volume of single-use consumables (vacuum bags, peel ply, infusion mesh).
- Recording energy inputs where possible (e.g., oven curing times).

This operational documentation provides the host company with highly valuable sustainability data, establishing a baseline for future green transition efforts, while fulfilling the trainee's analytical reporting requirements.

8 Assessment Framework

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Assessment Framework

To assess the learning outcomes, the evaluation process is divided into two verifiable segments:

- **Practical Competence Evaluation (Host Company)**: An assessment form completed by the shop-floor supervisor detailing the trainee's technical skills, reliability, safety compliance, and integration into the manufacturing team.

- **Academic and Analytical Evaluation (Higher Education Institution):** Grading of the final traineeship report, specifically evaluating the accuracy of the BOM documentation, the understanding of the applied materials, and the reflection on the dinghy fabrication process. Evaluation examples:

    - Final report / logbook / internship notebook
    - Report and presentation / defence
    - Company evaluation report

9 Conclusions

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Conclusions

The **TEcoNaut Trainee Program** provides a structured framework for integrating Higher Education students into the emerging eco-boatbuilding sector through a combination of academic learning and hands-on vocational training. By aligning Higher Education requirements with VET principles and CEDEFOP apprenticeship guidelines, the programme ensures that participants acquire both theoretical knowledge and practical competences directly relevant to the green transition of the maritime industry.

Through active involvement in sustainable composite manufacturing processes, the construction of a demonstrator dinghy, and the preparation of a detailed Bill of Materials (BOM), trainees gain valuable experience in the application of circular economy principles, sustainable materials, and environmental documentation practices.

The programme also creates **mutual benefits for participating companies and educational institutions. Students develop industry-relevant skills and improve their employability, while host companies gain access to motivated trainees and valuable sustainability-related production data**. Moreover, based on the project`s study program analysis, the majority of the programs, (**69%**) provides opportunities for cross-border or inter-city placements and exchanges. This element enforces the international cooperation through sustainability, while also equips students with various skills and knowledge used in other countries.

As a result, **the TEcoNaut traineeship model contributes to strengthening the skills ecosystem required for the future of sustainable boatbuilding and supports the broader objectives of innovation, circularity, and environmental responsibility within the European maritime sector**.