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Executive Summary

This deliverable, *D8.4 Training Curricula and Assessments V1*, presents the preliminary version of the training materials collected and developed to address the skills gaps identified among partners of the R3-MYDAS project use cases. These resources form the foundation of a structured training programme aimed at equipping the project workforce with the technical, operational, regulatory, and sustainability competencies required to implement and adopt innovative remanufacturing solutions. The courses presented herein address both the specific needs of the three demonstration cases, Demo 1: Oil & Gas Crankshafts, Demo 2: EV Batteries, and Demo 3: Wind Turbine Gearboxes Remanufacturing, as well as cross-cutting topics related to social sciences, humanities (SSH) , and circular economy and sustainability principles.

The preliminary R3-MYDAS training materials presented are organised by thematic areas across the three demonstration cases and cross-demo topics, reflecting the logical progression of activities carried out between M13 and M24. The development of the training programme follows three complementary approaches. First, newly designed courses—preliminary content of which is presented here—were created to address specific skills gaps, leveraging the expertise of project partners. Second, existing course outlines, for which new content has not yet been developed, were updated and refined to better align learning outcomes with project objectives and partner requirements. Third, relevant pre-existing training materials were reviewed by target partners and will be considered for integration to complement project-specific content, aiming to maximise the use of available expertise and ensure efficiency in course development.

The courses collectively address thematic areas identified as critical for the project, including advanced manufacturing and remanufacturing technologies, surface treatment and post-processing, material selection, automation and digital integration, battery systems and diagnostics, regulatory compliance, ethical AI deployment, and circular and sustainable production practices. Central to this report is the active involvement of project partners, who contributed by reviewing existing materials, sharing internal expertise, and providing input on proposed course syllabi.

The methodology reported follows a structured, iterative, and agile approach. Course design is being guided by pedagogical principles and standardised processes that capture essential course information, including learning objectives, module structures, assessment methods, and target audiences. Supporting tools for course development ensure alignment with Quality Assurance standards, accessibility requirements, and integration with the EITM Academy learning platform, which will be used for training delivery, enabling effective delivery and dissemination of training content.

Finally, this deliverable also presents the next steps in course development, outlining the planned refinement of training materials, piloting of selected courses, development of

asynchronous and extended course versions, and the staged delivery of the integrated training programme via the EITM Academy to foster knowledge transfer and support the uptake of R3-MYDAS solutions across the wider industrial and academic community.

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Definitions, Acronyms and Abbreviations

Acronym/ Abbreviation	Title
ADR	European Agreement concerning the International Carriage of Dangerous Goods by Road
AI	Artificial Intelligence
ALTAI	Assessment List for Trustworthy Artificial Intelligence
AM	Additive Manufacturing
AMPS	Additive Manufacturing Process Sheet
API	Application Programming Interface
CAD	Computer-Aided Design
CAM	Computer-Aided Manufacturing
CE	Circular Economy
CPS	Cyber-Physical Systems
CRISP-DM	Cross-Industry Standard Process for Data Mining
CSR	Corporate Social Responsibility
DED-LB	Directed Energy Deposition – Laser Beam
DPP	Digital Product Passport
EMI	Electromagnetic Interference
ERP	Enterprise Resource Planning
ESG	Environmental, Social & Governance
EV	Electric Vehicle
GDN	Graph Deviation Network
GDPR	General Data Protection Regulation
HMI	Human-Machine Interaction
HRI	Human-Robot Interaction
HSE	Health, Safety, and Environment
HTI	Human-Technology Interaction
IoT	Internet of Things
ISO	International Organization for Standardization
IT	Information Technology
KPI	Key Performance Indicator
LCA	Life Cycle Assessment
LCI	Life Cycle Inventory
LCIA	Life Cycle Impact Assessment
LCSA	Life Cycle Sustainability Assessment
LCT	Life Cycle Thinking

Acronym/ Abbreviation	Title
MES	Manufacturing Execution Systems
ML	Machine Learning
MOOC	Massive Open Online Course
MQTT	Message Queuing Telemetry Transport
OPC	Open Platform Communications
OPCUA	Open Platform Communications Unified Architecture
PEF	Product Environmental Footprint
PLC	Programmable Logic Controller
QA	Quality Assurance
QCP	Quality Control Procedures
RCA	Root Cause Analysis
S-LCA	Social Lifecycle Assessment
SME	Small-Medium Enterprise
SoH	State of Health
SOP	Standard Operating Procedures
SPC	Statistical Process Control
SSbD	Safe and Sustainable by Design
SSH	Social Sciences and Humanities
TAM	Technology Acceptance Model
UTAUT	Unified Theory of Acceptance and Use of Technology
WAAM	Wire Arc Additive Manufacturing

Term	Definition
Andragogy	The method and principles of teaching adult learners.
Bloom's Taxonomy	A framework to establish and categorise measurable educational goals.
Formative Assessment	A continuous, low-stakes evaluation used during the learning process to monitor students' understanding, provide feedback, and guide instructional adjustments. Its main goal is to support learning and improvement rather than to assign a final grade.
Learning Outcome	A statement describing what the learner should be able to know, do and understand at the end of the instruction period.
Microlearning	An educational strategy focusing on delivering content in small units.
Summative Assessment	An evaluation conducted at the end of a specific instructional period to measure learners' overall achievement of learning outcomes. Summative assessments are typically higher stakes than formative assessments and are used to determine whether learners have met

Term	Definition
	the intended objectives, often contributing to final grades or certification.
Technical Knowledge	Specialised knowledge and expertise to perform specific tasks or use specific tools, technologies or software. This may include proprietary processes or software.

1 Introduction

1.1 Project Information

Despite the multiple advantages of products remanufacturing, being widely recognised as an effective means for transitioning to a more circular economy, there is still need for improved research and experimental observations, to improve traceability and reliability of the final products from end-users' perspectives, as well as enhanced impacts monitoring. The primary R3-Mydas objective is to develop a multi-actor framework, integrating innovative digital technologies (ML for process and quality control, marketplace, graph models for defects detection, digital twins), advanced mechatronics (AM, laser-cladding, automated disassembly/reassembly) and newly developed approaches from SSH (extended TAM/UTAUT models, ethics and legal framework), for functionally, environmentally and economically sustainable circular value chains for remanufacturing of energy goods at the factory level (Oil&Gas crankshafts – demo 1, E-vehicles batteries – demo 2, Wind turbines gearboxes – demo 3).

R3-Mydas will deliver unprecedented impacts throughout the targeted value chains, as follows: up to 60% time reduction in programming for remanufacturing; up to 20% increased product quality; up to 30% rework reduction [Demo 1]; up to 30% improved detection of tiny deviations from normal behaviour; up to 50% faster anomaly localization; up to 30% increase the number of different modality data streams handled; up to 20% faster fusion process [Demo 2]; up to 99% reusage rate; -90% prevention rate; -75% lead time; up to 85% raw material savings potential [Demo 3]. R3-Mydas will deliver a marketplace associated with each remanufactured product or services/component for remanufacturing a Digital Passport-like set of information, ensuring full traceability. Finally, a dedicated training programme will be designed and delivered by EITM, targeting the P R3-Mydas project remanufacturing value chains (100+ training hours and 100+ diverse stakeholders engaged during the Project).

Table 1: The R3-Mydas consortium.

Number[1]	Name	Country	Short name
1(CO)	NETCOMPANY-INTRASOFT SA	Luxemburg	NCI
2	EUROPEAN FEDERATION FOR WELDING JOINING AND CUTTING	Belgium	EWF
3	EIT MANUFACTURING SOUTH SRL	Italy	EITM
4	FLENDER FINLAND OY	Finland	FLE-FI
4.1(AE)	FLENDER GMBH	Germany	FLE
5	AVL LIST GMBH	Austria	AVL

[1] CO: Coordinator. AE: Affiliated Entity. AP: Associated Partner.

Number[1]	Name	Country	Short name
6	TALLERES MECANICOS COMAS SLU	Spain	TMCOMAS
7	SPIN ROBOTICS IVS	Denmark	SPIN
8	ASOCIATION DE INVESTIGACION METALURGICA DEL NOROESTE	Spain	AIMEN
9	LAPPEENRANNAN-LAHDEN TEKNILLINEN YLIOPISTO LUT	Finland	LUT
10	INFORMATION TECHNOLOGY FOR MARKET LEADERSHIP	Greece	ITML
11	DEEP BLUE SRL	Italy	DBL
12	CHAROKOPEIO PANEPISTIMIO	Greece	HUA
13	IKERLAN S. COOP	Spain	Ikerlan
14	ZIKNES TECHNOLOGY SL	Spain	Ziknes
15 (AP)	CSEM CENTRE SUISSE D'ELECTRONIQUE ET DE MICROTECHNIQUE SA - RECHERCHE ET DEVELOPPEMENT	Switzerland	CSEM

1.2 Document Scope

This document provides a comprehensive overview of the preliminary training materials and assessment strategies for the R3-MYDAS project. It presents the initial outputs for each of the three demonstration cases—oil and gas components (Demo Case 1), electric vehicle batteries (Demo Case 2), and wind turbine gearbox components (Demo Case 3)—as well as materials addressing cross-demo knowledge.

The content presented in this section includes a range of training materials from newly designed courses, outlining the proposed structure, modules, learning outcomes, and assessment approaches. Together, these elements offer an early view of how the training will address the specific technical and cross-sectoral competences identified in the skills gap analysis. In addition, the report features a selection of sample resources for courses that are still under development. These materials, provided by academic and expert partners, such as EWF, LUT and EITM, draw on their own internal knowledge as well as on outputs from existing EU-funded projects that can be leveraged to maximise the impact of past results. The samples serve as concrete examples of the types of content that will support future learning activities and inform recommendations for course design.

These preliminary materials aim to ensure alignment with identified learning needs and market gaps, combining both existing resources and newly developed content to create a coherent, flexible, and targeted training framework. By presenting these early drafts and examples, the chapter lays the groundwork for further refinement, pilot testing, and validation, ensuring that the final training offer effectively supports workforce upskilling

across all relevant industrial contexts while integrating technical, ethical, and human-centric dimensions.

1.3 Document Structure

This document comprises the following chapters:

Chapter 1 provides an overview of the R3-MYDAS project, the objectives of this deliverable, and the context for the training materials presented.

Chapter 2 outlines the methodological approach, timeline, and tools applied for the development of the training courses' preliminary materials.

Chapter 3 presents the training materials collected to address the skills and competency needs specific to the remanufacturing of oil and gas crankshafts (Demo Case 1).

Chapter 4 details the training materials aimed at addressing the technical and operational skills for remanufacturing of wind turbine gearboxes (Demo Case 3).

Chapter 5 includes resources and courses that are relevant across both Demo Case 1 and Demo Case 3, covering shared competencies and common thematic areas, as well as next steps for course development.

Chapter 6 presents the training resources tailored to the skills required for electric vehicle battery remanufacturing (Demo Case 2).

Chapter 7 focuses on training materials addressing circular economy principles and sustainability practices applicable across all demo cases.

Chapter 8 presents the main conclusions, details the forthcoming actions for the development and delivery of the training courses, and demonstrates how the R3-MYDAS training strategy supports the project's strategic objectives while addressing the priority workforce needs identified by the Made in Europe partnership.

2 Methodology

This chapter outlines the methodology applied to the activities conducted within the R3-MYDAS project from M12, when the skills gap analysis was completed, until M24. It presents the steps implemented in the preparation of the preliminary training materials presented in this document, from the review of existing resources within the consortium to the development of draft materials for newly designed courses. Additionally, it focuses on the supporting instructional tools, such as course syllabus templates and learning design guiding principles, that are being utilised to lead authors in the training development.

The overall approach aimed to refine the course design process by aligning it with the technical skills and competencies identified in the previous phase. Additionally, it sought to integrate cross-sectoral elements that address both human-centric considerations and circular economy principles, ensuring that the training not only develops technical expertise but also raises awareness of sustainable practices and responsible decision-making within remanufacturing workflows.

2.1 Approach and Timeline

A comprehensive understanding of the skills and competencies required across the R3-MYDAS demo cases is essential for designing effective training pathways. This foundation was established through the skills gap analysis carried out during the project's first year, the findings of which are documented in Deliverable 8.2**,** *Skill Gap Inventory and Plan to Develop the Training Curricula*. The analysis involved the R3-MYDAS workforce engaged in the three industrial remanufacturing contexts—oil & gas components (demo case 1), electric vehicle batteries (demo case 2), and wind turbine gearbox components (demo case 3).

The results revealed a pronounced need for advanced technical skills, particularly in manufacturing processes and material knowledge for demo cases 1 and 3, along with a stronger understanding of the full battery development chain, diagnostic methods, data security for demo case 2, and circular economy principles and techniques across most project partners. Continuous assessment also highlighted the importance of acquiring regulatory awareness and an understanding of the ethical and human-centric dimensions of AI implementation. These insights underscore the need for a comprehensive training framework that effectively integrates Social Sciences and Humanities (SSH) considerations, in line with the Horizon Europe Strategic Plan (2025–2027)[2].

[2] https://research-and-innovation.ec.europa.eu/research-area/social-sciences-and-humanities/ssh-integration_en

The training framework and course design are structured to achieve the project's training Key Performance Indicators (KPIs), which include:

- **KPI 1**: >6 training courses developed (at least 2 for each use case).
- **KPI 2**: >100 Training hours (within the project).
- **KPI 3**: Increase workforce acceptance and effectiveness of the training courses (parameters: Trainee satisfaction, at least 4 on a scale of 1-5; Skills development, at least 80% of correct answers at end-of-course test; Transfer of learning, apply at least 75% of the skills and knowledge learned during the training in their daily work).
- **KPI 4**: >45 engaged stakeholders (30 employees, 10 managers, 5 other stakeholders) at training workshops with demo cases and >100 engaged stakeholders through the EITM Academy (formerly Skills.move) learning platform.

The results presented in this report combine three complementary approaches:

- **Newly designed courses**, such as the AI Act, the ethical and legal aspects course presented in Section 6.4, or the Life Cycle Assessment and Industrial circularity course described in Chapter 7.
- **Updated course outlines**, specifically for demo case 2, which have been revised to reflect partner feedback and evolving project needs.
- **Review and integration of existing partner resources**, applicable for all demo cases but mostly relevant for demo cases 1 and 3.

Using the training curricula and identified skills as a starting point, the methodology for course development and delivery follows a structured, phased approach:

1. Mapping of existing EIT Manufacturing Academy courses (M13–M17)
2. Identification and delivery of knowledge transfer sessions (ongoing)
3. Mapping of existing partners' courses (M15–M16)
4. Collection of partner feedback (M16–M20)
5. Identification of gaps and design of new courses with key partners, which will continue after M24 (M17–M24)

The first step involved a thorough internal review of the training materials already available on the EIT Manufacturing Academy e-learning platform, one of the largest European learning platforms 100% dedicated to manufacturing, designed by leading specialists of the European manufacturing ecosystem to foster innovation and skills preparedness in the current and future workforce. Courses were mapped against the specific skills needs identified for the project, providing a baseline of existing resources. Subsequently, key expert partners, EWF, LUT and TMCOMAS, conducted a review of their internal training materials against the same skills framework, which was then shared with all partners for structured feedback. This approach allows the project to

leverage existing resources wherever possible or to provide training recommendations in line with the stated needs.

The design of new courses is being guided by the EIT Manufacturing Academy authors' handbook and toolkit (described in Section 2.2), with a timeline agreed upon with the training providers. At this stage, the course design process (steps 1 and 2 as described below) has been initiated for a subset of courses, selected according to the feasibility of development. This approach follows an agile methodology, enabling iterative refinement of course content based on emerging project needs and partner feedback. For these selected courses, the design and delivery process is structured according to the main phases described below; however, the process will be the same for the remaining courses:

1. **Development of the initial course syllabus** (M22–M23): Drafting of the course description, definition of target learner profiles, outline of module structure and content, and formulation of intended learning outcomes.
2. **Validation of the course syllabus by relevant partners** (M23–M24): The draft syllabus is reviewed through a structured feedback questionnaire (see Appendix A), comprising three sections:
    - Participant Profile: Questions to identify the respondent's professional area, role, and level of expertise.
    - Course Content and Structure: Assessment of the relevance of proposed content to professional development needs and demo case activities, suitability for different professional groups, identification of missing topics, current level of knowledge, and interest in providing real-world use cases.
    - Delivery Timeline and Resources: Collection of information on potential constraints for pilot delivery, required supporting materials, and accessibility considerations.
3. **Preparation of draft training materials** (M24–M25): Based on the validated syllabus, partners develop preliminary learning materials, including presentations, readings, exercises, and assessment components.
4. **Pilot delivery of the course** (M25–M28): Draft materials are tested with a selected group of learners to evaluate clarity, relevance, and practicality of both content and delivery format.
5. **Collection of feedback and refinement of training materials** (M28–M31): Feedback from pilot participants and instructors is systematically gathered and analysed, and the course content, structure, and supporting materials are refined accordingly.
6. **Final delivery of the course** (M32–M34): The improved and finalised course is delivered to the intended target groups within the project.

7. **Impact and learning effectiveness assessment** (M35–M36): Post-delivery evaluation activities are carried out to assess learner achievement, perceived usefulness, and overall impact, contributing to the continuous improvement of the training offer.

In summary, the training development process within R3-MYDAS builds on a clear understanding of the skills gaps identified across the three demo cases and takes a structured, iterative approach to course design and development. By systematically mapping existing training resources, engaging expert partners, and incorporating continuous feedback, the methodology ensures that new learning materials are aligned with the specific technical, regulatory, and cross-sectoral competences required in the targeted industrial remanufacturing contexts.

Overall, this approach provides a solid foundation for delivering high-quality, needs-driven training courses that integrate technical, human-centric, and sustainability dimensions and that can effectively support workforce upskilling across the R3-MYDAS demonstration cases.

2.2 Courses Design Supporting Material

For formal professional training, the course design process adheres to established principles and tools from the EIT Manufacturing Academy, incorporating adult learning approaches such as Andragogy and microlearning [REF-03] [REF-04], which have been described in detail in D8.2. These principles ensure that courses are learner-centred, modular, and adaptable to professional contexts, enhancing engagement and knowledge retention.

The course design follows a structured approach to course development, beginning with the use of Bloom's taxonomy [REF-01] [REF-02] to define learning outcomes and to identify appropriate formative and summative assessments. This provides a systematic framework for specifying what learners are expected to know, understand, and be able to do at the end of the course, and allows alignment between learning objectives, content, and assessment methods. This allows for clear articulation of cognitive, affective, and practical skills, ensuring objectives are measurable and progressive, and supporting learners in achieving higher-order skills such as analysis, evaluation, and creation.

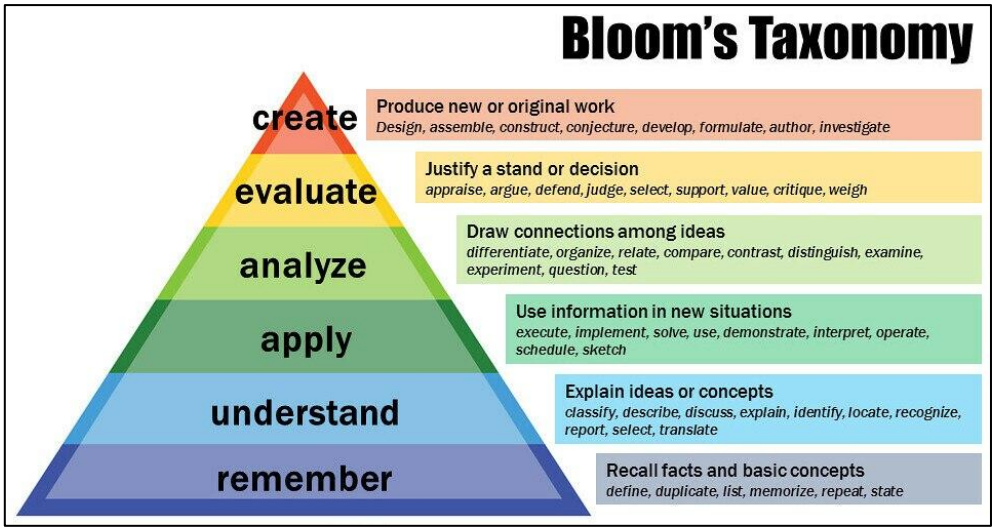


Figure 1: "Bloom's Taxonomy", Center for Teaching Vanderbilt University, CC BY 2.0.

To support consistent course development and facilitate transparency, a standardised Course Syllabus Template is being adopted, as shown in Table 2. This table intends to capture all key elements of a course, including title, description, target audience, learning outcomes, module structure, assessments, rationale, and timeline for development and delivery. By using this template, course authors can ensure that all components are clearly articulated, aligned, and measurable.

Table 2: Course Syllabus Template.

Course Syllabus Template	
Section	**Alignment**
Course Title	[course name]
Course Description	[brief overview, purpose, and relevance of the course]
Skill and Learning Gap	[A brief description of the rationale for the course, highlighting the identified learning or market gaps it addresses and the specific skills and competencies it aims to develop]
Instructor(s)	[Instructor's name]
Target Audience	[roles, experience level, prerequisites]
Mode of Delivery	[face-to-face, online, blended, on-the-job, etc.]
Course Duration	[n. of hours/days]
Overall Learning Outcomes / Objectives	1. [Objective 1] 2. [Objective 2] 3. [Objective 3] 4. [Objective 4] 5. [Objective 5]

Course Syllabus Template	
Section	**Alignment**
Course Structure	**[module n./name]** [module learning outcome] [module description] [assessment type] **[module n./name]** [module learning outcome] [module description] [assessment type]
Course Design, Development and Delivery Timeline	1. Course Syllabus Design: [M-M] 2. First Draft Course Material Development: [M-M] 3. Course pilot testing: [M-M] 4. Course Material refinement and final development: [M-M] 5. Course Delivery: [M-M] 6. Learning effectiveness and impact assessment/evaluation: [M-M]

All of the above tools come with a comprehensive manual detailing best practices,step-by-step guidance, and integration procedures within the Academy. This includes instructions on structuring content, sequencing modules, incorporating interactive elements, and designing assessment that reflect real-world applications. Additionally, instructions on the integration of the material into the learning platform are provided. All learning resources undergo a rigorous Quality Assurance (QA) process, including iterative reviews, peer evaluation, and administrative oversight. This ensures consistently high standards, facilitates the timely incorporation of feedback, and minimises rework by addressing potential issues at the earliest stage of development.

Accessibility and inclusivity are embedded throughout the authoring and review process. The Academy applies the Web Content Accessibility Guidelines (WCAG)[3] to ensure learning experiences are universally accessible, including for learners with disabilities, and that content can be effectively delivered across multiple modes, including online, blended, and in-person formats.

[3] https://www.w3.org/WAI/standards-guidelines/wcag/

2.3 Overview of Preliminary Training Curricula and Materials

This section provides a summary of the preliminary training curricula and materials collected and developed within the project, presented in the subsequent chapters. The table combines newly designed courses, updated course outlines reflecting partner feedback, and existing partner resources, offering a consolidated view of the available training content to support all demonstration cases and the development of competence-based learning pathways.

The training curricula and materials are organised by demonstration case:

- **Demo Case 1:** It presents existing EWF resources, both internal and from other projects in which EWF participates, which will be leveraged for developing targeted courses.
- **Demo Case 3:** Builds on existing EWF resources and includes a newly designed and delivered workshop to address specific skills needs.
- **Demo Case 2:** Combines updated training curricula reflecting partner feedback, existing resources, and a newly developed course.
- **Cross-Demo:** Features a newly developed course designed to support competencies relevant across multiple demonstration cases; this is currently under development.

Table 3: Overview of Preliminary Training Curricula and Materials.

Overview of Preliminary Training Curricula and Materials			
Demo Case	**Course Title**	**Author(s)**	**Skills**
Demo Case 1: Oil & Gas Crankshafts	*Principles of Industrial Manufacturing Processes*	LUT	Machining processes, sheet metal production, additive manufacturing, quality & manufacturability assessment, technical and scientific reporting
	Automation	LUT	Automation and digital control, PLC I/O integration, industrial communication and fieldbuses, PLC programming, automation system development
	CU09 Quality Assurance (QA) in DED-LB	EWF	Quality assurance in DED-LB, visual inspection and measurement of AM parts, interpretation of technical

Overview of Preliminary Training Curricula and Materials			
Demo Case	**Course Title**	**Author(s)**	**Skills**
			drawings, defect identification and reporting, preparation of QA test reports
	CU40 Production of DED-LB parts	EWF	DED-LB process simulation and part production, design for AM and toolpath creation, CAD-to-build file adaptation, defect analysis and distortion mitigation, DED-LB work instructions and process planning
	CU10 Health, Safety and Environment (HSE) in DED-LB	EWF	Health, safety and environmental compliance in DED-LB, risk assessment and hazard mitigation, safe operation of DED-LB equipment
	SAM (*Sector Skills Strategy in Additive Manufacturing*) Project	EWF (Project Partner)	Additive Manufacturing, QA, Limits of AM
	EAGLE (European 3D Printing Polymer Operators) Project	EWF (Project partner)	3D Printing
	Amable Initiative	EWF (Project partner)	Standardisation of DED processes
	Advanced data engineering solutions and system integration in manufacturing	Pannon Business Network (EIT Manufacturing Academy)	Data collection in manufacturing, API design and implementation, REST API development in Python, systems integration using APIs, and industrial communication protocols
	Additive Manufacturing II	Faculty of Engineering of the University of Porto - Kilometro Rosso (EIT	Material selection, AM processes, complex structures, performance optimisation, advanced testing, industrial applications, quality assurance,

Overview of Preliminary Training Curricula and Materials			
Demo Case	**Course Title**	**Author(s)**	**Skills**
		Manufacturing Academy)	industry compliance, reliability assurance
Demo Case 3: Wind Turbines Gearboxes	*3D Forming and Converting of Materials*	LUT	Forming and Converting processes, Material categorisation, Manufacturing applications, Polymer and fibre materials, Packaging solutions, Process limitations, Tooling knowledge
	CU26 Introduction to materials *CU27 AM with steel feedstock (excluding SS)* *CU28 AM with Stainless Steel (SS) feedstock* *CU29 AM with Aluminium feedstock* *CU30 AM with Nickel feedstock* *CU31 AM with Titanium feedstock* *CU32 AM with Tungsten feedstock* *CU33 Biomedical metallic materials*	EWF	Materials fundamentals, AM steel, AM stainless steel, AM aluminium, AM nickel, AM titanium, AM tungsten, Biomedical metals
	DEMO or DIE (Develop Engaging Massive Open	EWF (Project partner)	3D Printing Material Extrusion, CAD, Design for Material Extrusion, 3D Printer Operation

Overview of Preliminary Training Curricula and Materials			
Demo Case	**Course Title**	**Author(s)**	**Skills**
	Online Resources for Designers Innovative Education) Project		
	Laser Cladding: Characteristics and how do we apply it	TMCOMAS	Laser cladding, Principles, Equipment, Process optimisation, Industrial applications, Laser characteristics, Process parameters, Material selection, Quality control, Wear resistance, Corrosion resistance, Precision parts
	Surface Technologies as a Solution to Meet Industrial Needs	TMCOMAS	Surface engineering, Coatings, Laser cladding, Thermal spray, Welding, Material selection, Part condition assessment, Thickness and hardness evaluation, Optimising performance, Minimising defects, Industrial part repair
	Babbit Bearings: Manufacturing Techniques, Quality Control and Examples	TMCOMAS	Babbitt bearing manufacturing, bearing repair, Laser cladding, Welding, Thermal spray, Static casting, Microstructure analysis, Alloy composition, Adhesion techniques, Inspection standards, Testing procedures, Quality control, Fatigue life improvement
	Additive Manufacturing	Fraunhofer IAPT (EITM Academy)	Environmental impact reduction, Digital-to-physical fabrication, AR/VR applications, Quality assurance, Defect detection, Pre/post-process inspection, Business case development, Industry 4.0, Digital

Overview of Preliminary Training Curricula and Materials			
Demo Case	**Course Title**	**Author(s)**	**Skills**
			manufacturing, Sustainability in AM
	Hardening Techniques for Improving Wear Resistance on Gears	TMCOMAS	Surface hardening, Laser hardening, Case hardening, Nitriding, Welding, Thermal spray, Wear resistance improvement, Base material effects, Industrialisation considerations, Workflow optimisation, Practical applicability in industrial remanufacturing
Demo Cases 1 and 3	*Manufacturing of DED-LB Parts*	EWF	DED-LB manufacturing, Machine monitoring, Technical documentation, HSE procedures, Failure analysis, Reporting, Build process monitoring
	CU13 Post-Processing of DED-LB Parts	EWF	Post-processing, Manual tools, Part removal, HSE procedures, Manual preparation
	CU25 Post-Processing	EWF	Post-processing, Heat treatment, Cold work, Subtractive manufacturing, Finishing operations, Distortion reduction, Mechanical properties, Residual stress, Quality compliance
	EWF European Diploma in Laser Processing – Comprehensive Level	EWF	Material properties, Cutting, Welding, Surface treatment, Processing operations, Process interactions, Quality control, High-precision applications
Demo Case 2: E-Vehicles Batteries	*Circular EV Battery Systems and Disassembly course*	LUT (TBC)	Battery design, Remanufacturing, Material reuse, Safety handling, Disassembly/reassembly, DPP, Lifecycle assessment, Testing, Workflow optimisation, Regulatory compliance

Overview of Preliminary Training Curricula and Materials			
Demo Case	**Course Title**	**Author(s)**	**Skills**
	Smart Planning and Management Systems	University of Zagreb – FAMENA (EITM Academy)	Automation pyramid, Data acquisition, Network topologies, MES, ERP, Smart planning, Smart management, Production workflow, System features, IT integration
	Data Analytics and Battery Diagnosis	LUT, SPIN (TBC)	Time series analysis, Predictive maintenance, AI analytics, Edge AI deployment, Cloud IoT integration, Data governance, Cybersecurity, Privacy-preserving ML, Anomaly detection, Neural networks, Process optimisation, MES/ERP integration
	Essentials of Artificial Intelligence for Manufacturing	Faculty of Engineering of the University of Porto (EITM Academy)	AI in manufacturing, Machine learning algorithms, CRISP-DM methodology, Business-data alignment, Data cleaning, Data preparation, Data visualisation, Data wrangling, Predictive modelling, Model evaluation
	Cyberphysical systems and IoT	Faculty of Engineering of the University of Porto (EITM Academy)	CPS/IoT applications, System architecture, Edge devices, Connectivity protocols, Middleware, Interoperability, Software dependability, Adaptable systems, Resilient systems, Novel CPS/IoT paradigms
	Human–Robot Interaction (HRI) in Battery Remanufacturing	LUT, SPIN (TBC)	Human–robot collaboration, HRI concepts, Safety regulations, Explainability, Reliability metrics, Safety certification, Workspace design, End-effector design, Digital twin validation, Risk assessment, Safety function validation, Ergonomics integration

Overview of Preliminary Training Curricula and Materials			
Demo Case	**Course Title**	**Author(s)**	**Skills**
	New Machinery Directive	LUT, SPIN (TBC)	EU Machinery Directive, Safety compliance, Documentation requirements, Conformity assessment, Harmonised standards, Industrial application, Regulatory scope, Annex requirements, DPP traceability, Audit preparation
	Human-Machine Interaction	Aalto University - Faculty of Engineering of University of Porto - Czech Technical University - Intechcentras - Grenoble INP – UGA (EITM Academy)	Collaborative robotics, Cobot interaction, AGV operation, Wearable sensors, Human factors, Ergonomics, Digital human modeling, MQTT, OPC UA, Human-related dataflow, Digital Twin implementation, CPPS integration
	Human-Robot Collaboration	University of Tartu (EITM Academy)	Human-robot collaboration, Shared autonomy, System usability, Information automation, Human-aware motion planning, Industry 5.0 concepts, ROS applications, Intelligent robotics, Manufacturing technology trends
Demo Case 2 and Cross-Demo	*AI Act, Ethical and Legal Aspects*	Deep Blue	AI fundamentals, EU regulatory compliance, GDPR, AI Act, Ethical AI (ALTAI), Human factors analysis, Responsible AI deployment, Governance, Workforce impact
Cross-Demo	*Life Cycle Assessment and Circularity in Industry*	AIMEN	Life Cycle Assessment (LCA), Circular economy, Functional units, System boundaries, LCI data collection, Environmental impact assessment, Carbon

Overview of Preliminary Training Curricula and Materials			
Demo Case	**Course Title**	**Author(s)**	**Skills**
			footprint analysis, Digital Product Passports (DPP), Sustainability regulations, Industrial circularity

Each of the training materials and courses listed in the table will be presented in detail in the following sections. For each course, information will include the title, author, level, format, a brief description, modules, learning outcomes, sample content, and, where applicable, assessment methods and suggested next steps, illustrating the key skills and knowledge addressed and how each resource contributes to the overall competence-based training framework.

3 Demo Case 1: Oil & Gas Crankshafts

As part of the R3-MYDAS effort to strengthen workforce capabilities in advanced remanufacturing, a detailed analysis of current and emerging skills needs was conducted across the project's three demonstration cases and reported in D8.2. For Demo Case 1—focused on the remanufacturing of crankshafts—partners identified several critical skills gaps that must be addressed to ensure safe, efficient, and high-quality implementation of laser-based repair processes. These gaps include:

- Systems integration
- Understanding material properties relevant to laser cladding, including hardness, toughness, wear resistance, and the influence of environmental factors on base materials and cladding performance
- Welding
- Laser safety
- Quality control planning and assurance for Laser Metal Deposition
- Introductory knowledge of laser cladding processes, materials, and equipment

Based on the identified training needs, relevant training materials and a compilation of qualifications from R3-MYDAS partners—LUT, EWF, EITM—were collected and reviewed. The resources include existing courses, MOOCs, and other educational materials that address key competencies in automation, advanced manufacturing technologies, and manufacturing processes. Partners evaluated these materials to identify those most suitable for supporting skill development, and to inform the design of new training content where gaps were identified.

To begin with, among the reviewed resources, LUT provided a curated selection of courses specifically focused on automation and manufacturing processes. These courses were evaluated by the target partners for their relevance and applicability to the competences required in the respective demo cases. The courses presented here are those deemed most relevant by the partners and serve as a reference for the development of new, project-specific course materials.

1. **Principles of Industrial Manufacturing Processes**[4]

Learning Outcomes:

- Students should be able to identify the principles of machining products, sheet metal production, additive manufacturing, common welding processes, and packaging processes after completing this course module.

[4] https://sisu.lut.fi/student/courseunit/otm-0e06b447-2cae-4a0c-8a44-38d6c40d0b35/brochure

- In this course, students learn to describe the characteristics that describe the manufacturability of various materials and measures of quality, as well as aspects of efficient use of natural resources, sustainable production, and manufacturing.
- Students will also be able to seek out scientific information, evaluate it critically, and use it in their own writing in addition to writing technical and scientific reports.

Content: The course examines the most common industrial processes in manufacturing technology and ways to improve the sustainability of products through manufacturing. In addition, aspects of production management are considered.

Degree Level: Masters

Supporting Material: Literature - Manufacturing Processes for Engineering Materials (2016, 6th Edition) by Serope Kalpakjian

Format: Online

2. **Automation**[5]

Learning Outcomes: upon completion of the course, the student will be able to:

- apply automation and digital control theory to practical implementations,
- Connect IO to PLC system.
- use the analog and digital communication techniques applied to automation,
- apply fieldbuses,
- construct controllers and models of dynamic systems using IEC61131-3 and C programming languages,
- work in a group solving automation and control problems.

Content: IEC61131-3 programming languages, Feedback devices, Automation hardware and software. Fieldbuses. Utilising Simulink models in PLC systems. C/C++ languages in PLC systems. HMI, OPC, IoT in automation. Introduction to safety in automation.

Degree Level: Open University

Format: Online – Fully Digital plus two days in the lab

Furthermore, relevant qualifications, competency units and training materials from R3-MYDAS partner EWF were reviewed to support the design of targeted, competence-based courses. EWF develops harmonised training and qualification systems for welding and related manufacturing technologies—including additive manufacturing—and they will contribute to the development of R3-MYDAS training materials in these areas. The identified EWF resources are presented below:

[5] https://sisu.lut.fi/student/courseunit/otm-e4a32c25-22eb-419b-9372-367a2da578e5/brochure

Table 4: Quality Assurance (QA) in DED-LB Unit Description.

Competency Unit (CU) 09 Quality Assurance (QA) in DED-LB	
Subject Title	
• General Quality Assurance (QA) principles • AM Machine QA • AM Parts QA • Visual Inspection Overview	
Learning Outcomes	
Knowledge	• Quality Assurance in DED-LB • Visual inspection of DED-LB parts.
Skills	• Recognise the broader use of QA within engineering • Recognise the scope of the DED-LB operator qualification within the AM industry • Support the qualification and requalification procedures of DED-LB equipment • Identify the main procedures, equipment and their role • Prepare test reports based on the requirements specified by the manufacturer • Compare geometry and dimensions specified in the technical drawings with the as-built parts • Use simple measurement devices and techniques to carry out a basic visual inspection of the as-built part • Identify problems in the as-built parts, distinguishing between imperfections and defects • Report defects suggesting either their removal with post-processing operations of part disposal.

Regarding process optimisation, the following competence unit addresses this topic:

Table 5: Production of DED-LB Parts Unit Description.

Competency Unit (CU) 40 Production of DED-LB parts	
Subject Title	
• DED-LB process simulation • DED-LB part production • Case Studies	
Learning Outcomes	
Knowledge	Highly specialised knowledge and critical assessment of the principles and applicability of:

Competency Unit (CU) 40 Production of DED-LB parts	
	• DED-LB part production specifications, including simulation in formation, process parameters, pre- and post-manufacturing operations and work instructions
Skills	• Discuss Design for AM, features with other AM staff • Adapt CAD files to build files (e.g., toolpath) • Interpret reports of finite element analysis and numerical modelling to AM (e.g., topology optimisation, distortion, residual stresses) • Apply workflows for virtual pre-processing (e.g., part orientation) • Demonstrate competency in working with toolpath creation software • Select specific materials for different applications to meet part requirements • Propose a suitable tool path for a given part and identify the areas that will need thermal compensation • Propose methods to reduce distortion for a variety of part geometries and processes • Identify the cause of defects and propose methods for their mitigation • Identify the most suitable post-processing technique for a specific AM process and application • Create a DED-LB AMPS • Produce work instructions for the DED-LB Operator

For Risk Assessment, the competency unit CU10: Health, Safety and Environment (HSE) in DED-LB (7 h) was also selected, to support the need for guidance for understanding potential health risks and implementing measures to reduce exposure.

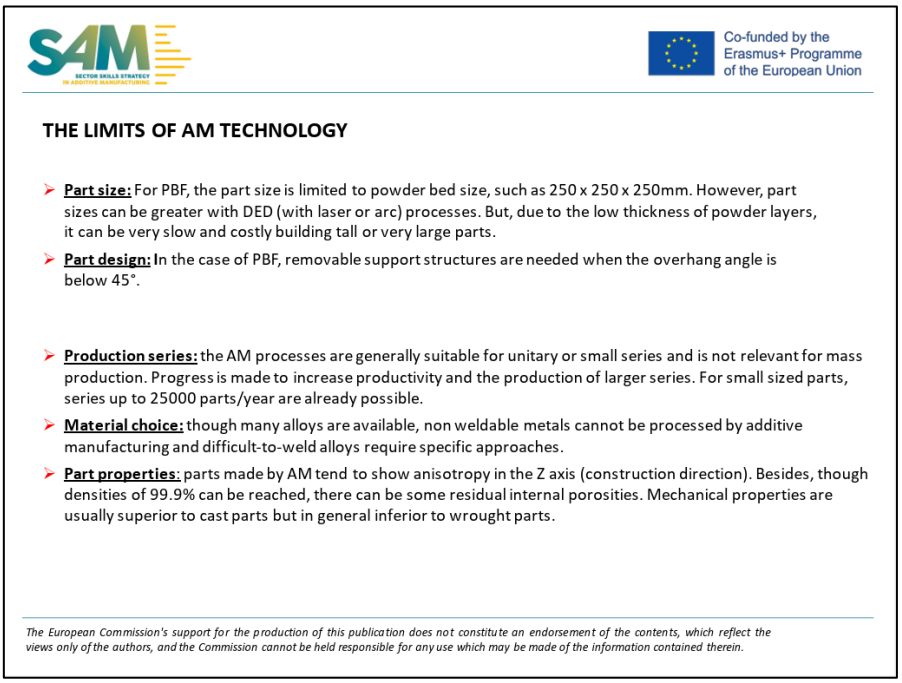
Furthermore, EWF provided references to additional materials developed in previous **Erasmus+** projects in which they participated. These materials are reported here as potential resources to support the development of R3-MYDAS training courses. In particular, it is possible to adapt resources from the **SAM** (***Sector Skills Strategy in Additive Manufacturing***)[6] project, co-funded by the European Commission under the

[6] https://www.skills4am.eu

framework of the Blueprint for Sectoral Cooperation on Skills[7] call, launched through the Erasmus+ programme.

Relevant outputs include podcasts[8] on topics such as Additive Manufacturing and Quality Assurance of AM parts or Additive Manufacturing and Standards, which can be leveraged to complement course content and provide learners with practical, up-to-date insights into the sector.

The project also includes a series of presentations on Additive Manufacturing[9], with materials on topics such as the benefits and limits of AM technology:


SAM
SECTOR SKILLS STRATEGY IN ADDITIVE MANUFACTURING

Co-funded by the Erasmus+ Programme of the European Union

THE LIMITS OF AM TECHNOLOGY

- **Part size:** For PBF, the part size is limited to powder bed size, such as 250 x 250 x 250mm. However, part sizes can be greater with DED (with laser or arc) processes. But, due to the low thickness of powder layers, it can be very slow and costly building tall or very large parts.
- **Part design:** In the case of PBF, removable support structures are needed when the overhang angle is below 45°.
- **Production series:** the AM processes are generally suitable for unitary or small series and is not relevant for mass production. Progress is made to increase productivity and the production of larger series. For small sized parts, series up to 25000 parts/year are already possible.
- **Material choice:** though many alloys are available, non weldable metals cannot be processed by additive manufacturing and difficult-to-weld alloys require specific approaches.
- **Part properties:** parts made by AM tend to show anisotropy in the Z axis (construction direction). Besides, though densities of 99.9% can be reached, there can be some residual internal porosities. Mechanical properties are usually superior to cast parts but in general inferior to wrought parts.

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Figure 2: The Limits of AM Technology, from the AM Basics presentation of the SAM Project.

Of particular interest is also the **EAGLE project** (European 3D Printing Polymer Operators)[10], funded by Erasmus+ (2021-1-CZ01-KA220-VET-000033007). A dedicated MOOC platform[11] is available, offering video lessons, documents, structured learning paths, and links to formal qualifications. These resources can be adapted and integrated into the R3-MYDAS training framework.

[7] https://employment-social-affairs.ec.europa.eu/policies-and-activities/skills-and-qualifications/working-together/blueprint-sectoral-cooperation-skills_en
[8] https://www.skills4am.eu/sam_podcast.html
[9] https://www.skills4am.eu/documents/03%20(EN)-basics%20of%20AM.pdf
[10] https://www.eagleproject.eu/project.html
[11] https://www.eagleproject.eu/mooc-platform.html

Furthermore, outputs from the **AMable initiative**[12], which brings together a consortium of European organisations that foster a new ecosystem for the adoption of additive manufacturing, provides valuable resources for the R3-MYDAS training curricula. Combining expertise in technology, business, and training, AMable focuses on supporting small and medium-sized enterprises (SMEs) in integrating additive manufacturing into their operations. Its outputs, including guidance on standardisation, process control, and supply chain integration, offer valuable resources that can be directly leveraged in the R3-MYDAS training curricula, such as the included slide on DED process standardisation.

Processes		
Standardization of DED processes	**Standard Available?**	No
	Is there any Work in Progress?	**F3187 – 16 - Standard Guide for Directed Energy Deposition of Metals** 1.1 Directed Energy Deposition (DED) is used for repair, rapid prototyping and low volume part fabrication. This document is intended to serve as a guide for defining the technology application space and limits, DED system set-up considerations, machine operation, process documentation, work practices, and available system and process monitoring technologies. 1.2 DED is an additive manufacturing process in which focused thermal energy is used to fuse materials by melting as they are being deposited. 1.3 DED Systems comprise multiple categories of machines using laser beam (LB), electron beam (EB), or arc plasma energy sources. Feedstock typically comprises either powder or wire. Deposition typically occurs either under inert gas (arc systems or laser) or in vacuum (EB systems). Although these are the predominant methods employed in practice, the use of other energy sources, feedstocks and atmospheres may also fall into this category. 1.4 The values stated in SI units are to be regarded as standard. All units of measure included in this guide are accepted for use with the SI. 1.5 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. *Note: This document is intended to serve as a guide for defining the technology application space and limits, DED system set-up considerations, machine operation, process documentation, work practices, and available system and process monitoring technologies.*
Material Jetting - flow rate, temperature, viscosity, pressure level, wetting of the orifice plate, etc.	**Standard Available?**	No
	Is there any Work in Progress?	No

Figure 3: Sample learning content on standardisation in AM.

In addition to project-specific materials, selected resources from the **EIT Manufacturing Academy**[13], EITM's learning platform dedicated to manufacturing were reviewed. These learning paths combine video lessons, practical exercises, and reference materials, allowing participants to progress at their own pace while acquiring skills aligned with industry needs. The following courses have been reviewed and received positive feedback from target partners:

1. Course Title: **Advanced data engineering solutions and system integration in manufacturing**

Author: Pannon Business Network

Level: Intermediate

The learning path describes Application Programming Interfaces (APIs) in general and the two most popular kinds of API are also detailed. Besides, the learning path summarises how to create an API and how it works. It is also shown how to create a REST API in Python. This learning path provides a short description of programmable logic controllers (PLCs) and also presents different communication protocols as well as

[12] https://www.amable.eu/
[13] https://eitmanufacturingacademy.eu/

different methodologies in connection with data collection from manufacturing, including some example codes in each method.

Course Modules include:

- Data Collection in Manufacturing using different methodologies
- Systems Integration using APIs

Although its direct applicability to the use case is still being assessed, the course *Advanced Data Engineering Solutions and System Integration in Manufacturing* has been provisionally included due to its strong relevance to digital integration workflows and its positive evaluation by the target partner of the use case. As the R3-MYDAS demonstrators increasingly rely on the seamless exchange of data between 3D scanning systems, CAD/CAM environments, path-planning software, and laser processing equipment, foundational knowledge of APIs and communication protocols can support the development of more automated and interoperable pipelines.

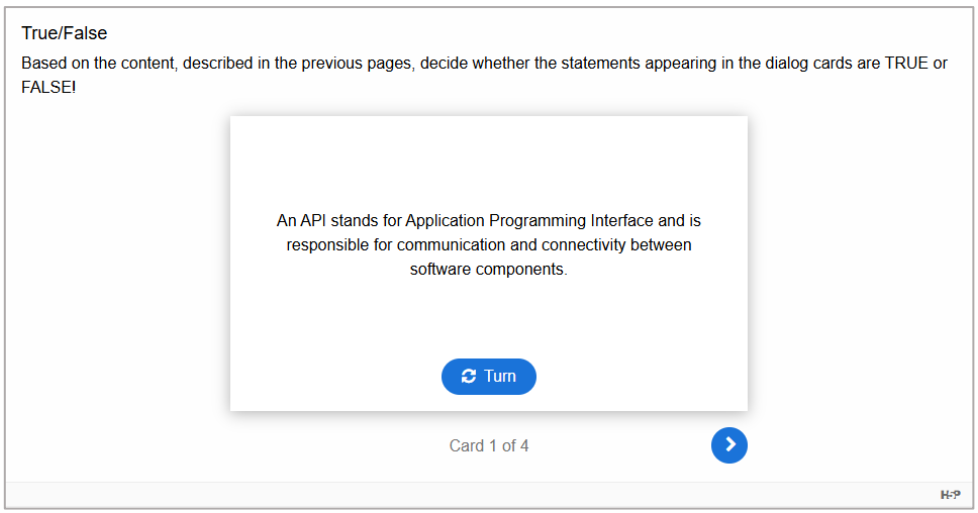


Figure 4: Sample True/False Exercise on APIs.

By introducing participants to API principles, system integration concepts, and data collection methodologies common in manufacturing, the course may contribute to future-proofing the training offer and enabling engineers to better manage digital connectivity, automate data transfers, and enhance the robustness of the remanufacturing workflow.

2. Course Title: **Additive Manufacturing II**

Author: Faculty of Engineering of the University of Porto - Kilometro Rosso
Level: Intermediate

In this course, learners acquire mastery in selecting appropriate materials and AM processes, enabling them to execute complex structures and components with enhanced performance and functionality. Secondly, they delve into testing and applying

advanced techniques tailored to meet the demands of diverse industrial applications, ensuring they can adeptly address complex challenges in real-world scenarios. Additionally, participants undergo rigorous training to implement robust quality assurance protocols, ensuring compliance with industry standards and regulations, and guaranteeing the quality and reliability of manufactured parts.

Course Modules include:

- How to Optimise Parts in Additive Manufacturing (AM)
- Additive manufacturing (AM) Design Thinking Exercise
- Laser Metal Deposition as a Repair Tool
- Wire Arc Additive Manufacturing (WAAM) technology as an enabler for raw materials saving
- Pellet Extrusion-Based Additive Manufacturing for Circular Manufacturing
- Post-Processing in Additive Manufacturing (AM): Main Approaches
- Post Processing for polymer in Additive manufacturing (AM)
- Post Processing for Metal Parts in Additive Manufacturing (AM)
- How to apply Optical Tomography in Additive Manufacturing (AM) processes
- Additive Manufacturing II – Assessment

A sample extract from the unit on Post Processing for Metal Parts, which introduces typical AM process defects, is reported below:



Figure 5: Sample slide from the Additive Manufacturing II course.

This course has been assessed as suitable for engineers working within technical departments; however, its content should be further customised to focus exclusively on

metals. Overall, the training materials reviewed, together with the qualifications and resources provided by LUT, EWF, and EITM, offer a valuable foundation for designing new courses to introduce and disseminate the solutions developed within the project's use cases.

In developing these tailored courses, R3-MYDAS will continue to collaborate closely with EWF, leveraging their subject-matter experts and established training frameworks to ensure that the resulting programmes are targeted, industry-relevant, and aligned with the competence needs identified throughout the project. The next steps in course development, as well as the proposed assessment strategies, will be presented in Chapter 5. This approach will address the needs of both Demo Case 1 and Demo Case 3, taking into account shared competencies between the two cases, which can be leveraged to design courses that may be developed and delivered jointly where appropriate.

4 Demo Case 3: Wind Turbine Gearboxes

This chapter presents existing training materials selected by partners from LUT, EWF, the EITM Academy, and TMCOMAS to address the key skills gaps identified for Demo Case 3. These resources were chosen for their relevance to the technical challenges and learning needs associated with advanced manufacturing and remanufacturing processes. In addition, EITM coordinated the design and delivery of a dedicated knowledge-sharing workshop led by TMCOMAS (Demo Case 1) for FLENDER (Demo Case 3), further strengthening cross-demo exchange of expertise and practical know-how. Details of this workshop are presented in 4.4.

The skills gaps addressed by the selected materials include:

- 3D Printing and Additive Manufacturing, covering material selection, process optimisation, failure analysis, risk assessment, and laser-based manufacturing
- Design for Additive Manufacturing
- Surface Treatment and Post-Processing Techniques
- Corrosion and Lubrication Simulation

In this context, the following course from LUT was reviewed by target partners, confirming its relevance to the identified skills gaps:

3D Forming and Converting of Materials[14]

Learning Outcomes: After this course, the student can:

- understand and categorise operations and functions of modern forming and converting processes, emphasising manufacturing and polymer- and fibre-based materials in packaging solutions.
- learn and recognise possibilities/limitations of forming and converting processes and tooling

Content: The course covers several topics in 3D-forming and converting of materials with a focus on the field of packaging technology

Degree Level: Masters

Format: Online

Furthermore, to support the identified need for targeted material selection—particularly in the context of laser cladding and remanufacturing processes—EWF competence units

[14] https://sisu.lut.fi/student/courseunit/otm-acc32321-c0b5-4328-86c8-13ed3d4bf089/brochure

offer structured guidance on the properties, behaviour, and selection criteria of various metallic materials. They provide insights into material possibilities and limitations in advanced remanufacturing, facilitate understanding of the parameters affecting weld outcomes, and enable participants to define informed requirements for the design of laser-cladded components.

The EWF competence units relevant to these objectives include:

- CU26 Introduction to materials
- CU27 AM with steel feedstock (excluding SS)
- CU28 AM with Stainless Steel (SS) feedstock
- CU29 AM with Aluminium feedstock
- CU30 AM with Nickel feedstock
- CU31 AM with Titanium feedstock
- CU32 AM with Tungsten feedstock
- CU33 Biomedical metallic materials

As a foundational resource for addressing Corrosion and Lubrication Simulation, the EWF **European/International Welding Engineer (E/IWE) qualification** can also be leveraged. While it does not cover simulation directly, it provides essential theoretical knowledge, including a 4-hour introduction to corrosion within the welding engineer profile. This foundational understanding supports the development of practical skills in corrosion and lubrication management, helping participants apply simulation tools more effectively in remanufacturing and additive manufacturing contexts.

The **DEMO OR DIE project[15] (Develop Engaging Massive Open Online Resources for Designers Innovative Education)**, funded under Erasmus+ and in which EWF participated as a project partner, aims to promote open access to online training in the field of 3D printing by engaging "non-manufacturing" professionals—such as health professionals—as well as students from both VET and higher education. The project seeks to enable individuals and companies to understand the capabilities and limitations of 3D printing, anticipate challenges associated with emerging technologies, and develop the multi-skilled competencies required for modern industry. The project provides a range of useful online resources on 3D printing that can be adapted to support training within the R3-MYDAS curricula, extending the reach of learning beyond traditional manufacturing contexts.

[15] https://demoordieproject.eu/

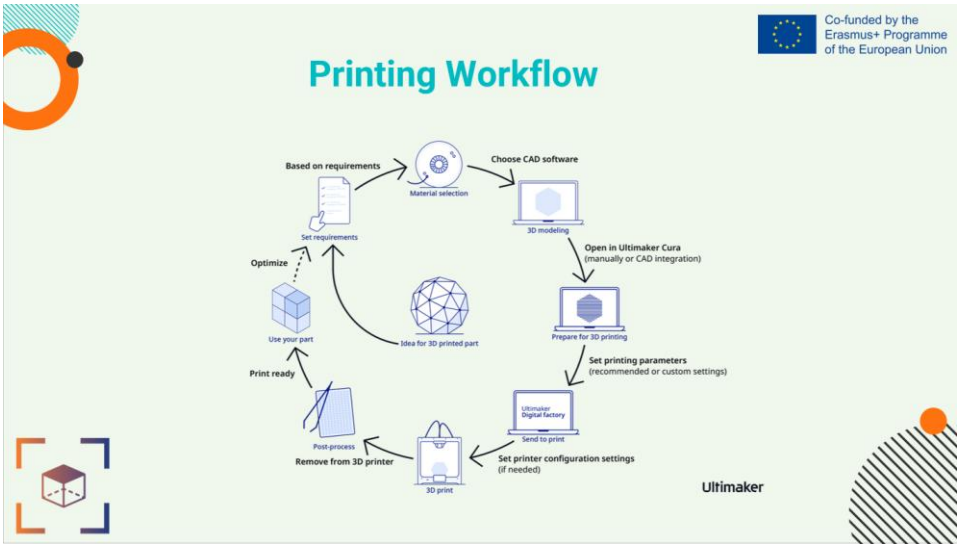


Figure 6: Sample content from the Demo or Die project: 3D Printing Workflow.

Finally, a series of open-access webinars by TMCOMAS has been positively reviewed by Demo Case 3 participants, demonstrating the value of practical, experience-based knowledge sharing across different demonstration cases. These include:

Laser Cladding: Characteristics and how do we apply it[16]. This TMCOMAS webinar presents an in-depth overview of laser cladding technology, focusing on its principles, equipment, process optimisation, and industrial applications. The speaker explains laser characteristics, process parameters, material options, and quality control methods, emphasising dimensional restoration, wear and corrosion resistance, and precision for rotating machinery and other critical parts. Real-world examples highlight applications across turbines, compressors, pistons, steel mills, and aerospace, showcasing the flexibility, accuracy, and advantages of laser cladding for complex repairs.

[16] https://www.youtube.com/watch?v=Mr4N05TrX0U&t=1s

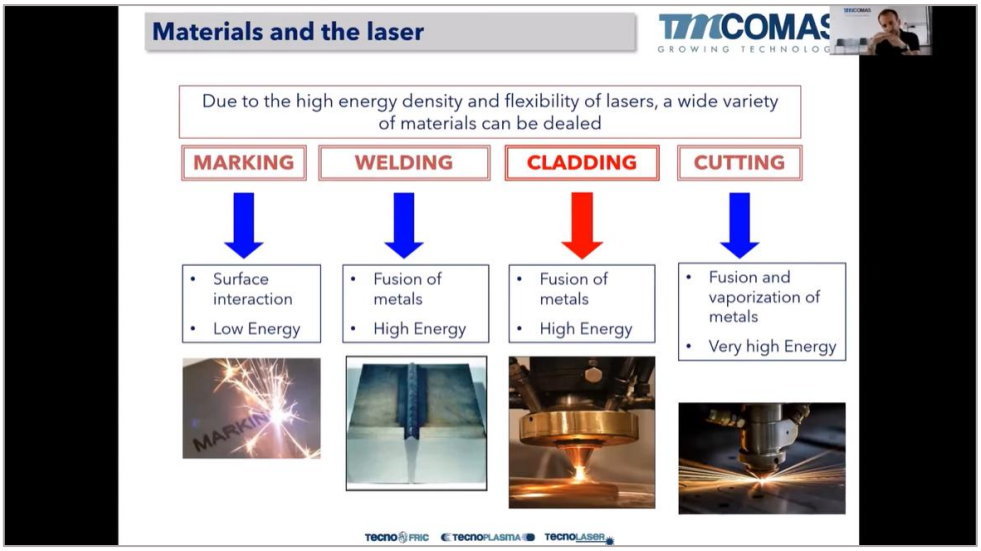


Figure 7: TMCOMAS Webinar on Laser Cladding.

***Surface Technologies as a solution to meet industrial needs*[17].** This TMCOMAS webinar explains surface engineering technologies for industrial part repair and enhancement, including coatings, laser cladding, thermal spray, and welding. It covers how to choose the right technique based on material, part condition, thickness, hardness, and customer requirements. The session emphasises practical applications, material compatibility, and optimising performance while minimising defects.

***Babbit Bearings: manufacturing techniques, quality control and examples*[18].** The webinar provided an in-depth overview of Babbitt bearing technology, covering manufacturing and repair techniques, bonding mechanisms, and quality control. Key methods discussed included centrifugal casting, laser cladding, welding, thermal spray, and static casting, with guidance on microstructure, alloy composition, and adhesion to various base materials. The session also reviewed inspection standards, testing procedures, and practical examples of different bearing types, emphasising how proper processing and quality control impact bearing performance and fatigue life.

Drawing from the EIT Manufacturing Academy catalogue, similar to Demo Case 1, the *Additive Manufacturing II* course was also reviewed by the target partners of Demo Case 3, with particular interest expressed in the content related to Optical Tomography. In addition, the following course provides further relevant material that supports the skills and knowledge needs of the partners in this demonstration case:

Course Title: *Additive Manufacturing*
Author: Fraunhofer IAPT

[17] https://www.youtube.com/watch?v=NobbshX6hCg&list=PLu-bMvYTaABhWd4XJeXebC5HU6Ebsui4A&index=12
[18] https://www.youtube.com/watch?v=LOwqdvNz6Ak&list=PLu-bMvYTaABhWd4XJeXebC5HU6Ebsui4A&index=1

Level: Advanced

This learning path addresses the following topics: Reduction of environmental impact during production as well as in use of parts; bringing digital ideas to real manufactured parts; Exemplary use of Augmented and Virtual Reality in Additive Manufacturing; safeguarding quality in complex manufacturing processes; Example business cases.

Modules:

- Sustainability through Additive Manufacturing
- Industry 4.0 – Digital Manufacturing
- From Digital to Fabrication
- Extended Reality in Digital Fabrication
- Quality Assurance – Applications in Additive Manufacturing (Quality Control, Pre-in-post process, defects, lack of fusion and gas porosity, applications)
- Additive Manufacturing Business Cases



Figure 8: Defects in AM - extract from the QA unit.

Overall, a comprehensive set of foundational training materials has been identified, which can be leveraged to support the development of targeted, competence-based courses while efficiently building on existing project results and established resources.

4.4 Hardening Techniques for Improving Wear Resistance on Gears Workshop

To address specific skills needs in Demo Case 3, a targeted workshop was developed focusing on surface hardening techniques to enhance the wear resistance of gears, a critical factor in remanufacturing and industrial applications. The technical workshop was designed, developed, and delivered by R3-MYDAS partner TMCOMAS, with the support of EITM, which provided instructional guidance throughout the development process. To ensure that the content met the participants' requirements, an interview was conducted with stakeholder representatives from Demo Case 3 before delivery, guaranteeing that the workshop addressed their specific training needs.

The workshop was held as a 1-hour synchronous, in-person session, providing practical insights into hardening methods, their effects on base materials, and considerations for industrialisation and workflow optimisation. Eight participants attended the session. Attendees were introduced to a range of commercially available hardening techniques, including laser hardening, case hardening, nitriding, welding, and thermal spray, with discussions highlighting their practical applicability in industrial settings.

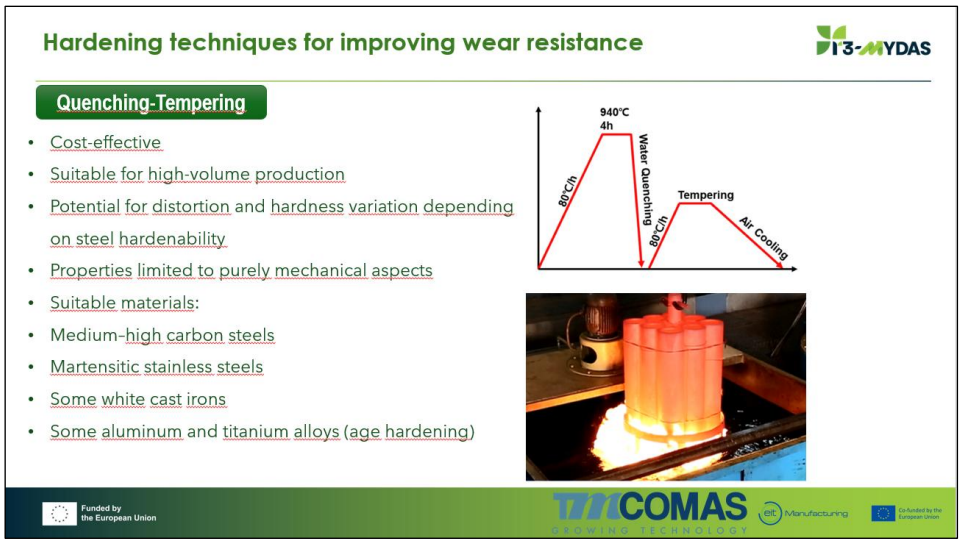


Figure 9: Hardening techniques for improving gear resistance - workshop slide.

The workshop also examined the effects of these techniques on the base material, exploring how microstructural changes influence mechanical properties and long-term performance.

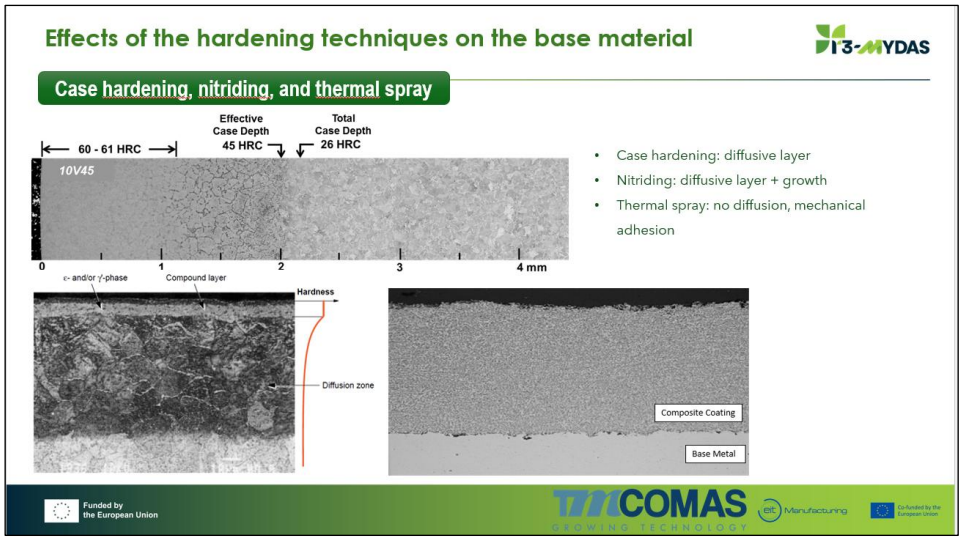


Figure 10: Effects of the hardening techniques on the base materials - workshop slides.

Furthermore, insights were provided into the industrialisation of hardening processes, addressing considerations for scaling, process optimisation, and integration into manufacturing workflows.

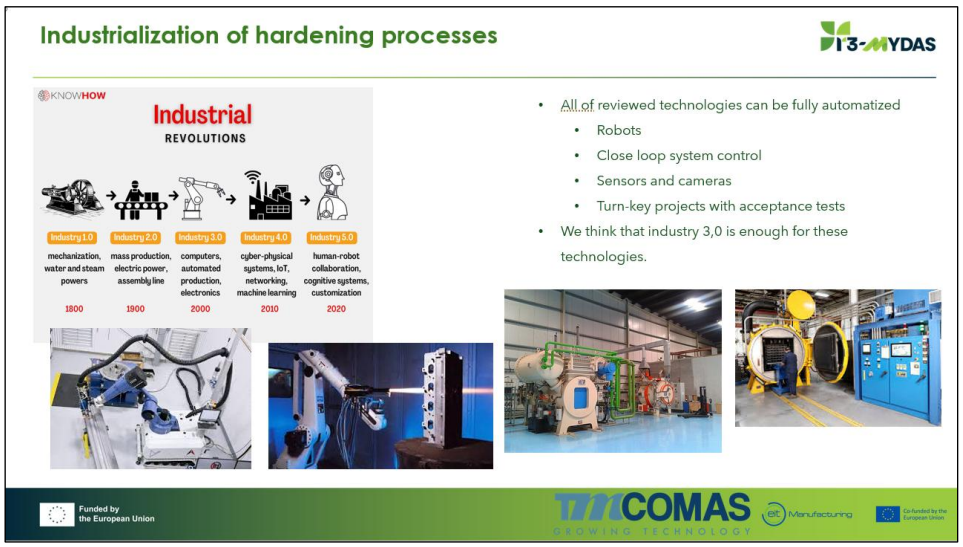


Figure 11: Industrialisation of hardening process - workshop slides.

While the workshop primarily focuses on surface hardening rather than additive manufacturing, it partially addresses the broader skill need of process optimisation by emphasising workflow considerations, material-performance interactions, and industrial efficiency. However, it does not cover AM-specific post-processing techniques, material usage optimisation, or predictive maintenance, which remain to be addressed in dedicated modules.

Feedback from the workshop, received from only one partner, indicated that the content was relevant, clear, and well-delivered. However, given the single response, these observations may not fully represent the wider participant perspective. Key recommendations include providing deeper coverage of surface treatment and cladding, focusing more on specific welding techniques, and offering additional support resources to facilitate practical application. Future workshops can build on these insights, refining content to better match use case needs and industrial practices, while exploring opportunities for assessments and further skill consolidation.

5 Courses Supporting Shared Competence Development in Demo Cases 1 and 3 and Plan for development

In addition to the training mapped against the specific needs of Demo Cases 1 and 3, an additional set of existing training courses offered by EWF has been identified as particularly relevant for addressing common skills and knowledge requirements shared by Demo Case 1 (Oil & Gas Crankshafts) and Demo Case 3 (Wind Turbine Gearboxes).

Leveraging these EWF courses allows the project to adopt a consistent and efficient approach to competence development, promoting cross-demo knowledge transfer while ensuring participants acquire practical skills that are directly applicable to both demonstration cases. Furthermore, as R3-MYDAS will collaborate closely with EWF for both demos, the development of new, project-specific training materials will be synchronised wherever possible, enabling efficient use of resources, reducing duplication of effort, and facilitating alignment with the identified skills gaps. The courses listed in the following tables have been reviewed and highlighted as relevant by partners from both Demo Case 1 and Demo Case 3.

Table 6: Manufacturing of DED-LB Parts Unit Description.

Manufacturing of DED-LB parts	
Subject Title	
• Machine functionalities and monitoring systems • Documentation	
Learning Outcomes	
Knowledge	Factual and Broad of: • Manufacturing of DED-LB parts • DED-LB machine functionalities and monitoring systems
Skills	• Perform parts manufacturing according to the build instruction applying HSE procedures • Interpret technical documentation related to the requirements of the as built parts • Identify the main reasons for failure during the manufacturing process • Prepare reports on the manufacturing process, including identified issues

Manufacturing of DED-LB parts	
	• Monitor and escalate errors of the build process

Table 7: Post-Processing of DED-LB Parts Unit Description.

CU13 Post-processing of DED-LB parts	
Subject Title	
• Post build cycle operations, manual tools and methods for post-processing operations	
Learning Outcomes	
Knowledge	Factual and Broad of: • Manual tools and methods for post-processing operations
Skills	• Remove the as build parts and build platform from the machine, applying the necessary HSE procedures • Carry out simple manual preparation of the as built part for different post-processing methods

Table 8: Post-Processing Unit Description.

CU25 Post processing	
Subject Title	
• General considerations, thermal treatment, plastic deformation methods, subtractive manufacturing, finishing operations, practical application	
Learning Outcomes	
Knowledge	Advanced knowledge and critical understanding of the theory, principles and applicability of • Post processing methods (heat treatment, cold work methods, subtractive manufacturing, finishing operations
Skills	• Discuss methods to reduce distortion, using different post processes, for a variety of part geometries and AM processes. • Explain the applicable post-processing methods to several AM processes as built parts • Describe the effect of different heat treatments on microstructure, mechanical properties, residual stress and defects • Explain the requirements that the as built part needs to have/comply according to each post process

Furthermore, the EWF **European Diploma in Laser Processing – Comprehensive Level**, a 340-hour programme, can address the shared need for knowledge of material properties by providing an integrated curriculum across cutting (52 h), welding (80 h), surface treatment (48 h), and processing operations (140 h), equipping participants with both theoretical knowledge and practical insights into material behaviour, process interactions, and quality control considerations relevant to high-precision industrial applications. Selected portions of this programme can be used to extract relevant material, given the overall length of the course.

Building on the review of existing training materials and the skills gaps identified, the next step in the R3-MYDAS training programmes for Demo Cases 1 and 3 is to advance the development of new, targeted courses while defining corresponding assessment strategies. As no new formal courses have yet been fully designed, the assessment approach at this stage is intended to be formative, flexible, and iterative. Assessment approaches may include:

- Formative assessments during course delivery, such as quizzes, short exercises, and scenario-based questions, to monitor learners' understanding and provide immediate feedback.
- Practical exercises and case studies simulating real industrial tasks in remanufacturing and additive manufacturing, allowing participants to apply knowledge directly to workflow challenges.
- Pilot evaluation metrics, including trainee satisfaction surveys, alignment of learning outcomes with practical skills acquisition, and feedback from instructors and industry mentors. These will inform subsequent refinements and adaptations of the course materials.

To advance the design of new courses, EITM will organise a co-design workshop with subject matter experts from EWF. This workshop will:

- Prioritise which courses to develop based on technical relevance, feasibility, and alignment with the identified skills gaps.
- Define detailed learning objectives, assessment methods, and appropriate delivery modes for each course.
- Ensure the integration of competence-based training approaches, leveraging EWF's harmonised qualification frameworks and industry expertise.
- Provide guidance for modular course design, enabling iterative improvements and flexibility to adapt to emerging project needs or additional skill requirements.

This agile, collaborative approach ensures that course development remains closely aligned with project objectives, technical needs, and the practical requirements of participants in Demo Cases 1–3, while also ensuring their implementation during the project timeline.

6 Demo Case 2: E-vehicles batteries

The R3-MYDAS courses presented in this chapter address key competencies for the circular remanufacturing of EV batteries, covering battery technology, lifecycle management, safe disassembly, and data-driven methods for diagnosis and predictive maintenance. Training also integrates regulatory, ethical, and human-centred aspects of deploying advanced machinery, robotics, and AI systems, ensuring alignment with EU frameworks such as the Battery Regulation, AI Act, and New Machinery Directive. Importantly, the courses include knowledge of Digital Product Passport (DPP) fields, intended to teach participants to interpret and collect battery data for traceability, compliance, and informed decision-making.

At this stage, some of the course materials have not yet been collected or developed. For these courses, the focus is on updated course outlines, which incorporate the latest project priorities, partner feedback, and available expertise, while for other topics, development of training materials has already commenced.

6.1 Circular EV Battery Systems and Disassembly

This course outline, already presented in D8.2, provides a comprehensive overview of EV battery systems with a focus on enabling circularity through design, disassembly, and material recovery processes. It combines foundational knowledge of battery technology and lifecycle management with practical insights into safe handling, operational procedures, and regulatory compliance, supporting efficient and traceable remanufacturing of EV batteries. The version presented here includes integrations and updates provided by academic partners and use-case participants, reflecting technical refinements and clarified competency needs. In addition, relevant elements from an existing EIT Manufacturing (EITM) course are presented, selected for their partial alignment with the subject matter and their potential to support or complement the project-specific training materials.

Table 9: Circular EV Battery Systems and Disassembly – Course Modules with integrated feedback.

Circular EV Battery Systems and Disassembly – Course Modules with integrated feedback	
Unit 1: Battery Design and Development Lifecycle	This unit introduces the stages of EV battery design and development, emphasising features that support remanufacturing and material reuse. Feedback indicated strong relevance but suggested including design standards, hazard mitigation, alignment with Digital Product Passports (DPPs), and lifecycle feedback loops.

Circular EV Battery Systems and Disassembly – Course Modules with integrated feedback	
Unit 2: Battery State-of-Health (SoH) Foundation and Evaluation	Focused on evaluating battery performance, lifespan, and suitability for reuse, this unit covers SoH assessment methodologies. Relevance was rated high, and newly integrated topics include second-life eligibility criteria, test plans (capacity/impedance), safety gates during diagnostics, relevant DPP data fields, and data quality and labelling. This unit represents a key component of the R3-MYDAS training strategy; however, subject matter expertise within the consortium is under evaluation, and where necessary, external contributions may be sourced to ensure coverage.
Unit 3: Battery Assembly & Disassembly Process, Manipulation and Safety	This unit addresses safe handling and disassembly/reassembly practices for high-voltage battery packs, including mechatronics-assisted techniques. Feedback confirmed high relevance, with additional suggestions including hazard classification, waste handling, emergency procedures, training and certification requirements, and documentation templates (SOPs). As with other units, the availability of subject matter expertise within the consortium is currently being assessed.
Unit 4: Circular Economy, Supply Chain, and Battery Regulations	This unit examines circular value chain principles, DPP implementation, EU regulatory compliance (e.g., Battery Regulation EU 2023/1542), and the impact of regulations on design, logistics, and remanufacturing. Rated as highly valuable, feedback recommended adding circularity metrics (material recovery rates, CO_2e, cost-benefit), DPP data model design and interoperability, logistics and transport considerations (ADR), ethics of data sharing, and supplier compliance auditing.
Unit 5: Production Planning and MES Integration	Focused on scheduling disassembly, testing, and material reuse activities, and using MES systems to monitor and optimise workflows. Missing topics include workflow modelling in MES, scheduling under constraints, and ERP-MES integration considerations.

To support Unit 4 on Circular Economy, Supply Chain, and Battery Regulations, the information collected on the Digital Product Passport (DPP) fields by NCI in the R3-

MYDAS marketplace can be leveraged to train stakeholders—including technicians, quality teams, recyclers, second-life operators, and regulatory staff—on interpreting battery data and identifying the fields required for regulatory and operational compliance. For this deliverable, only a subset of DPP fields is presented; the full dataset will inform the development of comprehensive training materials and will be presented fully in D6.4, *R3-MYDAS marketplace module*, led by NCI and due in M36 of the project

The DPP fields are organised into four main categories, each providing different levels of access and detail that are directly relevant for training stakeholders in EV-battery remanufacturing:

1. **Publicly accessible information** – includes battery type, manufacturer, technical performance, carbon footprint, and recycling data. This information can be used to train participants on assessing battery quality, sustainability attributes, and general operational characteristics.
2. **Restricted information for stakeholders with legitimate interest** – covers battery composition, dismantling instructions, part numbers, and safety measures. This supports training on operational compliance, safe handling, and practical decision-making during remanufacturing.
3. **Restricted information for authorities** – such as compliance test reports, data storage protocols, and protection of proprietary data. This helps trainees understand regulatory requirements, reporting obligations, and how to align operations with EU frameworks.
4. **Individual battery information** – including state of health, usage data, updates after remanufacturing, and ownership history. This category enables hands-on training in interpreting lifecycle and performance data to make informed, compliance-aligned operational decisions.

By presenting these categories with representative examples, training participants gain practical experience in identifying, collecting, and applying the appropriate DPP information to support both efficient remanufacturing and full regulatory compliance.

The DPP-related knowledge can be transferred through interactive, hands-on workshops with scenario-based exercises. This allows stakeholders—such as technicians, recyclers, second-life operators, and regulatory staff—to work directly with representative DPP datasets, interpret battery information, and identify the data fields needed for regulatory and operational compliance. Practical exercises help participants develop decision-making skills and competencies that cannot be fully gained through lectures or webinars.

Furthermore, to support Unit 5 on Production Planning and MES Integration, a 1.5-hour online professional course on the EIT Manufacturing Academy e-learning platform, developed within the context of the ConnectSEE project, is available:

Course Title: Smart Planning and Management Systems
Author: University of Zagreb – FAMENA
Level: Intermediate

The course introduces learners to the automation pyramid, its hierarchical levels, and associated IT systems, with a focus on smart planning and management. Participants gain a practical understanding of system features, functions, and benefits, and the application of MES within production workflows.

Course Modules include:

- Automation Pyramid – from data acquisition to process automation (ERP, MES, PLC, etc.)
- Data Types
- Network Topologies (Bus, Tree, Ring, Star)
- Smart Planning Systems: Manufacturing Execution Systems (MES)
- Smart Management Systems: Enterprise Resource Planning (ERP)
- ERP/MES vendors
- MES Software Sample

The image below illustrates a sample course material on a basic MES architecture.

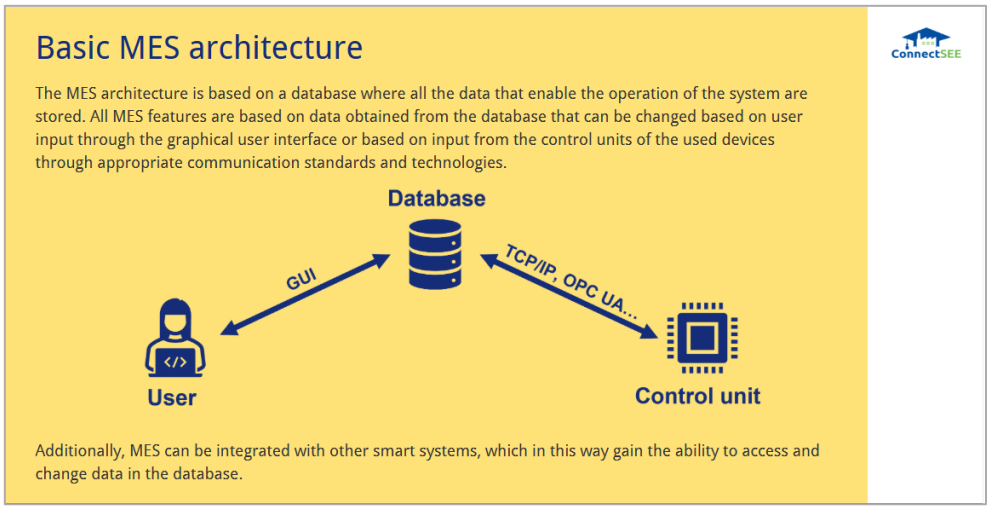


Figure 12: Basic MES Architecture. Sample Material from the Smart Planning and Management Systems course.

This EITM course can serve a dual purpose: it can be leveraged as a foundation for developing customised training modules tailored to the specific needs of the target partners, or be recommended directly for adoption by the partners to strengthen material knowledge across the consortium.

6.2 Data Analytics and Battery Diagnosis

The following course, presented here in its updated version, equips participants with the knowledge and skills to apply data-driven methods for monitoring, diagnosing, and optimising EV battery performance within remanufacturing processes. It integrates foundational analytics, predictive maintenance, edge and cloud AI, and data security considerations, supporting both operational efficiency and lifecycle management. Feedback from consortium partners indicates that the course units are generally of medium relevance to the project use case, suggesting that some modules may be adapted, removed or partially developed. Identified gaps may require supplementary content or external expertise to complement the consortium's capabilities and ensure comprehensive coverage of all necessary skills.

Table 10: Data Analytics and Battery Diagnoses - Course Modules with integrated feedback.

Data Analytics and Battery Diagnosis – Course Modules with integrated feedback	
Unit 1: Time Series Analysis and Predictive Maintenance	This unit covers methods to analyse and forecast battery performance data for anomaly detection in remanufacturing processes. Missing topics identified include labelling strategies, incorporation of domain knowledge, edge constraints for sampling rates, and interpretability of results.
Unit 2: Predictive Maintenance Analytics	Focused on the application of AI and analytics to monitor quality, optimise processes, and support decision-making, feedback suggested integrating cost-sensitive thresholds, what-if analyses for maintenance policies, deployment and monitoring of models, false positive/negative cost modelling, uncertainty-aware decision-making, and MES/ERP integration patterns.
Unit 3: Edge AI Integration	This unit addresses implementing AI solutions on edge devices for real-time battery monitoring. Missing topics include electromagnetic interference (EMI) and environmental constraints, as well as cybersecurity at the edge. Learning outcomes include optimising models for edge deployment, measuring latency, power, and thermal constraints, and implementing streaming pipelines.
Unit 4: Cloud-based IoT Platforms and Integration	Focusing on cloud-based IoT platforms for monitoring, data collection, and process optimisation, feedback highlighted topics such as adversarial robustness, secure model lifecycle, and supplier security mandates. Learning

Data Analytics and Battery Diagnosis – Course Modules with integrated feedback	
	outcomes include implementing data governance (access control, retention, GDPR-compliant pipelines) and designing operational and quality dashboards.
Unit 5: Data Security in AI and IoT Systems	This unit addresses data privacy and cybersecurity principles for battery and AI/IoT systems. Learning outcomes include conducting threat modelling, planning incident response, applying privacy-preserving machine learning where necessary, and aligning with regulatory requirements for battery and DPP data.
Unit 6: Graph Deviation Networks (Neural Network-based) for Anomaly Detection	This unit introduces AI models to detect anomalies in EV batteries and interpret results for process optimisation, with a suggested broader description as "Neural Network-based Anomaly Detection" to encompass GDNs. Missing topics include data requirements, module/cell-level labelling, explainability, and deployment considerations. Learning outcomes include interpreting anomalies to actionable maintenance steps and quantifying business impact.

To support the above units, the EIT Manufacturing Academy course "Essentials of Artificial Intelligence for Manufacturing" provides a foundational introduction to AI/ML applications in manufacturing, data preparation, and structured project execution (CRISP-DM). While it does not cover EV-battery-specific topics such as predictive maintenance, DPP data, or regulatory compliance, it offers valuable baseline knowledge for both technical and less-technical stakeholders, forming the basis for R3-MYDAS-specific modules that address battery diagnostics, edge/cloud integration, and compliance requirements.

Course Title: *Essentials of Artificial Intelligence for Manufacturing*
Author: Faculty of Engineering of the University of Porto
Format: Online, < 3h
Level: Beginner
Notes: EIT Labelled course[19]

Starting with an introductory module on the transformative potential of AI and ML in manufacturing, the path explores algorithm applications, introduces the Cross-Industry Standard Process for Data Mining (CRISP-DM) methodology for structured project execution, and emphasises aligning AI initiatives with business objectives. Participants

[19] *EIT Label is a quality mark awarded to programmes demonstrating outstanding innovation, educational excellence and societal impact.*

learn the crucial steps of data preparation, including cleaning and visualisation techniques, which unveil valuable insights from manufacturing data. They delve into data wrangling and practice these skills on real-world manufacturing data. The learning path then progresses to the modelling phase, covering diverse machine learning algorithms and evaluation techniques essential for building predictive models in manufacturing scenarios

Modules:

- AI & Machine Learning in Manufacturing
- Algorithms and Manufacturing Applications
- CRISP-DM Methodology
- Business and Data Understanding
- Data Cleaning and Preparation
- Data Manipulation – Visualisation
- Data Wrangling; Data Task; Modelling & Evaluation; Modelling Task

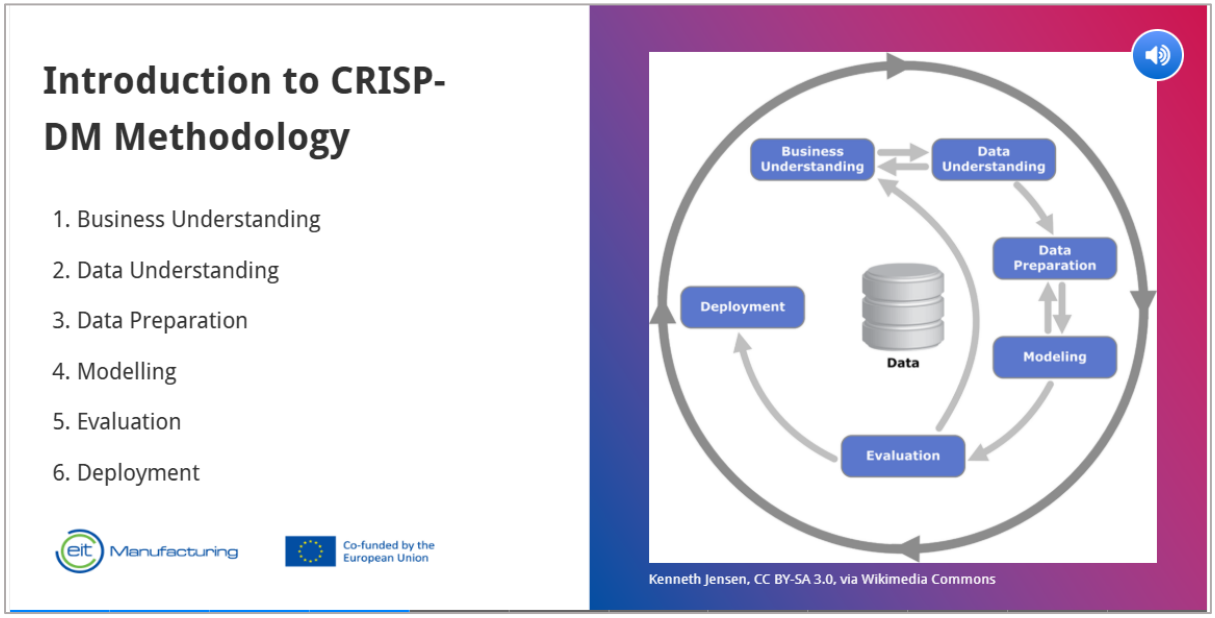


Figure 13: Introduction to CRISP-DM Methodology. Sample training material.

Additionally, the EIT Manufacturing Academy course "Cyber-Physical Systems and IoT" provides foundational knowledge relevant to Units 2–6 of the Data Analytics and Battery Diagnosis course, including predictive maintenance analytics, edge AI deployment, cloud-based monitoring and integration, data security, and real-time anomaly detection.

Course Title*: Cyberphysical systems and IoT*
Author: Faculty of Engineering of the University of Porto
Format: Online, 2h
Level: Advanced

This course introduces students to applications of CPS/IoT and illustrates how these concepts are used to create new systems which are adaptable and resilient to changes in the environment.

Modules:

- Reference models, use cases and requirements
- System Architecture of the CPS
- Edge devices, end-to-end connectivity and protocols
- Middleware/ platforms and interoperability
- Software Engineering Dependability
- Novel paradigms in CPS and IoT

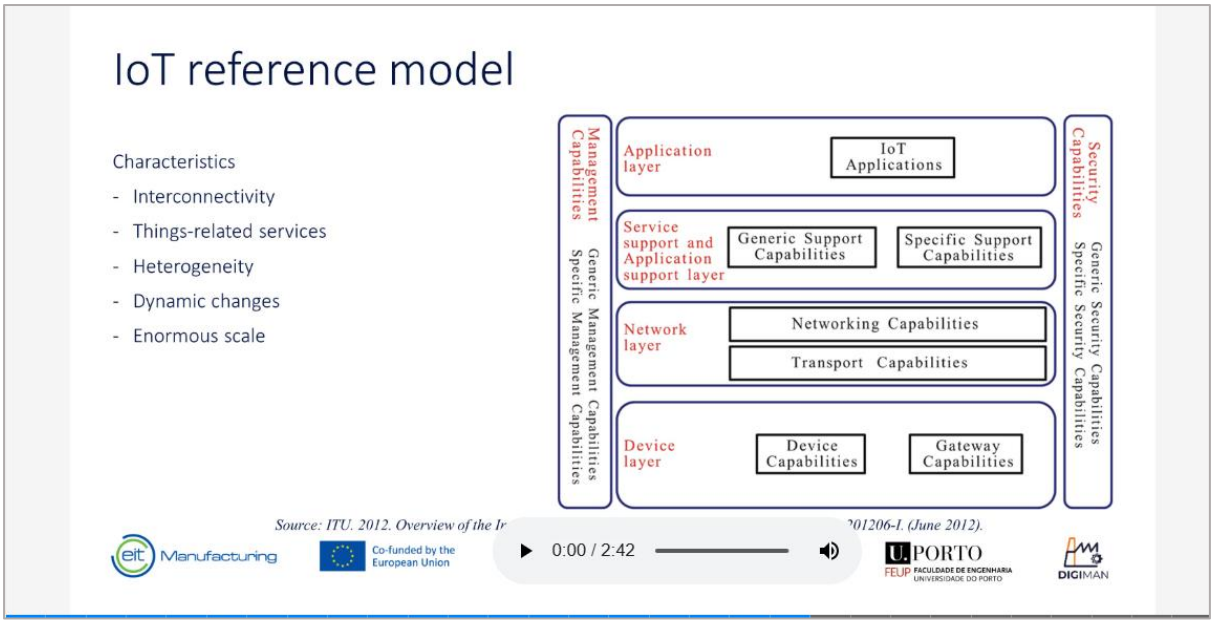


Figure 14: IoT Reference Model.

Similar to the previous course, the syllabus for this course has been revised by academic and demo case partners; at this stage, no new training materials have been developed. The existing resources presented will guide content development or will be recommended for professional development.

6.3 Machinery Regulations and Human–Robot Collaboration

These two courses focus on the regulatory, operational, and human-interaction aspects of deploying advanced machinery and robotics in EV-battery remanufacturing, addressing safe human–robot collaboration, compliance with EU machinery legislation, and the integration of ethical and reliability principles in automated processes. Feedback from consortium partners confirms the high relevance of the units, while

highlighting areas where additional expertise or external contributions may enhance the coverage.

Course 1: Human–Robot Interaction (HRI) in Battery Remanufacturing

This course addresses principles and best practices for safe and effective human–robot collaboration in battery remanufacturing. Learning outcomes cover HRI concepts, relevant regulations, and the application of explainability and reliability metrics in collaborative robotic systems. Based on partner feedback, additional topics such as safety certification pathways, workspace design, end-effector considerations, digital twin validation, collaborative risk assessment, safety function validation, and ergonomics integration have been incorporated. Both SPIN and LUT have expressed willingness to contribute to this unit, with SPIN indicating active participation.

Course 2: New Machinery Directive

This unit provides an overview of the EU New Machinery Directive (2023/1230), covering key provisions, safety, compliance, and documentation requirements for machinery and automation systems, as well as practical application in industrial settings. Learning outcomes include explaining the scope, key definitions, Annex requirements, harmonised standards mapping, and producing conformity assessment artifacts.

Feedback highlighted missing topics such as practical templates and examples, interplay with the Battery Regulation and DPP traceability, documentation maintenance, and audits. SPIN indicated full willingness to contribute, while LUT indicated maybe, reflecting partial engagement; external contributions may be considered to address areas requiring additional technical expertise.

Existing courses from the EITM Academy catalogue were identified to complement the project-specific training, providing additional knowledge and resources for human–machine and human–robot interaction in manufacturing contexts.

Course Title*: Human-Machine Interaction*
Authors: Aalto University - Faculty of Engineering of University of Porto - Czech Technical University - Intechcentras - Grenoble INP – UGA
Format: Online, 7h
Level: Intermediate

Description: This learning path focuses on collaborative production systems, IoT, wearables, digital twins, virtual commissioning, and human-machine interfaces. At the end of the Learning Path, the users can 1) Cite the relevant robotisation use cases in manufacturing; 2) Explain the relevant practicalities of collaborative robotics; 3) Show and compare how MQTT and OPCUA are used for the human-related ergonomic data flow; 4) Identify enabling factors for the assessment and optimisation of ergonomic

factors for an operator. 5) Implement a Digital Twin of the Human Operator using Visual Components; 6) Conclude what are the most relevant scenarios where using Digital Twin of the Human Operator may benefit a business.

Modules:

- Collaborative Robotics – Introduction, Safety Standards
- Cobot Interaction Basics
- AGV Introduction
- Wearable Sensor Technologies – Overview
- Human Factors Overview
- Ergonomics and Well-Being Aspects in Industries – Current State
- Ergonomic Evaluation in Digital Human Modeling Software
- Principles and Use of MQTT
- Principles and Use of OPC UA
- Human-Related Dataflow Management; Digital Twin – Key Technologies and Main Challenges CPPS

Course Title*: Human-Robot Collaboration*
Author: University of Tartu
Format: Online, 0.5h
Level: Intermediate

Description: The sociotechnical domain of human-robot collaboration links together concepts of shared autonomy, system usability, information automation, and human-aware motion planning. In this course, the learner analyses trends in technology to recognise their applicability in the manufacturing context, they cover concepts associated with Industry 5.0 and associated technological challenges.

Modules:

- Trends in Robotics
- Human-Robot Collaboration in Industry 5.0
- ROS Enabling Intelligent Robotics in Manufacturing
- Human-Robot Interaction in Autonomous Systems

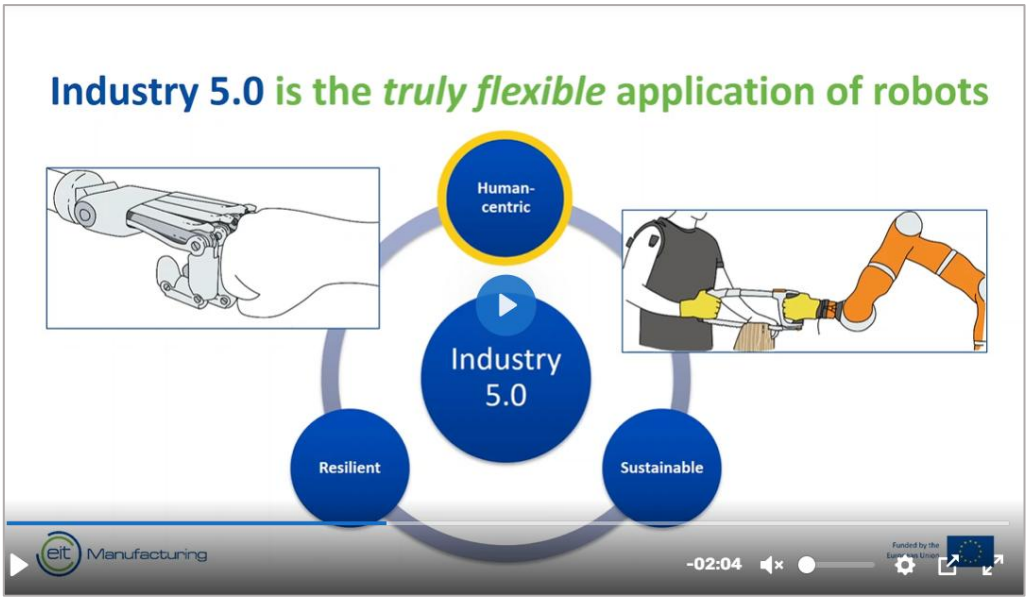


Figure 15: Industry 5.0 principles in Human-Robot Collaboration. Sample Course Material.

As mentioned, preliminary feedback indicates that R3-MYDAS partner SPIN has the capacity to contribute actively to these thematic areas. Consequently, the units may be developed internally as workshops or webinars, making use of both partner expertise and the identified existing resources to support effective learning outcomes. Assessment will be primarily formative, using short quizzes, poll questions, and guided reflection exercises to ensure participants understand HRI principles, safety standards, and regulatory requirements, while promoting engagement and applied learning within the webinar setting.

6.4 Regulatory and ethical aspects of AI deployment

The implementation of advanced Artificial Intelligence (AI) services within R3-MYDAS, specifically for processing and integrating technical data in remanufacturing processes, including AI-based anomaly detection for EV batteries, must ensure that AI deployment adheres to ethical principles, complies with relevant international and EU regulations, and considers human-centric aspects of technology integration.

The project incorporates approaches from Social Sciences and Humanities (SSH), reflecting their key role in the twin green and digital transitions. Beyond embedding ethics and SSH considerations in technical project activities, these principles will also be addressed from a training perspective. Aligning with Horizon Europe guidelines for SSH integration[20] and the European Commission's Ethics Guidelines for Trustworthy AI[21],

[20] https://research-and-innovation.ec.europa.eu/research-area/social-sciences-and-humanities/ssh-integration_en
[21] https://digital-strategy.ec.europa.eu/en/library/ethics-guidelines-trustworthy-ai

workforce training on ethical, regulatory, and human-related aspects of AI deployment contributes to the well-being of the workforce, EU citizens and communities by raising awareness of the challenges and considerations associated with implementing such technologies.

In collaboration with Deep Blue, the partner providing expertise in ethics, R3-MYDAS will develop a dedicated training course on the ethical, regulatory, and human aspects of AI implementation. This course also aligns with Made in Europe (MiE)'s specific objective related to ensuring a human-centred and human-driven approach to manufacturing innovation.

The table below provides an overview of the course structure, learning objectives, target audience, and development timeline. Following the table, sample slides and detailed module descriptions are provided to illustrate the content and instructional approach being implemented.

Table 11: AI Act, ethical and legal aspects Course Syllabus.

AI Act, ethical and legal aspects Course Syllabus	
Section	**Alignment**
Course Title	AI Act, ethical and legal aspects
Course Description	The modern manufacturing sector is undergoing a profound transformation, with artificial intelligence (AI) serving as a core driver of the Industry 4.0 revolution. However, the successful integration of AI goes far beyond technical implementation and requires a deep understanding of the associated ethical, regulatory, and human factors. While AI offers immense potential for increased efficiency and productivity, it also introduces critical challenges related to data privacy, governance, and workforce management. This course is strategically designed to address these non-technical but essential SSH challenges. It is crafted for decision-makers and technical leads who need to navigate a landscape where AI's impact is not just on the factory floor but on the people and compliance systems that surround it. The program's core value proposition is to provide a clear, practical, and evidence-based understanding of how to implement AI responsibly, ensuring it aligns with core ethical principles and evolving regulatory frameworks. This course will empower professionals to lead their organisations in adopting AI in

AI Act, ethical and legal aspects Course Syllabus	
	a way that is trustworthy, compliant, and—critically—enhances human capabilities rather than displacing them, fostering a collaborative and productive work environment.
Skills and Learning Gap	The rapid adoption of AI in manufacturing exposes a critical skills gap among engineers, managers, and technical leads in understanding ethical, legal, and human-centred aspects of AI implementation. While technical AI skills are increasingly available, there is a shortage of professionals able to integrate AI solutions responsibly, ensuring compliance with EU regulations (AI Act, GDPR), managing human–machine interaction, and addressing societal and organisational implications. This gap limits the ability of organisations to implement AI safely, sustainably, and in alignment with evolving regulatory and ethical frameworks.
Instructor(s)	Dr. Elisa Spiller; Dr. Andrea Capaccioli (Deep Blue S.r.l.)
Target Audience	• Decision-makers in manufacturing organisations • Technical leads and engineers • Managers overseeing AI deployment and digital transformation • Professionals responsible for compliance, governance, and workforce management
Mode of Delivery	Pilot test: synchronous; Final Delivery: Asynchronous, fully remote through the EITM Academy platform
Course Duration	Two hours
Overall Learning Outcomes / Objectives	Upon successful completion of this course, students will be able to: • Comprehend foundational AI terminology and concepts. • Navigate EU regulatory frameworks concerning AI, specifically GDPR and the AI Act. • Navigate the main ethical issues on AI, particularly according to ALTAI. • Grasp the Human Factors approach and applicable methodologies for AI solution deployment.
Course Structure	• Module 1 – AI Fundamentals and EU Context • Module 2 – Ethics of AI in the European Framework (ALTAI)

AI Act, ethical and legal aspects Course Syllabus	
	• Module 3 – Regulation and Compliance: EU AI Act and GDPR • Module 4 – Human Factors Analysis for AI Deployment
Instructional Strategies and Assessments	To be determined – they may include knowledge tests and case studies
Course Design, Development and Delivery Timeline	1. Course Syllabus Design: [M23-M24] 2. First Draft Course Material Development: [M24-M25] 3. Course pilot testing: [M25-M26] 4. Course Material refinement and final development: [M27-M31] 5. Course Delivery: [M32-M34] 6. Learning effectiveness and impact assessment/evaluation: [M35-M36]



Figure 16: AI Act, ethical and legal aspects training journey.

Module 1 – AI Fundamentals and EU Context

The module covers the following key topics:

- Fundamental concepts of Artificial Intelligence and key applications in the manufacturing sector.
- Implications of AI for individuals and organisations: opportunities, risks, and impact on production processes.
- Introduction to human factors in AI adoption and management.

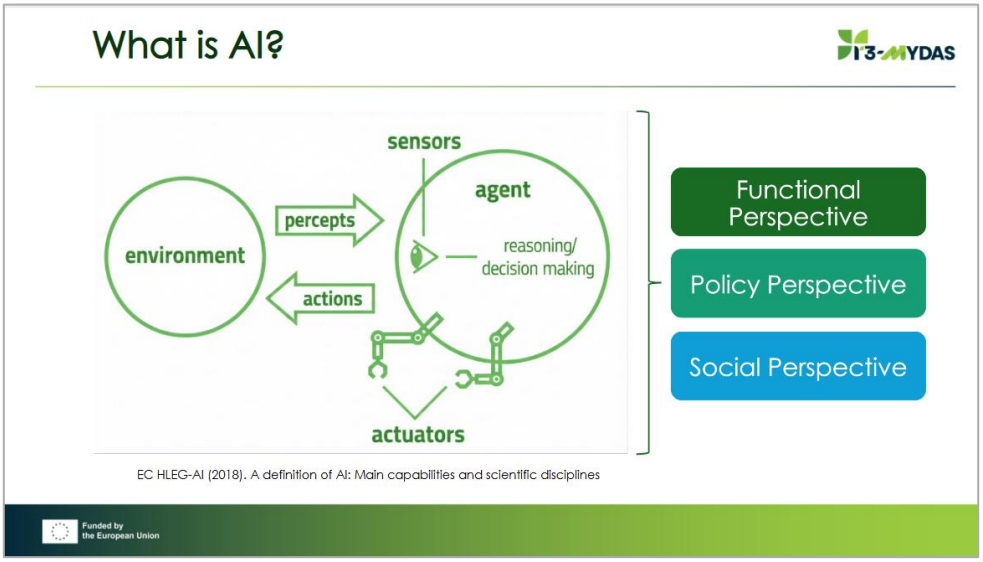


Figure 17: What is AI?

Module 2 – Ethics of AI in the European Framework (ALTAI)

The module equips learners with competencies related to:

- Overview of the European Commission's Ethical Guidelines and the ALTAI (Assessment List for Trustworthy AI) framework.
- Core principles: transparency, fairness, accountability, safety, and respect for fundamental rights.
- Practical application of ALTAI in manufacturing: risk assessment and mitigation strategies, by design

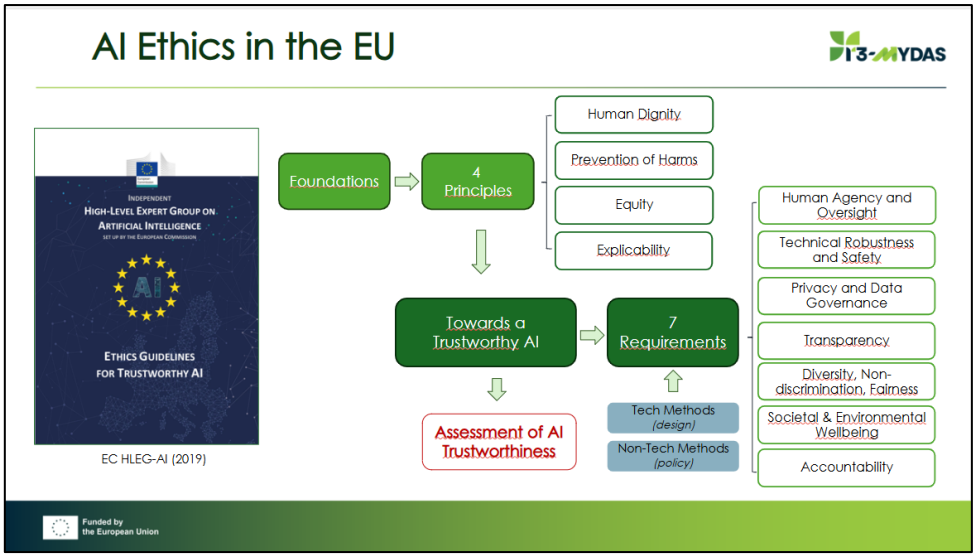


Figure 18: AI Ethics in the EU. Sample Course Content.

Module 3 – Regulation and Compliance: EU AI Act and GDPR

This module provides participants with a comprehensive understanding of the following:

- Key structure and requirements of the EU AI Act: risk classification and obligations for providers and users.
- Interaction with the GDPR: data protection, privacy by design, and consent management.
- Operational strategies to ensure legal compliance and responsible AI adoption in organisations.

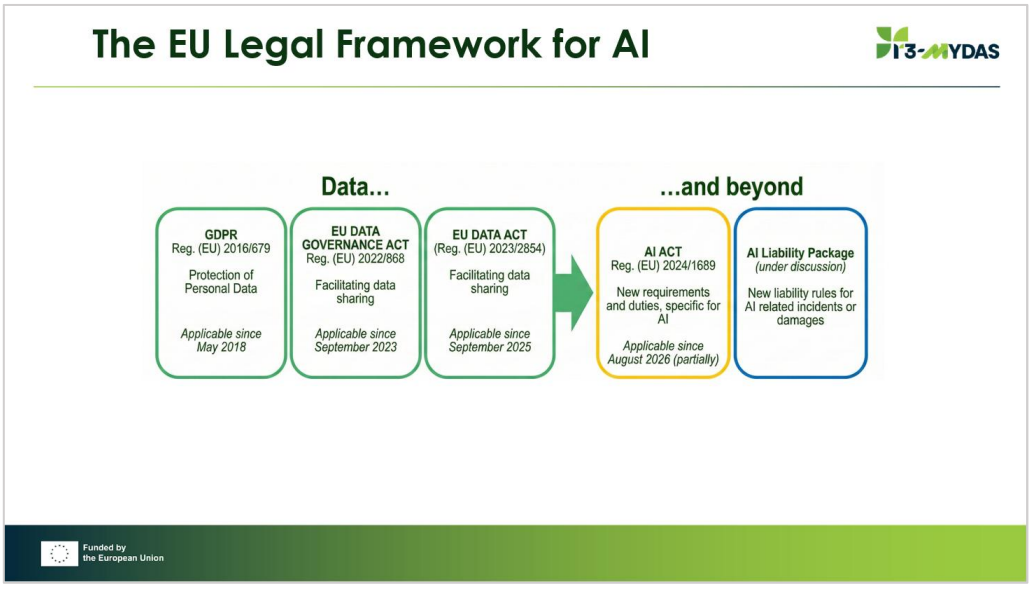


Figure 19: The EU Legal Framework for AI.



Figure 20: The EU AI Act.



Figure 21: AI and GDPR.

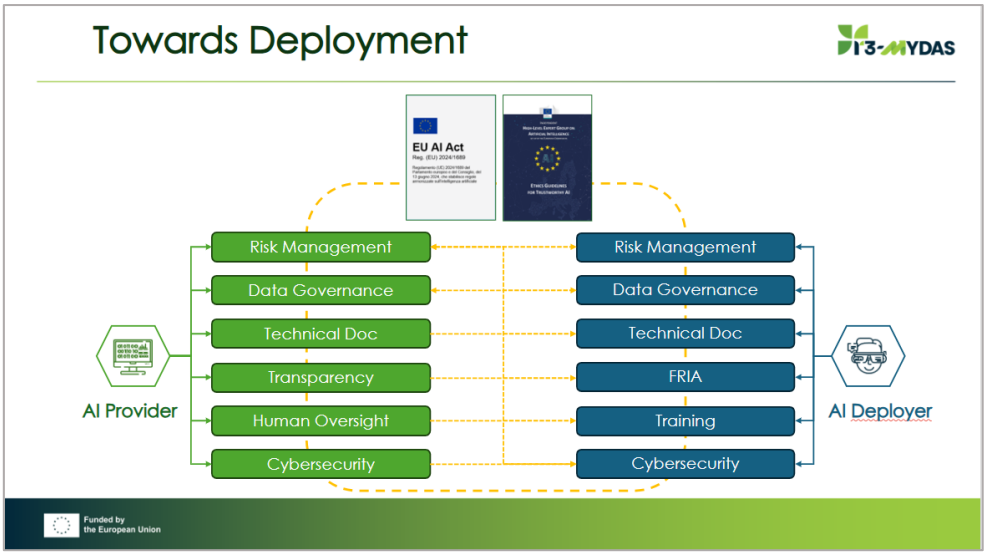


Figure 22: Towards Deployment.

Module 4 – Human Factors Analysis for AI Deployment

This module concludes the course covering:

- Principles of Human-Centred AI and *human-in-the-loop* oversight to ensure transparency, user trust, and human agency in automated decision-making.
- Cognitive, organisational, and behavioural impacts of AI deployment: changes in roles, responsibilities, and decision processes.
- Practical strategies for responsible deployment: participatory design, workforce training, usability testing, and post-deployment monitoring of user well-being and trust.

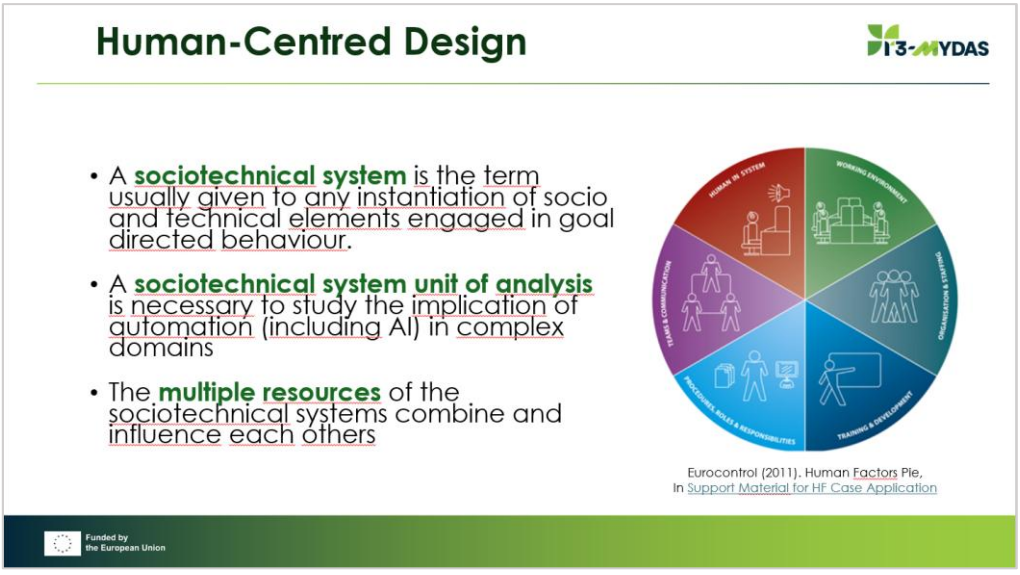


Figure 23: Human-Centred Design.

As for the assessment strategies for the course, a formal knowledge test is considered a straightforward and effective method to evaluate participants' understanding of the core concepts. While case studies can provide valuable opportunities to assess applied learning, they are more suitable for face-to-face or synchronous settings where interaction and guidance are feasible. Since this course is planned for asynchronous delivery through the EIT Manufacturing (EITMAcademy platform, case-study-based assessments may present practical challenges for monitoring and evaluation. Therefore, alternative or adapted approaches may be required to ensure reliable assessment. Careful consideration of delivery format, interactivity, and evaluation logistics is essential to maintain the validity and effectiveness of the assessment process.

To gather input on the AI Act and Ethical & Legal Aspects course, EITM prepared a structured feedback questionnaire targeting R3-MYDAS partners. The survey assessed the relevance of the course content, pilot and final delivery timelines, professional roles of participants, and other practical considerations. The full questionnaire is included in the Appendix.

Preliminary responses from participants, so far representing three project partners, indicate that the course is generally considered highly relevant for both professional development and for supporting project-related activities. Key observations from participants include:

- The course provides a clear introduction to AI in manufacturing and to EU regulatory frameworks, including the AI Act and GDPR, particularly useful for staff who do not require deep technical expertise but need awareness of regulatory and ethical implications.
- The level and depth of content are considered appropriate for entry-level and mid-level professionals, cross-functional staff, and executives involved in project or demo case management.
- Suggested enhancements include the integration of real-world use cases, particularly examples of AI adoption across sectors, including successes and failures, and quantitative data to support learning.
- Some participants highlighted the value of targeting new staff members or those joining from outside the EU, to ensure familiarity with relevant legislation and standards.
- Logistical considerations for participation were noted, including approvals and scheduling constraints for pilot sessions in late January and early February 2026.
- Consider the integration of additional topics such as
    - AI limitations and uncertainty (e.g., uncertainty, bias, concept drift, over-reliance on automation) in Module 1, allowing decision-makers to better understand when AI should, and should not, be used.

- Explainability and transparency in practice: a short practical discussion on explainable AI (XAI), which could be added in Module 2 or Module 4, focusing on what "explainability" means for users, managers, and regulators.
- AI lifecycle and governance perspective: a lightweight overview of the AI lifecycle (from data and training to deployment and post-deployment monitoring) to be potentially integrated in Module 3 or Module 4, especially in connection with AI Act obligations and ongoing compliance responsibilities.

Overall, the feedback confirms the relevance of the course and its potential impact while guiding how to enrich the syllabus with further concepts, practical examples and case studies, ensuring alignment with the skills needs identified by project partners.

The next steps for the development and delivery of the *AI Act, ethics and legal aspects course* will follow a phased, feedback-driven approach, including consolidation of partner feedback, finalisation of course content, pilot delivery with selected participants, and iterative refinement based on the results. The detailed plan of activities and timeline can be reviewed in Table 11.

7 Sustainability, Circularity, and Life Cycle Approaches

One of the key cross-cutting dimensions of the R3-MYDAS project is its focus on environmental sustainability, operationalised through the integration of Life Cycle Assessment (LCA), Life Cycle Costing (LCC), and Social Life Cycle Assessment (S-LCA) methodologies. These approaches enable the systematic evaluation of the environmental, financial, and social performance of the project's use cases, supporting evidence-based decisions for sustainable remanufacturing practices.

To ensure that the knowledge and results generated by these analyses are transferred effectively to both internal and external stakeholders, a dedicated course on LCA and circularity is currently being developed in collaboration with R3-MYDAS partner AIMEN. The course aims to equip participants with the skills necessary to monitor and optimise circular value chains, facilitating the implementation of sustainable remanufacturing, repair, reuse, refurbishment, and recycling strategies.

This training initiative also aligns with key European priorities. The European Skills Agenda[22] highlights the importance of upskilling industrial stakeholders in circular economy principles and green technologies. The following table summarises the preliminary course outline, providing a structured framework for the modules, learning outcomes, and alignment with industry and project needs:

Table 12: Life Cycle Assessment and Circularity in Industry Course Syllabus.

Life Cycle Assessment and Circularity in Industry Course Syllabus	
Section	**Alignment**
Course Title	**Life Cycle Assessment and Circularity in Industry**
Course Description	This course provides a comprehensive introduction to Life Cycle Assessment (LCA) and its role in driving industrial sustainability and circular economy strategies. Participants will learn how to interpret LCAs, integrate circularity into product and system design, and understand relevant European and global frameworks. Practical exercises and examples will strengthen the link between theory and industrial application
Skills and Learning Gap	Despite the widely recognised benefits of remanufacturing, including energy savings, waste reduction, and cost control, there remains a need for

[22] https://employment-social-affairs.ec.europa.eu/policies-and-activities/skills-and-qualifications/european-skills-agenda_en

Life Cycle Assessment and Circularity in Industry Course Syllabus	
Section	**Alignment**
	improved research, data collection, and experimental evidence to quantify the impacts of these strategies. Industry stakeholders require interdisciplinary and documented support to assess the potential of implementing circular value chains in their operations. The course will also complement activities on business modelling and exploitation, as the results of LCA analyses will inform strategic decisions regarding product lifecycle management and investment in circular solutions.
Instructor(s)	Rocio Pena Rois, Ana Fuentes Moldes (AIMEN)
Target Audience	Industry partners in R3-MYDAS, industrial managers, engineers, supply-chain and operations staff, and other non-expert industry stakeholders involved in circular economy or end-of-life decision-making.
Mode of Delivery	Synchronous online (pilot testing) + asynchronous online (final delivery)
Course Duration	6-8 hours (theory + practice)
Overall Learning Outcomes / Objectives	By the end of the course, participants will be able to: • Understand the fundamental principles of LCA and its role in sustainable decision-making. • Define functional units, system boundaries, and circular scenarios. • Collect, analyse, and interpret life cycle inventory (LCI) data. • Assess environmental impacts and carbon footprints using LCA tools. • Integrate circular economy (CE) principles—such as R-cycles and digital product passports (DPP)—into industrial systems. • Recognise relevant international and European sustainability regulations, standards, and initiatives.
Course Structure	• Module 1: Introduction to LCA and Industrial Circularity • Module 2: Goal and Scope Definition – Circular Scenarios & End-of-Life • Module 3: Life Cycle Inventory (LCI) – Data Collection & Management

Life Cycle Assessment and Circularity in Industry Course Syllabus	
Section	**Alignment**
	• Module 4: Life Cycle Impact Assessment (LCIA) & Interpretation
Instructional Strategies and Assessments	Video lectures, readings and infographics, quizzes, and case discussions.
Course Design, Development and Delivery Timeline	1. Course Syllabus Design: [M23-M24] 2. First Draft Course Material Development: [M24-M25] 3. Course pilot testing: [M25-M26] 4. Course Material refinement and final development: [M27-M31] 5. Course Delivery: [M32-M34] 6. Learning effectiveness and impact assessment/evaluation: [M35-M36]

The course is structured into modular content to provide participants with a progressive understanding of sustainability concepts, industrial circularity, and life cycle assessment methodologies. Each module integrates theoretical foundations, practical examples, and interactive learning activities. Below is the full outline, integrating preliminary slides to illustrate key content.

Module 1: Introduction to LCA and Industrial Circularity

- Sustainability Overview:
  - The three pillars of sustainability (environmental, social, economic).
  - Global challenges (climate change, resource depletion, waste).
- Industrial Sustainability:
  - Key terminology: eco-efficiency, decarbonization, circularity.
  - Sectoral initiatives and frameworks (e.g., Science-Based, ISO 14000 series).
  - *Additional information: Global and European Legislation, Standards, and Initiatives:*
    - EU Green Deal, Circular Economy Action Plan, Critical Raw Material Act, SSbD, NetZero Industry, Ecodesign.
    - ISO 14040/44 (LCA standards), ISO 59020 (circularity performance), EN 45558/59 (material efficiency), and Product Environmental Footprint (PEF) method.
- Life Cycle Thinking (LCT):
  - Systems thinking and cradle-to-grave analysis.
  - Examples of life cycle approaches in industry.
- Circular Economy Concepts:

- R-framework (Refuse, Rethink, Reduce, Reuse, Repair, Refurbish, Remanufacture, Repurpose, Recycle, Recover).
- Industrial symbiosis and material loops.
- Digital Product Passport (DPP): structure, data flow, and applications.
  - Case Example: DPP in the battery industry (traceability, critical raw materials, EU Battery Regulation).

- LCA, LCC & sLCA:
  - Integration of environmental (LCA), economic (Life Cycle Costing), and social (Social LCA) dimensions.
  - Introduction to Life Cycle Sustainability Assessment (LCSA).

Learning Activity

- Short quiz: Key LCA and CE concepts.



Figure 24: Pathways to sustainable innovation.



Figure 25: Circular Strategies.



Figure 26: Ecodesign.



Figure 27: Safe and Sustainable by Design.

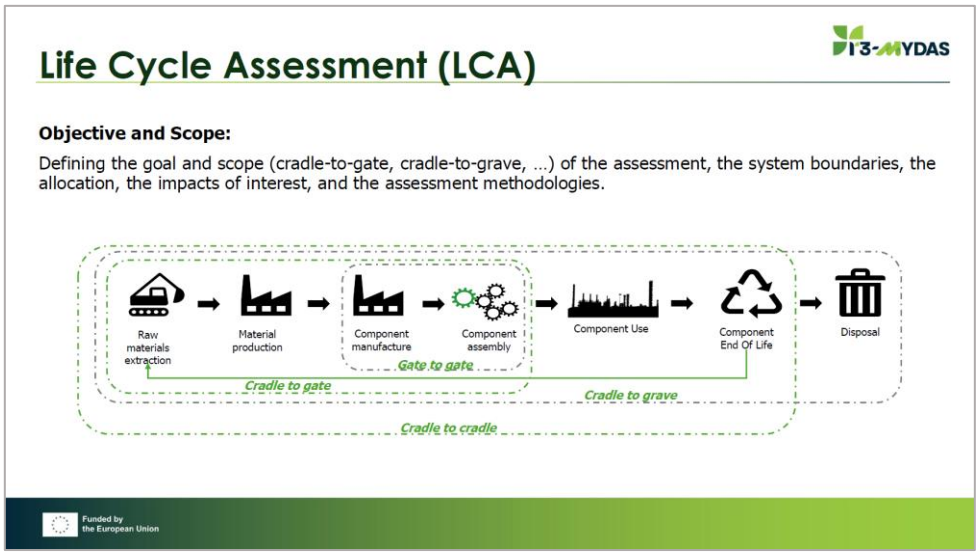


Figure 28: Life Cycle Assessment (LCA).

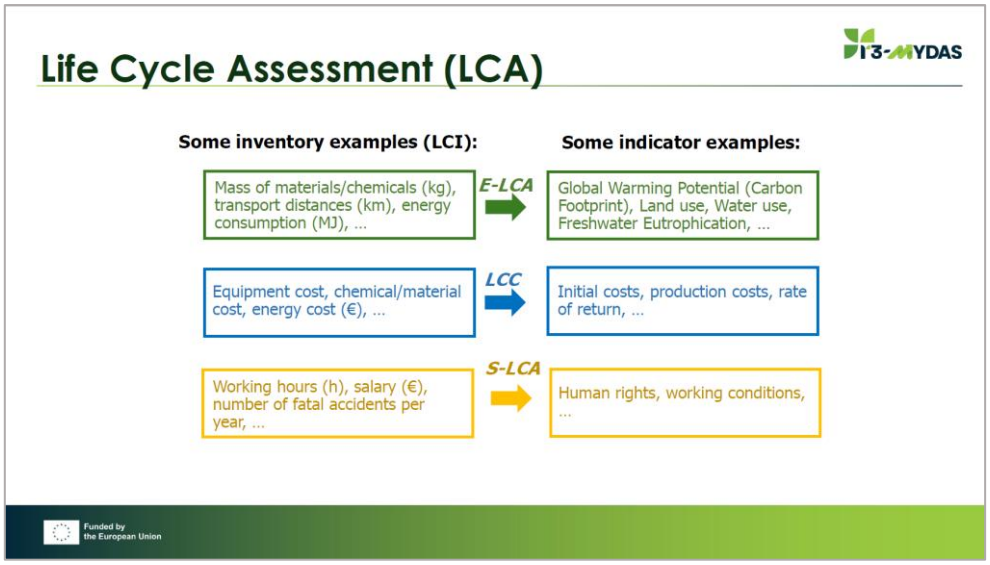


Figure 29: LCI, E-LCA, LCC and S-LCA.

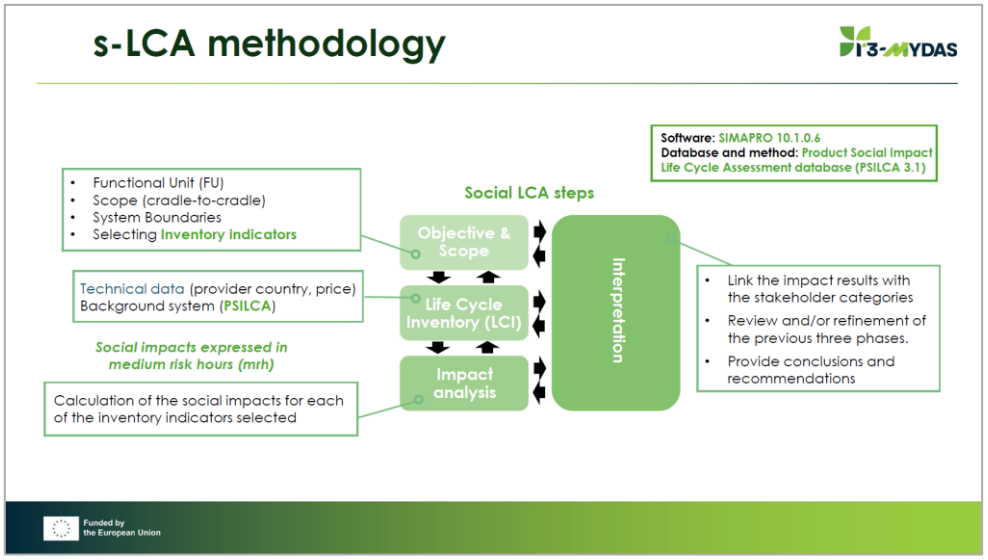


Figure 30: S-LCA Methodology.

Module 2: Goal and Scope Definition – Circular Scenarios and End-of-Life

- Purpose and intended application of an LCA.
- Defining system boundaries, assumptions, and limitations.
- Selecting functional units and reference flows.
- Modelling end-of-life options: recycling, reuse, repurpose, remanufacturing, downcycling and upcycling.
- Creating circular scenarios (closed-loop, open-loop, and cascading use).
- Stakeholder and value chain considerations.

Learning Activity

- Case discussion: Circular initiatives in industrial sectors (automotive, electronics, energy, packaging).

Exercises

1. Functional Unit Definition: Students define the functional unit for a selected case study (e.g., 1 kWh of stored energy for a battery system, or a component of a large equipment).
2. Circular Value Chain & Scenario Design: Teams design alternative life cycle scenarios that introduce circular strategies—such as material recovery or component reuse—and compare them with the baseline.

Module 3: Life Cycle Inventory (LCI) – Data Collection and Management

- Data types: primary, secondary, and tertiary sources.
- Data quality indicators (time, geography, technology).
- Use of LCI databases: ecoinvent.
- Data gaps, uncertainty, and sensitivity analysis.
- Digitalisation and automation of data collection (IoT, DPP, blockchain).

Exercise

- Complete a Life Cycle Inventory: Students compile inventory data for a chosen product or process, identify data sources, and construct an LCI model

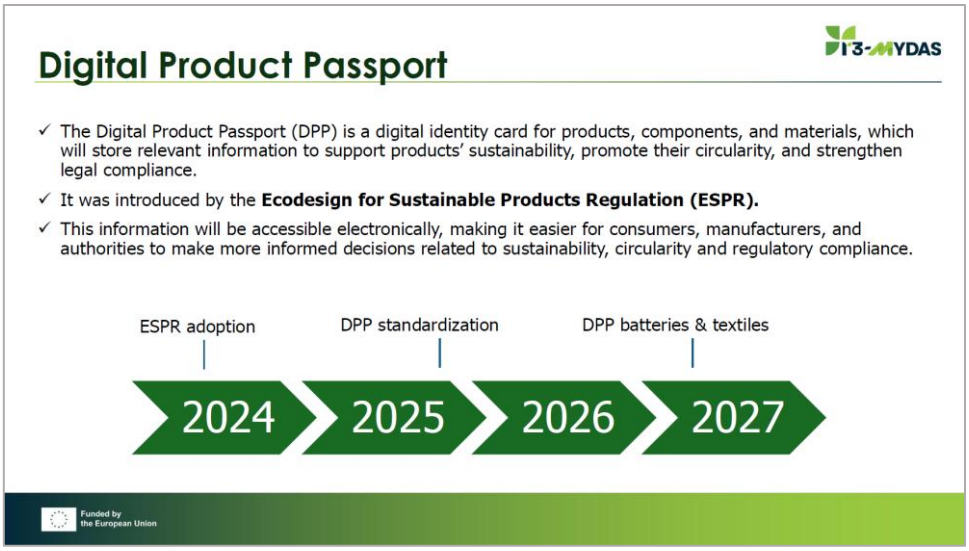


Figure 31: Digital Product Passport.

Module 4: Life Cycle Impact Assessment (LCIA) and Interpretation

- From inventory to impact: impact categories (climate change, eutrophication, toxicity, resource depletion). Common methods: ReCiPe, CML, EF 3.1.
- Interpretation of results. Hotspot identification and improvement potential.
- Integration of LCA results into design, product development, and policy decisions.
- R3MYDAS Results Interpretation: Example of circular design optimization through life cycle.

Exercise

- Carbon Footprint Calculation: Quantify the carbon footprint of a product or process and analyse key contributors to GHG emissions.

As shown, the proposed modules incorporate a diverse set of assessment strategies, including case discussions, practical exercises, and data analysis tasks, which have already been identified and mapped to the course content. This variety ensures that participants can develop both theoretical understanding and hands-on skills in circularity and life cycle assessment. The timeline for developing, piloting, and delivering this course aligns closely with that of the AI course presented in Section 6.4, facilitating coordinated implementation and allowing synergies in training activities across the project.

8 Conclusions

8.1 Relevance to Made in Europe

The tables below summarise the contributions towards the Made in Europe strategy[23] stemming from the work reported in this deliverable.

Table 13: Contributions towards specific objectives of Made in Europe.

Objectives	Our contribution
Specific Objective 1: Efficient, responsive and smart factories and supply chains	
• R&I Objective 1.4: Artificial intelligence for productive, excellent, robust and agile manufacturing chains - Predictive manufacturing capabilities & logistics of the future	While the training strategy does not directly influence the deployment of AI systems, it provides technical training and simultaneously develops cross-cutting competencies in ethical, human-centric, and safe AI practices. This approach supports predictive manufacturing capabilities, agile responses to process deviations, and robust decision-making in EV battery remanufacturing and other industrial contexts.
Specific Objective 4: Human-centred and human-driven manufacturing innovation	
• R&I Objective 4.2: Advanced human-device interaction	The training addresses key thematic areas that enable workers to interact safely and intuitively with robots and automated systems used in the project's remanufacturing processes. By covering ergonomics, communication cues, shared workspaces, and fundamental safety principles, the training directly supports more effective, human-centred collaboration with robotic technologies, fully aligned to advance human-device interaction in manufacturing.

[23] See https://effra.eu/wp-content/uploads/2023/12/made_in_europe-sria.pdf.

Objectives	Our contribution
• R&I Objective 4.4: Manufacturing Innovation and change management	The development of targeted, cross-demo courses, combined with pilot testing and feedback mechanisms, fosters workforce upskilling and supports the adoption of innovative manufacturing processes. This ensures smoother organisational change management and facilitates the integration of advanced remanufacturing solutions into industrial practice.

Table 14: Contributions towards key technologies and enablers of Made in Europe.

Key technologies and enablers	Our contribution
A skilled workforce	The R3-MYDAS training activities contribute to developing **a skilled workforce** by providing targeted upskilling across digital, green, and human-centred manufacturing domains. The project delivers new courses—such as those on AI ethics and regulatory compliance, Life Cycle Assessment and Circularity, and Human-Robot Interaction—and complements them with mapped existing training on materials processing, post-processing, surface treatment, and additive manufacturing. Together, these learning pathways enhance the competencies needed for data-driven remanufacturing, sustainable value-chain management, and safe, effective integration of advanced technologies in industrial environments.

8.2 Concluding Remarks

The R3-MYDAS training framework strategically addresses the intersection of digital, green, and human-centred competencies required for advanced remanufacturing of energy goods at the industrial level. The preliminary material presented in this report

combines existing consortium resources with newly designed courses that leverage internal expertise to ensure that the modules are aligned with project activities, market needs, and European policies and priorities. Incorporating partner feedback ensures that training remains relevant, adaptable, and responsive to stakeholders' needs. The training is designed for key audiences—including technicians, managers, recyclers, second-life operators, and regulatory/compliance staff—to promote the wider adoption of remanufacturing processes by equipping participants with practical knowledge and the skills required to implement these processes.

To achieve these objectives, the framework adopts a modular approach that enables adaptation to different contexts and evolving project requirements. Flexible learning is supported through e-learning modules delivered via the EITM Academy platform for more theoretical topics, while practical content is conveyed through hands-on and scenario-based exercises. Most of the materials will be publicly available, ensuring accessibility and transferability, and allowing stakeholders outside the consortium to benefit from the training and apply the knowledge in diverse industrial settings.

The implementation of this approach is guided by a phased, feedback-driven development process—including pilot testing and iterative refinement—which ensures that training is evidence-based, partner-informed, scalable, and transferable across demonstration cases.

Together, these elements ensure that the R3-MYDAS training activities reinforce EU priorities such as "A Skilled Workforce" under Made in Europe, promote the adoption of circular economy principles, foster ethical AI and human–machine collaboration, and maximise both industrial competitiveness and societal impact. The framework also ensures measurable outcomes, including stakeholder engagement, effective skills development, and the practical application of acquired knowledge, thereby supporting the long-term uptake and replication of innovative remanufacturing processes beyond the consortium.

The following steps will guide the continued development, piloting, and deployment of R3-MYDAS training activities:

1. Consolidation and Analysis of Partner Feedback

- Continue to collect, consolidate, and review feedback from target partners.
- Use this feedback to refine learning objectives, content coverage, and alignment with target audiences across all courses.

2. Finalisation of Course Design

- Demo Cases 1 and 3 – Advanced Manufacturing and Remanufacturing Processes: Collaborate with EWF to identify subject-matter experts (SMEs) who will refine

course syllabi and select training materials to be customised for R3-MYDAS courses.

- Demo Case 2 – Battery Systems, Battery Analysis, and HRI Courses: Identify subject-matter experts from LUT and collaborate with SPIN, AVL, and NCI to gather training materials for the development of new courses.
- *AI Act, Ethical, and Regulatory Aspects* and *LCA and Industrial Circularity* Courses: Prepare for pilot delivery (M25–M26).
- Existing Courses: Integrate EITM and partner resources into updated course outlines or provide them as recommendations if other content is prioritised.
- Ensure consistency, quality assurance, and alignment with identified skills gaps and project objectives.

3. Pilot Delivery and Final Materials Development

- Conduct pilot sessions with selected R3-MYDAS partners to test content clarity, practical applicability, and assessment methods.
- Collect feedback to inform iterative improvements across all courses.
- Develop finalised courses materials and integrate on EITM Academy platform.

4. Final Course Delivery

- Release finalised courses in asynchronous or blended formats via the EITM Academy, incorporating refinements from pilot feedback and partner input.

5. Monitoring and Evaluation

- Assess learning effectiveness, knowledge transfer to demonstration cases, and practical application of acquired skills.
- Evaluate the need for additional modules or workshops to address emerging skills gaps or newly identified needs.

This structured approach ensures that R3-MYDAS training will continue to prioritise partner needs and leverage synergies across courses and demonstration cases, fostering meaningful skills development while maximising impact and achieving project objectives.

9 References

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Appendix A AI Act, ethical and legal aspects: feedback questionnaire

Introductory Text

This course has been designed to address the **skills needs identified in the Skills Gap Analysis (Task 8.4)** conducted by **EITM**, ensuring that the training content responds to the growing demand for competencies that enable professionals to work effectively in an industrial environment increasingly shaped by artificial intelligence (AI) and digital technologies.

Your feedback on this syllabus will help us ensure that the course content and delivery approach remain relevant to the real skills needs of the R3-MYDAS partners. Completing this form will take approximately 15 minutes, and it can be circulated within your organisation to gather a broader perspective on workforce needs across different roles and levels of responsibility.

Section 1: Respondent Profile

1. [SINGLE CHOICE] Please select your organisation
2. [SINGLE CHOICE] Which of the following best describes your current professional level?*
    - Early-career/Associate
    - Mid-level professional
    - Senior professional / Manager
    - Executive / Leadership
3. [SINGLE CHOICE] Primary area of work*:
    - Technical / Operations
    - Business / Management
    - Policy / Governance
    - Education / Training
    - Other:

Section 2: Course Content and Structure

4. [SINGLE CHOICE] Please review the course syllabus before answering this question. How relevant is the proposed course to your current role or professional development needs?*
    - Very relevant
    - Somewhat relevant

- Neutral
- Not very relevant

5. [OPEN TEXT] Please provide more details to explain your previous answer
6. [SINGLE CHOICE] How relevant is the proposed course to the activities carried out in the demo case you're involved in (if applicable)?*

    - Very relevant
    - Somewhat relevant
    - Neutral
    - Not very relevant
    - Not applicable

7. [OPEN TEXT] Please provide more details to explain your previous answer
8. [SINGLE CHOICE] How appropriate is the level and depth of content for professionals in your field?*

    - Too basic
    - Appropriate
    - Too advanced

9. [SINGLE CHOICE] Which organisational roles or levels do you believe this course would be most suitable for?*

    - Entry-level professionals
    - Mid-level professionals
    - Senior managers / Specialists
    - Executive leadership
    - Cross-functional staff
    - Other:

10. [OPEN TEXT] Could you specify the relevant roles within your organisation this course would be most suitable for?
11. [OPEN TEXT] Is there any missing topic, related to the course focus, that you would like to see covered?*
12. [LIKERT SCALE] How would you rate your current knowledge level in the course topics?*

None: I have no prior knowledge of this topic.
Basic: I am somewhat familiar but have limited understanding.
Intermediate: I understand the main concepts and can apply them with some

guidance.
Advanced: I have a strong grasp and can apply the concepts independently.
Expert: I have deep, comprehensive knowledge and can mentor others on this topic.

Topic 1: AI Fundamentals and EU Context
Topic 2: Ethics of AI in the European Framework (ALTAI)
Topic 3: Regulation and Compliance: EU AI Act and GDPR
Topic 4: Human Factors Analysis for AI Deployment

13. [OPEN TEXT] Is there anything from your work activities you'd likely apply the knowledge to?
14. [OPEN TEXT] What kinds of real-world use cases or industrial scenarios would you find most useful to include in the course? *(For example, applications in production planning, quality control, predictive maintenance, etc.)*
15. [SINGLE CHOICE] Would you be willing to contribute to the design of a use case drawing on a project or demonstration case from your organisation?*

- Yes
- Possibly / I'd like to know more
- No

Section 3: Delivery Timeline and Resources

16. [OPEN TEXT] This course might be piloted in a synchronous format over 1–2 days in the first months of 2026. Do you foresee any organisational or personal constraints to participating in late January or February?*
17. [OPEN TEXT] Is there anything you would need in order to participate in the course (e.g., resources, approvals, accessibility considerations)?
18. [OPEN TEXT] Please share any additional suggestions or comments for improving the course syllabus.