D2.3.

THE SYMBIOTECH TRAINING IMPLEMENTATION REQUIREMENT PLAN

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1. Introduction

The objective of the *SymbioTech Training Implementation Requirement Plan* is to define and describe the necessary requirements, competences and collaboration factors which must be in place to implement the digital Industrial Symbiosis (IS) training.

According to the data obtained during the interviews (D2.2), the recommendations for designing the HEI and VET training in IS, which address both the content and the structure of such programs and emphasise the need to equip managers with the necessary knowledge, skills, and competences and the need to integrate practical case studies, digital tools and cross-sectoral perspectives, are the following: complementarity of HEI and VET training, balance between theory and practice, strengthening the digital and technological component, highlighting the legal and regulatory component, development of soft and facilitation skills, highlighting sectoral and industry specialisations, integration of technical and social competences, ensuring sustainable leadership, and the development of modular training programs based on microcredentials. Based on the above it is apparent that the ideal training program for digital IS managers should blend technical, digital, regulatory, financial, and soft skills, emphasising practical and cross-sector collaboration.

The entire digital IS training program and each module has been planned in accordance with the quality cycle (D2.2): *planning* (defining objectives, learning outcomes, assessment methods, and success criteria), *implementation* (actual delivery of the course (bootcamp, e-learning, work tasks), *evaluation* (checking whether the objectives and learning outcomes have been achieved), *review* (evidence archived for continuous improvement and quality assurance), and *recognition* (digital badge awarded upon successful performance across all tasks).

The structure of the *SymbioTech Training Implementation Requirement Plan* is as follows: first, the purpose of the training program is analytically presented, and the target audience is determined. This is followed by defining the learning objectives and outcomes as well as the content of the courses to be delivered. In the next section, the teaching methods of HEI training in IS and the key tools and resources for VET training in IS are presented as well as the training schedule and the technical and logistical requirements. The methods for the training evaluation & feedback are then presented. Finally, the risk assessment and mitigation and the marketing plan of the SymbioTech training program are presented.

2. Purpose of the Training

The SymbioTech training program aims to:

- build knowledge and capacity of the SymbioTech project partners for the effective use, deployment, and scaling of Digital IS platforms and practices,
- build knowledge and capacity of HEI teachers and VET providers to improve their IS digital competences, produce better teachers and trainers, increase their range of academic teaching and training offerings, and find them new students and customers,
- equip SymbioTech business staff and managers and stakeholders with the necessary knowledge, skills, competences, and tools to effectively adopt and apply digital technologies in IS practices with regard to the use and exchange of resources, waste reduction, etc.,
- educate HEI and VET students to fill the role of a SymbioTech manager after study, who will be in charge of establishing and performing digital IS mechanisms and supervising their operation through cutting-edge technologies,

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- exchange knowledge and good IS practices among Symbiotech project partners, business managers, HEIs and VET providers and their students, labour market actors representing several industry sectors, SMEs, facilitators, specialised research institutes, business support organisations and relevant policy-maker institutions,
- increase the attractiveness of upskilling and reskilling activities in the field of Digital IS,
- support the wider adoption and replicability of the Digital IS program,
- leverage transnational education-business collaboration in the IS ecosystem and establish partnerships in several countries among HEIs, VET providers, SMEs, labour markets, facilitators, specialised research institutes, business support organisations and relevant policy-maker institutions to enhance IS skills and opportunities by leveraging cutting-edge technologies,
- enhance the cooperation between education and training, research, labour market, the public and business sector,
- promote cross-industry collaboration,
- set the foundations for formulating local, regional and even broader networks for IS implementation,
- facilitate the creation of the SymbioTech Digital IS Alliance,
- provide the SymbioTech managers with innovative digital tools to facilitate the creation, establishment, operation, monitoring and evaluation of the symbiotic collaborations between SMEs,
- create innovative labour market opportunities for the SymbioTech managers to assist SMEs in delivering performing and sustainable Digital Symbiotic practices and collaborations,
- support the SMEs' transition towards the Digital IS paradigm,
- empower more women employed in European SMEs to take the role as SymbioTech managers,
- advance the Circular Economy through the innovative Digital IS paradigm,
- promote green entrepreneurship for the SymbioTech managers,
- promote sustainable industrial practices and sustainable growth,
- support compliance with industry standards,
- support EU policies that promote and facilitate digital IS,
- use innovative educational techniques and real-world Digital IS practices to provide HEI and VET students with the qualifications sought by the labour market,
- develop and describe new professional learning pathways for upskilling Digital IS skills among European SMEs,
- implement the course materials produced for the development of Digital IS training skills with pilot training on target groups,
- gather feedback on the validity, suitability and quality of the IS training materials and evaluate them by taking into consideration the opinions of the field experts,
- boost innovativeness.

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3. Target Audience

HEI and VET students are the primary candidates for training in digital IS practices. However, given that the SymbioTech project will develop a EU-wide digital platform to transfer knowledge also to other training providers (except for HEIs and VET) and the general public (D2.2.), the HEI and VET students are not the only candidates to be trained. Business managers or even employees of different departments of a company (either SME or large) such as operations, purchasing, sales, inventory, quality, finance, accounting, marketing, human resources, product/service development, IT, and administrative are welcome to participate in digital IS training. A company's decision on which manager or employee to train in IS depends on factors such as its policy, general training program and schedule, performance data, observations and informal discussions. Employees' records, know-how and experience in the subject, willingness to learn more about company's resources and the capability to exchange them are also factors that should be taken into consideration when a company makes a decision on whom to train in digital IS. A company can also invite partners or even competitors to the IS training program as possible candidates for creating a symbiotic network. Making a decision on which partner to invite depends on factors such as the partners' profiles, know-how and experience in IS, need of information on company's resources (water, energy, by-products, and waste), interest in learning more about the company's resources and capability to exchange them, and whether training or specific information influences the partners' decisions to participate in IS networks and exchange resources. Contributors to developing an IS network such as consultants, facilitators, specialised research institutes, business support organisations and relevant policy-maker institutions can also be invited to participate in digital IS training program.

Based on the above it is suggested that each partner of the Symbiotech project should determine specific organisations in their country for inviting candidates to the digital IS training program. Such organisations can be, in each partner country, HEIs, VET providers, other training providers, industrial/manufacturing companies either large or small-to-medium sized, facilitators, specialised research institutes, business support organisations and relevant policy-maker institutions. Specific strategies for approaching these organisations should be selected by each project partner, enabling them to communicate the message of the Symbiotech IS training program effectively. A brief description of the principles of Circular Economy and IS along with the respective benefits achieved in terms of sustainable growth, can serve as a stimulus for these organisations to seriously consider the invitation to the digital IS training program.

The key prerequisites for the digital IS training, which refer to the skills and knowledge required for trainees to participate in such a program, are as follows: behavioural and social skills, management, organisational, and marketing skills, technical knowledge and IT skills, knowledge of regulatory and environmental issues, and knowledge of mathematical concepts.

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4. Learning Objectives – Outcomes

The "Training Needs Mapping Report" (D2.2) identifies learning objectives – outcomes for multiple modules in both Higher Education (HEI, EQF 6) and Vocational Education and Training (VET, EQF 5) curricula for SymbioTech Managers. While each module has its own specific objectives, the general pattern is that learning outcomes are grouped into knowledge, skills, and competencies.

4.1 Learning Objectives – outcomes of HEI Modules and Expanded Student Competencies

Based on the contents in the "Training Needs Mapping Report" (D2.2), the **overarching learning outcomes** of the HEI modules in the SymbioTech Managers curriculum revolve around equipping learners with the theoretical foundations, analytical tools, and applied methods needed to design, implement, and evaluate Industrial Symbiosis (IS) projects within the broader Circular Economy (CE) framework. Across all seven HEI modules, learners are expected to be able to interpret and apply relevant EU policies and regulatory frameworks, identify and assess symbiotic opportunities within industrial networks, and integrate digital and technological solutions, such as AI, machine learning, blockchain, and simulation tools, into IS practice. They should also be able to evaluate environmental, economic, and social impacts using methodologies like Life Cycle Assessment (LCA), develop viable business models for symbiotic cooperation, and communicate project proposals effectively to diverse stakeholders. The overarching goal is to prepare graduates to become strategic leaders and facilitators of digitalised, sustainable industrial ecosystems.

The **expanded student competencies** for the HEI pathway can be summarised into the three integrated domains of **knowledge**, **skills**, and **competencies** that cut across all HEI modules:

- **Knowledge**: Students gain advanced, specialised knowledge of the principles, history, and evolution of IS, the structure and methodologies of LCA, theories of inter-organisational collaboration, Artificial Intelligence/Machine Learning concepts for material-flow forecasting, blockchain architecture for transparent traceability, energy-efficiency models in industrial networks, and Environmental Management System (EMS) frameworks (ISO 14001, EMAS). They develop a deep understanding of EU sustainability policies (e.g., Fit for 55, taxonomy, CSRD, Energy Efficiency Directive), sector-specific resource flows, and the ethical, legal, and governance considerations associated with deploying digital technologies for sustainability.
- **Skills**: Learners develop the ability to analyse industrial clusters and stakeholder networks, map and model material and energy flows using tools like QGIS, SankeyMATIC, OpenLCA, RETScreen, and HOMER, and apply AI/ML algorithms for forecasting and optimisation. They learn to design governance frameworks, facilitate stakeholder engagement, negotiate agreements, resolve conflicts, and build trust. Technical skills include deploying blockchain-based traceability systems, simulating energy integration scenarios, conducting audits, and creating actionable EMS documentation. Communication skills are emphasised through report writing, oral presentations, and the ability to translate technical results into business-friendly recommendations.

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- **Competences**: Graduates are expected to be capable of independently designing and implementing IS initiatives that integrate technical, economic, and environmental considerations. They will be able to lead cross-sectoral and interdisciplinary teams, make strategic decisions in uncertain environments, and align projects with regulatory and market expectations. Competences also include fostering inclusivity and ethical leadership, ensuring compliance with sustainability standards, and promoting continuous improvement through monitoring, evaluation, and the use of micro-credentials to document expertise. Importantly, they are prepared to bridge technological innovation and organisational change, enabling them to act as both strategists and facilitators in the transition toward a digital and circular economy.

It is interesting to determine a competence map structured between the 8 Core (and transferable) Competence Areas presented in the IS Manager Competency Matrix (pages 24-25 of the "Training needs mapping report" – D2.2.), and the Cross-Cutting vs. Unique elements included in the HEI module learning outcomes (presented in the HEI-level curriculum in the "Training needs mapping report" – D2.2). In Table 1, a modular competency is considered "cross-cutting" if it appears in more than three of the seven HEI curriculum modules and is unique if it occurs only once or twice.

Table 1. Cross-Cutting vs. Unique Elements in HEI Level Competencies Map

Core Competence Area	Cross-Cutting (appears in ≥3 HEI modules)	Unique / Module-Specific
1. Technical Competences	– Understanding of CE & IS principles (Modules 1, 2, 3, 4, 5, 6, 7). – Awareness of sectoral systems, material/energy flows (Modules 1, 2, 6). – Standards knowledge: ISO 14040/14044 (LCA), ISO 50001 (energy), EMAS (EMS) (Modules 2, 6, 7).	– Energy flows, cogeneration, smart grids (Module 6). – EMS design, audits, compliance cycles (Module 7).
2. Digital Competences	– Use of digital mapping/analysis tools (QGIS, Sankey, OpenLCA, Power BI) (Modules 1, 2, 4, 6). – Data interpretation & visualisation for decision-making (Modules 1, 2, 4, 5, 6).	– AI/ML model building (ARIMA, LSTM, clustering) (Module 4). – Smart contract coding (Module 5). – Energy simulation tools (RETScreen, HOMER) (Module 6).
3. Legal & Regulatory Competences	– Understanding of EU policy frameworks (Fit for 55, taxonomy, CEAP) (Modules 1, 2, 5, 6, 7). – Compliance with standards & directives (ISO, EMAS, CSRD, ESG) (Modules 2, 5, 6, 7).	– Blockchain traceability protocols & compliance frameworks (Module 5).
4. Business & Economic Competences	– Evaluating economic feasibility & cost-benefit analysis (Modules 1, 2, 6). – Integrating business model design in IS projects (Modules 1, 3, 6).	– AI-driven process optimisation planning (Module 4). – Blockchain-enabled ESG reporting & anti-greenwashing (Module 5).
5. Strategic & Analytical Competences	– Systems thinking & multi-criteria decision-making (Modules 1, 2, 6, 7).	– Forecasting supply-demand trends with AI/ML (Module 4).

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Core Competence Area	Cross-Cutting (appears in ≥3 HEI modules)	Unique / Module-Specific
	– Integrating technical, economic & environmental perspectives (Modules 1, 2, 6).	
6. Soft & Leadership Skills	– Communication & presentation skills (Modules 1, 2, 3, 4, 5, 6, 7). – Teamwork in multi-disciplinary contexts (Modules 1, 2, 3, 4, 6, 7).	– Conflict resolution & resistance management (Module 3). – Negotiation for shared goals (Module 3).
7. Sector-Specific Competences	*(No broad overlap — each tech module focuses on its own sectoral application)*	– AI/ML for resource flow forecasting (Module 4). – Blockchain for transparent traceability (Module 5). – Symbiotic energy system integration (Module 6). – EMS leadership & audits (Module 7).
8. Inclusive & Social Competences	– Ethical responsibility in data use & sustainability reporting (Modules 2, 4, 5, 7). – Stakeholder engagement & collaboration (Modules 1, 2, 3, 5, 6, 7).	– Privacy/confidentiality trade-offs in blockchain systems (Module 5).

A closer look at Table 1 shows that:

- core technical and digital competences are reinforced in almost every module — these could be centralised into a foundational skills block.
- unique competences are concentrated in the tech-specialisation modules (4, 5, 6, 7), suggesting a modular "core + specialisation" structure.
- soft skills (communication, teamwork) and inclusive/social competencies (ethics, stakeholder engagement) are transversal and can be integrated into assessment rubrics rather than taught in isolation.
- legal and regulatory competences are present in most modules but could benefit from a dedicated capstone policy module that links all domains.

4.2 Learning Objectives - outcomes of VET Modules

Based on the "Training Needs Mapping Report" (D2.2), the **overarching learning outcomes** for the VET (Vocational Education and Training) level in the SymbioTech program aim to prepare learners – particularly current or aspiring SymbioTech Managers – to operate effectively in circular economy (CE) and industrial symbiosis (IS) contexts. Across all seven VET modules, learners are expected to acquire a practical, applied understanding of CE/IS principles, digital and analytical tools, and sector-specific operational processes. By the end of the program, participants should be able to observe, document, and analyse material and energy flows; apply relevant sustainability assessment methods, such as Life Cycle Assessment (LCA); initiate and facilitate inter-organisational cooperation; and work with enabling technologies, including AI, blockchain, and energy-efficiency systems. The overarching outcomes also include the ability to implement Environmental Management Systems (EMS) and contribute to

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sustainability reporting, regulatory compliance, and operational optimisation in SMEs and industrial clusters.

The **expanded student competencies** at VET level can be described across three domains – **knowledge**, **skills**, and **competences/autonomy and responsibility** -which are embedded in all modules:

- **Knowledge**: Learners gain a foundational yet industry-relevant understanding of CE and IS concepts, life cycle thinking, and sustainability frameworks (including the UN Sustainable Development Goals and EU Green Deal). They are introduced to relevant standards and regulations such as ISO 14040/14044 for LCA, ISO 50001 for energy management, and ISO 14001 for EMS. They also develop awareness of enabling technologies (AI/ML, blockchain, digital mapping tools) and their practical applications in industrial contexts.
- **Skills**: Practical capability development is a central component of the VET curriculum. Learners acquire the ability to map and visualise resource flows (e.g. using Sankey diagrams), conduct simplified LCAs with software tools such as openLCA, prepare and interpret data dashboards, and carry out basic predictive modelling. They also practice facilitating early-stage partnerships, drafting Memoranda of Understanding (MoUs), performing mini energy audits, creating blockchain-based traceability records, and developing operational documents such as Standard Operating Procedures (SOPs). These skills are reinforced through a blended learning approach comprising boot camps, e-learning, workplace tasks, and roleplay simulations, ensuring strong links between theory and real-world application.
- **Competences / Autonomy and Responsibility**: Graduates of the VET pathway are expected to operate with a significant degree of independence in identifying opportunities for circularity, engaging stakeholders, and applying improvement measures. They demonstrate the ability to take responsibility for specific CE/IS processes within their organisation, from data-driven decision-making to compliance with environmental standards. The competencies emphasise ethical responsibility, effective communication with diverse stakeholders, cross-team collaboration, and the capacity to adapt to evolving technological and regulatory environments. Learners are also prepared to document their achievements through micro-credentials, ensuring recognition, portability, and relevance of their qualifications in the labour market.

It is interesting to determine a competence map structured between the 8 Core (and transferable) Competence Areas presented in the IS Manager Competency Matrix (pages 24-25 of the "Training needs mapping report" – D2.2), and the Cross-Cutting vs. Unique elements from the VET module learning outcomes (presented in the HEI-level curriculum in the "Training needs mapping report" – D2.2). In Table 2, the Cross-Cutting Overlaps column shows competencies from the VET syllabuses that map to each of the eight categories and appear in two or more modules. The Unique Elements column shows module-specific competencies within that category – these are the "signature" skills of specific modules. This integration ensures the VET map is consistent with the overarching IS Manager competence framework, as outlined on pages 24–25 of the "Training needs mapping report" (D2.2), while still reflecting the hands-on, operational emphasis of EQF 5 training.

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Table 2. Cross-Cutting vs. Unique Elements in VET Level Competencies Map

Competence Category	Cross-Cutting Overlaps from VET Modules (appears in ≥2 VET modules)	Unique Elements from VET Modules
1. Technical Competences	- Recognise/classify material & energy flows (Modules 1, 6). - Apply CE/IS principles in real contexts (Modules 1, 2, 6). - Conduct basic environmental audits (Modules 6, 7).	- Create Sankey diagrams (1). - Perform thermal imaging & Pinch Analysis (Module 6). - Develop EMS policies/objectives (Module 7).
2. Digital Competences	- Use visualisation & mapping tools (SankeyMATIC, Power BI) (Modules 1, 4).	- Build dashboards + forecasting models in Power BI/Prophet (4). - Manage Hyperledger ledger & QR codes (Module 5). - Operate blockchain for traceability (Module 5).
3. Legal & Regulatory Competences	- Awareness of ISO standards (14001, 50001) (Modules 6, 7).	- Apply EMS to meet EU/national environmental rules (Module 7). - Understand EMAS/ISO compliance (Module 7).
4. Business & Economic Competences	- Integrate sustainability gains into workplace improvements (Modules 1, 2).	- Identify efficiency improvements with cost-benefit logic (Module 6). - LCC integration into LCA projects (Module 2).
5. Strategic & Analytical Competences	- Interpret flow/LCA data for decision-making (Modules 1, 2, 4). - Identify hotspots, inefficiencies, and optimisation measures (Modules 1, 6).	- Forecast supply/demand trends from process data (Module 4).
6. Soft & Leadership Skills	- Communicate technical findings clearly (all modules).	- Handle resistance & build trust in partnerships (Module 3). - Draft MoUs for IS collaborations (Module 3).
7. Sector-Specific Competences	- Apply CE/IS to manufacturing, utilities, and waste sectors via workplace tasks (Modules 1, 2, 6).	- Energy audits in industrial clusters (6).
8. Inclusive & Social Competences	- —	- Engage stakeholders in IS discussions (Module 3). - Operate with SHE compliance (Module 1).

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4.3 Comparing HEI and VET competencies through curricula

One way to identify the core transferable skills for SymbioTech Managers is to devise a "crosswalk matrix" that shows which competencies repeat across modules. We use the crosswalk matrix to map two curricula (HEI and VET) by using recurring competencies across all HEI (EQF 6) and VET (EQF 5) modules. Table 3 presents the "Core Transferable Competencies" as explicitly stated in the learning outcomes for each module. Citations point to the original module descriptions in the source. A technical note explaining the derivation of the crosswalk matrix is attached in the Appendix.

Table 3. Core Transferable Competencies and HEI and VET modules.

Core Transferable Competency	HEI Modules (EQF 6)	VET Modules (EQF 5)	Notes
Stakeholder engagement and trust-building	1. IS Framework 3. Inter-org Relations 5. Blockchain (transparency for stakeholders)	3. Inter-org Relations (VET)	Consistently linked to IS project success; appears in both strategic (HEI) and operational (VET) contexts.
Use of digital tools for mapping/analysis	1. IS Framework (QGIS, Sankey) 4.AI/ML (Python, Power BI, QGIS) 5. Blockchain (Solidity, DPPs) 6. Energy Efficiency (RETScreen, HOMER, Sankey)	1. IS Operator (SankeyMATIC) 2. LCA Essentials (OpenLCA) 4. AI Basics (Power BI, Prophet) 5. Blockchain Basics (Hyperledger) 6. Energy Ops (thermal imaging, Pinch)	Digital tool literacy is a universal requirement – from basic visualisation (VET) to advanced simulation/modelling (HEI).
Data analysis and interpretation	2. LCA 4. AI/ML 6. Energy Efficiency	2. LCA Essentials 4. AI Basics 6. Energy Ops	Strong focus on turning data into actionable decisions at both levels.
Application of EU/international standards	1. IS Framework (EU Fit for 55, taxonomy) 2. LCA (ISO 14040/14044) 5. Blockchain (ISO 22095, CSRD) 6. Energy Efficiency (EU Energy Directive) 7.EMS (ISO 14001, EMAS)	2. LCA (ISO 14040/14044) 6. Energy Ops (ISO 50001) 7. EMS Basics (ISO 14001, EMAS)	Standards literacy is embedded across environmental, energy, and digital traceability modules.

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Core Transferable Competency	HEI Modules (EQF 6)	VET Modules (EQF 5)	Notes
Project design and implementation	1. IS Framework 3. Inter-org Relations 6. Energy Efficiency (design scenarios) 7. EMS (complete EMS plan)	1. IS Operator (flow mapping project) 3. Inter-org Relations (engagement plan) 6. Energy Ops (audit & improvement plan) 7. EMS Basics (implementation tasks)	Both HEI and VET require applying concepts to real or simulated projects.
Communication and reporting	1. IS Framework (oral/written proposals) 2. LCA (communicate findings) 3. Inter-org Relations (persuasion, negotiation) 4.AI/ML (business-friendly reporting) 6. Energy Efficiency (technical reports) 7. EMS (external stakeholder communication)	1. IS Operator (oral exam) 2. LCA (presentation and defence) 3. Inter-org Relations (roleplay, MoU) 4. AI Basics (dashboard presentation) 5. Blockchain (traceability presentation) 6. Energy Ops (audit findings) 7. EMS Basics (policy and audit findings)	Communication is consistently assessed, often in oral + written formats.
Ethics, compliance and responsible practice	2. LCA (ethical reporting) 4. AI/ML (data ethics) 5. Blockchain (anti-greenwashing, governance) 6. Energy Efficiency (ethical energy data use) 7. EMS (regulatory compliance)	5. Blockchain Basics (data integrity) 6. Energy Ops (safe operations) 7. EMS Basics (compliance focus)	Ethical and compliance dimensions are embedded in both technical and managerial topics.

From Table 3, we see that:

- most universal competencies across both HEI and VET are Communication and reporting, Use of digital tools, and Data analysis and interpretation, which appear in every pathway.
- HEI focus: Strategy, policy integration, advanced modelling, and leadership in multi-actor settings.
- VET focus: Operational execution, tool operation, and early-stage facilitation.
- Bridging skills (appear in both): Project design/implementation, stakeholder engagement, and standards application – these are the glue between tactical and strategic roles.

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According to the occurrence of these competences in the 7 HEI and VET modules, we adopted a scoring method (per level, 0–5 scale) as follows:

- 0 = Not explicitly present in any module at that level
- 1–2 = Present in a few modules (low coverage)
- 3–4 = Present in most modules (high coverage)
- 5 = Present in *all* or almost all modules at that level

The scoring method yielded the inferred coverage scores shown in Table 4.

Table 4. Scores of competencies as they appear in the 7 HEI and VET modules.

Competency	HEI Coverage Score	VET Coverage Score
Stakeholder engagement & trust-building	4	3
Use of digital tools for mapping/analysis	5	5
Data analysis & interpretation	4	4
Application of EU/international standards	5	4
Project design & implementation	4	4
Communication & reporting	5	5
Ethics, compliance & responsible practice	4	3

From Table 4, the following radar diagram of Figure 1 is drawn. The radar graph highlights distinct but complementary competency profiles between HEIs and VET curricula. Both demonstrate comparable strengths in the use of digital tools for mapping and analysis as well as in communication and reporting. However, HEIs stand out with higher capacities in stakeholder engagement and trust-building, ethics and responsible practice, and particularly in the application of EU and international standards. VET providers, by contrast, exhibit a somewhat narrower skills base, with a stronger emphasis on technical and digital competences, but comparatively weaker performance in compliance and standardisation. Taken together, these profiles suggest that HEIs and VET curricula can generate synergies by combining the technical and applied expertise of VET with the regulatory, analytical, and engagement strengths of HEIs.

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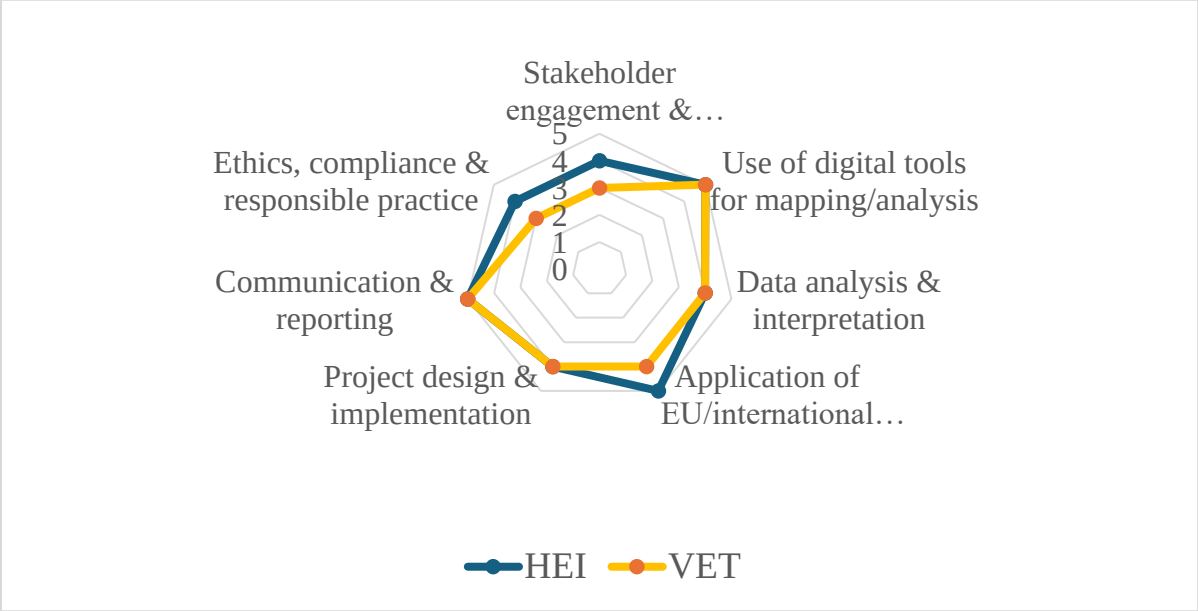

Figure 1. Competency Profiles of HEIs and VET Curricula Across Core Transferable Competencies.

5. The content to be delivered (course content)

The SymbioTech training program builds on the project's ambition to advance the Digital Industrial Symbiosis (IS) paradigm as a cornerstone of Europe's transition towards circular economy. Two curricula are designed for the digital Industrial Symbiosis (IS) training program:

i. one for the Higher Education (HE) level.
ii. one for Vocational Education and Training (VET) level.

Each curriculum includes 7 modules. The modules are designed to strengthen green and digital competences, addressing both Higher Education (HE) learners who require analytical and systemic perspectives, and VET participants who need practice-oriented tools that can be applied directly within SMEs. The main content of each module is presented below.

Module 1: The Industrial Symbiosis Framework

It introduces the conceptual foundations of IS as part of the European Green Deal. HE learners focus on systemic analysis and innovation potential, while VET learners examine practical pathways for resource-sharing and regional cooperation.

Module 2: Life Cycle Assessment (LCA)

It provides methods for assessing environmental trade-offs of industrial exchanges. For HE audiences, emphasis is placed on advanced modelling and impact categories; for VET participants, on simplified tools that can guide operational decisions in production processes.

Module 3: Inter-organisational Relations

It addresses the social and managerial dimensions of symbiosis. HE learners study governance mechanisms and inter-firm networks; VET learners develop skills in negotiation, trust-building, and partnership facilitation relevant for SMEs.

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Module 4: Artificial Intelligence (AI) and Machine Learning (ML)

It explores the use of AI-driven solutions to anticipate material flows and optimise supply chains. HE learners engage with data analysis and modelling, while VET learners use decision-support applications and interactive dashboards.

Module 5: Blockchain Technologies

It focuses on the potential of blockchain to secure and validate exchanges of materials and energy. HE participants consider architecture and compliance frameworks, whereas VET participants are trained in applied use cases such as traceability and digital certification.

Module 6: Symbiotic Energy Efficiency Models

It covers models for collaborative energy management and integration of renewable sources. HE learners address systemic energy optimisation, while VET participants engage with case studies and practical solutions to reduce energy intensity in SMEs.

Module 7: Environmental Management Systems (EMS)

It demonstrates how industrial symbiosis can be embedded into environmental and organisational standards. HE audiences examine the alignment of EMS with ESG and ISO frameworks, while VET learners acquire operational competencies in auditing, monitoring, and reporting.

The structure of the training content is summarised in the following table, which outlines the seven modules and highlights their relevance for both HE and VET learners.

The dual focus on HE and VET ensures that the training is relevant to both academic learners and practitioners in SMEs. The following Table 5 provides a comparative overview of how each module is oriented towards HE and VET contexts.

Table 5: A comparative overview of the modules

Module	HE (Higher Education) focus	VET (Vocational Education & Training) focus
1. Industrial Symbiosis Framework	Systems thinking, conceptual models, policy analysis (EU Green Deal, CE frameworks).	Practical pathways for resource-sharing, local/regional IS initiatives, SME-level applications.
2. Life Cycle Assessment (LCA)	Advanced modelling, quantitative impact categories, integration with research methodologies.	Simplified LCA tools for operational decision-making, basic footprint analysis for SMEs.
3. Inter-organisational Relations	Theories of governance, stakeholder networks, strategic collaboration models.	Negotiation skills, trust-building exercises, practical partnership facilitation in SME context.
4. Artificial Intelligence & Machine Learning	Algorithmic modelling, data science applications, forecasting of complex resource flows.	Application of user-friendly AI dashboards, digital decision-support tools for supply chain optimisation.
5. Blockchain Technologies	Design of blockchain architectures, compliance frameworks, certification systems.	Applied use cases: traceability, transparency, secure digital certification in SMEs.
6. Symbiotic Energy Efficiency Models	Energy systems modelling, integration of renewable energy in industrial ecosystems.	Case studies of energy saving practices, practical audits, hands-on optimisation methods.
7. Environmental Management Systems (EMS)	Strategic integration with ISO, EMAS and ESG frameworks; organisational policy alignment.	Operational auditing, monitoring and reporting competences, application in SME contexts.

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6. Training methods and tools

The digital Industrial Symbiosis (IS) training program will combine online courses, practical workshops, case studies, and projects carried out in cooperation with enterprises. This approach will connect theory with practice, which is particularly important in IS. The integration of practical case studies, digital tools, and cross-sectoral perspectives into the training process is also important to ensure that the programs are aligned with real-world challenges and the evolving demands of sustainable development. Except for the synchronous classes which will be available for the training, the learning will also be asynchronous, meaning that a plethora of course materials will be available online to trainees, including presentations, Word files, figures, videos, and more. From the above it is apparent that the mode of this training program will be blended / hybrid (lectures, workshops, labs, interactive seminars, simulations, group projects, peer collaboration).

6.1 Teaching Methods of HEI Training in Industrial Symbiosis (IS)

The teaching methods which are going to be used can be classified as follows:

1. *Case–based learning*

- Case studies such as the Kalundborg case and emerging clusters.
- In-depth analysis of IS cases to develop critical thinking.
- Case study analyses based on European and global IS projects.
- Case study analysis exploring successful implementations of energy symbiosis projects, focusing on renewable integration, demand-side management, and cost reduction strategies.
- Case-based learning concerning real Environmental Management Systems from industry.
- Presenting real-world cases of IS.

2. *Collaborative Projects*

- Group problem-solving sessions including collaborative exercises where students develop and propose energy management solutions tailored to specific industrial contexts.
- Group project work where students collaborate to conduct a simplified Life Cycle Assessment, enhancing teamwork and integration of knowledge.
- Group projects focusing on industrial process optimisation challenge.
- Projects encouraging collaboration and practical application.

3. *Co-Creation Workshops*

- Co-creation workshops focusing on group activities designing multi-stakeholder forums.
- Workshops that include interactive activities, focusing on problem-solving, group work, and the application of Life Cycle Assessment methods (e.g. ReCiPe).
- Planning workshops for energy integration.
- Design studio approach for IS concepts.

4. *Interactive Lectures & Seminars*

- Interactive lectures presenting key concepts on renewable energy technologies, energy efficiency strategies, and symbiotic energy management models within industrial networks; incorporating the latest research findings and case studies.
- Interactive lectures integrating recent research and policy updates.
- Interactive lectures with demos (Jupyter, Excel ML, PowerBI).

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- Interactive lectures focusing on concepts which are integrated with IS case examples and collaborative activities.
- Lectures and seminars introducing core theoretical concepts and ISO standards (ISO standards 14040 & 14044).
- Lectures with Environmental Management System reference materials.

5. *Flipped Classroom*

- Flipped classroom and expert videos.
- Flipped classroom including video tutorials & machine learning model walkthroughs before class.
- Flipped learning for technical standards.

6. *Practical Labs & Technical Training*

- Hands-on lab sessions with datasets (industrial waste, transport logs).
- Hands-on labs using RETScreen, HOMER, SankeyMATIC.
- Hands-on labs using standard software tools (e.g. Open LCA) to provide practical experience with real-life datasets.
- Mini-hackathons with toolkits (for ML) such as scikit-learn and TensorFlow Lite.
- Open-source and commercial mapping and digital tools (e.g. QGIS, SankeyMATIC).
- Stakeholder mapping labs using PowerMap and QGIS to visualise engagement strategies.
- Technical workshops and hands-on labs using energy simulation software, optimisation tools, and real-world data to analyse energy flows and identify efficiency improvements in industrial clusters.

7. *Expert Contributions & Field/Virtual Visits*

- Expert webinars focusing on AI in waste valorisation.
- Field visits/virtual tours including optional visits or virtual tours of industrial sites practising energy symbiosis to observe technology applications and management practices firsthand.
- Guest contributions from energy auditors or local grid operators.
- Guest lectures and industry talks including sessions led by experts from the energy sector, highlighting cutting-edge technologies, policies, and market trends related to sustainable energy use.
- Guest lectures from industry experts and policy makers (optional).

8. *Simulation & Role-Play Exercises*

- Peer review and role play.
- Practical exercises focusing on policy design, aspect identification, mock audits.
- Simulation for energy integration.
- Simulation-based evaluation.
- Role plays & communication labs including exercises in pitching ideas, answering critical questions, and presenting techniques for negotiation under pressure.
- Conflict resolution simulations and trust-building games.

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9. *Reflection, Coaching*

- Reflection and coaching focusing on individual coaching sessions to enhance personal communication, confidence, and credibility.
- Student presentations with peer feedback and discussions to strengthen communication skills and peer learning.

6.2 Key Tools and Resources for VET Training in Industrial Symbiosis

The key tools and resources to be used can be classified as follows:

1. *Visualisation & Analysis Tools*

- SankeyMATIC – Free web-based software for building Sankey diagrams; used to visualise flow intensity and losses in systems.
- Microsoft Power Business Intelligence (BI) – A leading BI tool for building visual dashboards, exploring time-series data, and performing simple analyses and forecasts.
- Power BI for Shopfloor Workers e-Book (2024) – A practical guide for beginners, explaining how to build and share Power BI dashboards; includes a "10 Common DAX Patterns" cheat sheet for basic calculations.
- Thermal Imaging Camera & Sensors – Used during bootcamp and project work to detect and document heat losses in equipment or processes.

2. *Circular Economy & Industrial Symbiosis Frameworks*

- Circular Economy Canvas Cheat Sheet – Visual reference for identifying loop-closing strategies relevant to SMEs and local production systems.
- Industrial Symbiosis for SMEs Handbook (Ellen MacArthur Foundation, 2024) – Primary reading that explains key IS strategies, practical steps, and case studies tailored to small- and medium-sized enterprises.
- Scenario Comparison Template – A guided worksheet to help learners evaluate "baseline vs improved" or "linear vs circular" product scenarios.
- Partnership and security risk management – PDF used to support trust-building techniques and ethical partnership development.
- Memorandum of Understanding Template Document – Editable outline including key components of a basic agreement.

3. *Life Cycle Assessment (LCA) & Costing*

- Open LCA Software – A free, open-source LCA tool developed by Green Delta; learners use the built-in "Quick LCA" wizard for simplified workflows and gain experience modelling complete product systems.
- Open LCA Beginner's Guide (Green Delta, 2023) – A step-by-step instruction manual that introduces key LCA concepts, open LCA functionality, and guidance for building, analysing, and interpreting models.
- Bill of Material (BoM) and Life Cycle Inventory Template (LCI) Templates – Structured Excel sheets provided to support learners in organising raw material inputs, energy data, and life cycle inventory data before entering into open LCA.
- S-LCA & Life Cycle Costing (LCC) Worksheets – Optional data collection tools to support integration of fundamental social and economic indicators into LCA models, including stakeholder and cost mapping templates.

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4. Stakeholder Engagement & Communication

- Presentation & Pitch Checklist – A guide to help learners structure their 5-slide presentation and prepare for the oral exam or pitch (oral defence) session.
- Stakeholder Mapping Templates – Visual tools and worksheets to categorise actors by influence, interest, and relevance.
- Communication and Influence Toolkit – Includes tips on tone, timing, framing techniques, and persuasion principles adapted from business negotiation best practices.
- Change Resistance Scenario Deck – A set of cards with typical objections and resistance cases used during role-play training.

5. Blockchain & Digital Tracking

- Hyperledger Composer – A low-code blockchain framework for modeling assets, participants, and transactions in permissioned networks.
- Blockchain Composer command-line interface (CLI) Cheat Sheet – A reference guide for executing common ledger operations (e.g. deploying networks, retrieving records) using the Hyperledger Composer command-line interface.
- Blockchain Basics with Hyperledger Composer (Linux Foundation, 2024) – Core learning resource with conceptual explanations and technical tutorials tailored for beginners.

6. Energy & Environmental Management

- Pinch Analysis for Energy and Carbon Footprint Reduction, Ian C. Kemp, Jeng Shiun Lim (2020).
- Energy Efficiency Checklists – Based on ISO 50001, these tools help learners systematically inspect processes and identify common causes of energy inefficiency (e.g. idle machinery, lack of insulation).
- Guide to the requirements of ISO 14001 – A plain English guide to the ISO 14001:2015 Environment Management System (Author: Karam Malkawi,or Pocket Guide to the Basics What every employee needs to know about the iso 14001:2015. A Pocket Guide to the Basics. Harold J. Steudel, P.E., Terry Mann of Steudel and Mann).
- Aspect-Impact Matrix Template – A structured spreadsheet or document for recording environmental aspects, associated impacts, significance, and existing controls.
- Standard Operating Procedures (SOP) Writing Guidelines – Instructional materials and templates for drafting effective procedures (including scope, responsibilities, steps, and emergency instructions).
- EF 3.1 Impact Factor Card – A quick-reference tool that supports learners in interpreting environmental impact results, normalisation values, and midpoint indicators according to the EU Environmental Footprint method.

7. Forecasting & Data Science

- Prophet Forecasting Library – An open-source time-series forecasting model developed by Meta; used for generating simple predictions with confidence intervals.

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7. Training Schedule

Weekly schedules have been established for the syllabi of the 7 training modules of the curriculum for the HEI level. Specifically, in each syllabus, the activities will be conducted within 14 weeks. It is worth noting that, for Modules 1-3, the first 12 weeks include key topics and activities of the module, while the last 2 weeks are dedicated to practical (group) projects, final reviews, and exam preparation. For modules 4-7, the first 11 weeks cover key topics and activities (lab practices/activities) of the module. In the last 3 weeks, group project work, group presentations, a wrap-up, written or oral exams are conducted.

Weekly schedules have also been established for the syllabi of the 7 training modules of the curriculum for the VET level. Specifically, in each syllabus, the activities are going to be conducted within 4 weeks and specifically, on-site bootcamp (face-to-face) in week 1, mentored e-learning and workplace tasks in weeks 2–3, and final assessment in week 4.

8. Technical and Logistical Requirements

The successful implementation of the SymbioTech training programme requires a robust system of infrastructure, equipment, and support services, capable of serving both Higher Education (HE) and Vocational Education and Training (VET) learners while addressing contemporary pedagogical needs.

8.1 Digital Infrastructure

The backbone of the training will be an integrated Learning Management System (LMS) or a customised Digital Industrial Symbiosis (DIS) platform. This system must integrate both synchronous and asynchronous functions, encompassing course management, online lectures, resource sharing, and progress tracking.

Drawing on lessons from comparable projects, the platform should:

- **Ensure multi-device compatibility**, with responsive design for PCs, tablets, and mobile devices.
- **Support accessibility and scalability** through a cloud-based architecture capable of serving large and diverse cohorts, with built-in redundancy mechanisms.
- **Provide best-practice tools**, such as dashboards for monitoring material and energy flows, decision-support systems for IS, and connectors with external platforms (e.g. resource marketplaces, blockchain applications for traceability).
- **Guarantee data protection and GDPR compliance**, including user rights management, encryption of sensitive information, and secure access protocols.

8.2 Equipment for Trainees

In line with established technical guidelines for virtual learning environments, all participants will be expected to have:

- **A laptop or desktop computer** running a modern operating system (Windows 10 or later; MacOS X 10.7 or later), with a dual-core processor, at least 4 GB of RAM, and basic file management skills.
- **A broadband internet connection**, with a minimum bandwidth of 2 Mbps for video conferencing sessions.
- **Updated web browsers** (Chrome, Firefox, Safari) with cookies, pop-ups, and JavaScript enabled.

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- **Installed software** including PDF readers and office productivity tools (e.g. Adobe Reader, Microsoft Office or equivalents).
- **Peripheral devices** such as a webcam and headset/microphone are required for interactive sessions. For modules requiring immersion in virtual or augmented reality, guidance will be provided on the use of VR headsets and compatible controllers.

8.3 Logistical and Technical Prerequisites

To ensure smooth program delivery, the following enablers must be in place:

- **Technical support services**, including a helpdesk with defined procedures for issue resolution and staff training in troubleshooting.
- **Pilot testing**, ensuring all modules and platform functionalities are validated prior to official launch, with particular attention to laboratory compatibility and integration of immersive tools such as VR applications.
- **Alternative access options**, allowing learners to download lecture recordings, videos, and study notes in PDF format for asynchronous study, particularly in cases of low connectivity.
- **Trainer preparation**, equipping instructors not only with technical skills for using the LMS and supporting learners, but also with pedagogical competences in collaborative and digital learning.
- **Interoperability features**, enabling seamless integration with enterprise systems (ERP, MES) and common data standards for cross-platform information exchange.

8.4 Relevance to Digital Industrial Symbiosis (DIS)

Beyond delivering training content, the platform will serve as a **practical laboratory for IS applications**. Learners will be able to:

- Utilise **real-time dashboards** to track material and energy flows in collaborative scenarios, further enhanced by AI/ML predictive tools.
- Participate in **digital marketplaces** that simulate the exchange of resources, waste, and by-products among enterprises.
- Engage with **blockchain demonstrators** to ensure transparency, traceability, and trust in industrial exchanges.

By embedding these functionalities, the training environment will provide both the **technical literacy** and the **hands-on experience** required to prepare participants for their role as future SymbioTech Managers.

These requirements form the backbone of the SymbioTech training program, ensuring accessibility, reliability, and alignment with the project's pedagogical and technological objectives.

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9. Evaluation & Feedback

The evaluation framework of the SymbioTech training program combines engagement analytics, applied projects, formal assessment, and structured feedback. Its purpose is to ensure that training outcomes are transparent, competence-based, and fully aligned with European frameworks for qualifications and lifelong learning. More specifically it includes:

Engagement Metrics

The digital platform records usage patterns including login frequency, module completion, time spent on tasks, and peer interaction. These metrics provide early indicators of learner engagement allowing for targeted support.

Practical Project

Each participant completes an applied project, transferring IS concepts into real or simulated business contexts. This component validates the ability to integrate theoretical knowledge in practice.

Final Exams

Formal evaluation consists of multiple-choice questions, open responses, and case-based problem-solving exercises. These methods ensure a balanced measurement of knowledge, skills, and competences.

Participant Feedback

Structured surveys are conducted to collect learners' reflections on the program. Questions address:

- ✓ how well the training matches their needs and objectives,
- ✓ what knowledge and competences are gained,
- ✓ changes in their professional performance,
- ✓ perceived benefits for their organisation.

Success Indicators & Micro-credentials

Evaluation benchmarks include an average post-assessment score of 80% or higher, as well as qualitative measures such as improved confidence and innovation capacity. To ensure portability and formal recognition, each module concludes with a micro-credential (digital badge), designed in accordance with EQF standards and awarded ECTS/ECVET credits. The following Tables summarise the credentials, workload, assessment, and success indicators of the modules for the HEI curriculum and the VET curriculum.

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Table 6: The credentials, workload, assessment, and success indicators of the modules of the HEI curriculum

Module	Micro-credential (Badge)	EQF Level	Workload / Credits	Assessment / Evidence	Success Indicators
1. Industrial Symbiosis Framework	IS Foundations Badge	EQF 6	100h = 4 ECTS	Case study analysis, written report, seminar presentation	Ability to map material/energy flows and propose IS opportunities
2. Life Cycle Assessment (LCA)	LCA Practitioner Badge	EQF 6	100h = 4 ECTS	Group LCA project, lab assignment, written report, final exam, participation	Correct application of ISO 14040/44; ability to evaluate environmental trade-offs
3. Inter-organisational Relations	Collaboration & Negotiation Badge	EQF 6	100h = 4 ECTS	Stakeholder engagement plan, peer role-play, reflective essay	Ability to design actionable partnership models and governance mechanisms
4. Artificial Intelligence & Machine Learning	AI for Symbiosis Badge	EQF 6	100h = 4 ECTS	Predictive model, dashboard application, case-based report	Accurate forecasting of resource flows and optimisation scenarios
5. Blockchain Technologies	Blockchain Traceability Badge	EQF 6	100h = 4 ECTS	Prototype of blockchain solution, compliance case study, presentation	Ability to design transparent and secure traceability systems
6. Symbiotic Energy Efficiency Models	Energy Loop Designer Badge	EQF 6	100h = 4 ECTS	Energy audit, simulation exercise, project pitch	Capacity to reduce energy use in case study application
7. Environmental Management Systems (EMS)	EMS Practitioner Badge	EQF 6	100h = 4 ECTS	EMS implementation plan, final written exam, participation	Ability to design, implement and audit EMS aligned with ISO/EMAS

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Table 7: The credentials, workload, assessment, and success indicators of the modules of the VET curriculum

Module	Micro-credential (Badge)	EQF Level	Workload / Credits	Assessment / Evidence	Success Indicators
1. Industrial Symbiosis Framework	IS Foundations Badge	EQF 5	75h = 3 ECVET	Bootcamp exercise, Sankey diagram of flows, oral exam	Ability to identify and document material/energy flows; basic IS opportunity recognition
2. Life Cycle Assessment (LCA)	LCA Practitioner Badge	EQF 5	75h = 3 ECVET	Simplified LCA assignment, oral defense, quiz	Correct use of simplified LCA tools for SME decision-making
3. Inter-organisational Relations	Collabora-tion & Negotiation Badge	EQF 5	75h = 3 ECVET	Role-play negotiation, short group project, mentor feedback	Demonstrated negotiation skills and trust-building in SME context
4. Artificial Intelligence & Machine Learning	AI for Symbiosis Badge	EQF 5	75h = 3 ECVET	Use of AI dashboard, case study exercise, short written reflection	Ability to use decision-support tools to improve supply chains
5. Blockchain Technologies	Blockchain Traceability Badge	EQF 5	75h = 3 ECVET	Applied blockchain case study, tool-based traceability exercise	Demonstrated ability to apply blockchain for certification/ traceability
6. Symbiotic Energy Efficiency Models	Energy Loop Designer Badge	EQF 5	75h = 3 ECVET	SME-focused energy audit, group simulation, short presentation	Evidence of identifying practical energy-saving solutions
7. Environmental Management Systems (EMS)	EMS Practitioner Badge	EQF 5	75h = 3 ECVET	Practical EMS exercise, group assignment, short final test	Competence in applying EMS principles in SME operations

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10. Risk Assessment and Mitigation

The implementation of the SymbioTech training program entails certain risks that may impact participation, delivery, and long-term outcomes. Table 8 below summarises the key risks, their estimated likelihood and impact, and the mitigation measures foreseen.

Table 8: Key risks, likelihood/impact and mitigation strategies

Risk	Likelihood / Impact	Mitigation Strategy
Low participation from industry / SMEs	Medium likelihood / High impact	Early stakeholder engagement through targeted campaigns, sector-specific communication, and incentives (recognition, networking, visibility). Involvement of champions from pilot regions to build trust.
Platform usability and technical issues	Medium likelihood / Medium impact	Pre-training demos, tutorials and user manuals; dedicated IT helpdesk; service-level agreement for issue resolution within 24h (as per DOA).
Inconsistent digital access / low digital maturity	Medium likelihood / High impact	Hybrid learning format (online + offline materials); provision of downloadable content; training hubs in pilot regions; extra support for SMEs with low digital readiness.
Resistance to data sharing / lack of trust	High likelihood / High impact	Case studies showing value of data exchange; legal assurance workshops on General Data Protection Regulation (GDPR) and data protection; transparent communication of security (encrypted databases, GDPR compliance).
Reluctance to see the need for a "SymbioTech Manager" role	Medium likelihood / Medium impact	Tailored information campaigns, sector-specific success stories, and alignment with organisational strategies to highlight added value.
Limited funding or resource constraints in SMEs	Medium likelihood / Medium impact	Encourage use of EU/national upskilling funds; offer micro-credentials as low-cost, flexible qualifications; promote employer recognition of training outcomes.
Low long-term impact / sustainability of training	Medium likelihood / High impact	Continuous feedback loops; integration of modules into HE & VET curricula; strong link with exploitation and dissemination plan to ensure continuity beyond project life.

11. Marketing plan of the SymbioTech Training program

Stimulating participation in the SymbioTech training program requires a proactive marketing and communication strategy that increases awareness, builds trust, and highlights tangible benefits. Irrespective of the target audience of the Digital IS training program (e.g. HEI and VET students, business managers and employees, consultants, facilitators, specialised research institutes, business support organisations and relevant policy-maker institutions), specific strategies can be adopted to make the program more widely visible and accepted, such as the following:

Visibility and Information Access

A central point of entry will be established through an official program website, complemented by a wiki page, FAQ section, and dedicated email address. These resources will ensure clarity about the objectives, content, and benefits of the training.

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Evidence-Based Communication

The promotion of the training program will emphasise industry research, policy frameworks, and practical examples to demonstrate how participation in the training supports competitiveness, compliance with EU environmental goals, and organisational innovation.

Testimonials and Peer Feedback

Surveys and feedback collected from early participants will be transformed into promotional material, such as short quotes, infographics, and case studies. This peer-to-peer perspective provides authenticity and stimulates interest among potential learners.

Embedded Promotion within Learning Materials

The training program itself becomes a marketing tool: references to the SymbioTech program integrated into course modules, presentations, and case studies, thereby reinforcing brand identity and increasing visibility.

Advocacy and Champions

Key individuals, including early digital IS adopters, project ambassadors, and industry advocates, will be mobilised to promote the program through blogs, social media, and professional events. Their authentic voice increases credibility and reach.

Momentum and Engagement Campaigns

To maintain interest and anticipation, teaser campaigns will be launched ahead of training roll-out. These include short promotional videos, newsletters, and early-release descriptions of modules to generate momentum.

The following Table 9 presents the marketing strategies to promote the digital IS training.

Table 9: Marketing strategies to promote the digital IS training.

Focus Area	Target Audience	Tools / Channels	Intended Effect
Visibility & Access	Managers, SMEs, employees	Website, wiki page, FAQ, dedicated email	Clear, accessible information hub
Evidence-Based Messaging	Industry stakeholders, clients	Research citations, EU agenda links, pilot cases	Establish credibility and policy relevance
Peer Feedback & Surveys	Potential trainees	Testimonials, survey results, case studies	Authentic promotion through learner voice
Integration in Learning	Training participants	Program branding in modules & materials	Every course doubles as a promotional channel
Advocacy & Champions	Ambassadors, alumni	Blogs, social media, events	Authentic advocacy, wider outreach
Campaigns & Teasers	General public, SMEs	Videos, newsletters, teasers	Build anticipation and sustain excitement

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Appendix

Methodological Note:
The stages for deriving the crosswalk matrix, the categories of which are shown in Table 3:

1. Extracted learning outcomes and competencies from each module plus the "General Learning Outcomes" and "Key Competences Demonstrated" lists (presented in the HEI-level curriculum in the "Training needs mapping report" – D2.2).

- Example: HEI Module 1 – *Industrial Symbiosis Framework* explicitly lists "Identify symbiotic opportunities… using mapping and digital tools" and "Communicate IS project proposals effectively" (pages 57–58). → These were noted down as "digital tools" and "communication" competencies.

2. Matched the *same or similar* competencies across modules

- Used text mining software to look for **recurring verbs and objects** in the learning outcomes ("analyse…", "design…", "communicate…", "apply standards…") and matched them even if wording varied.
  - E.g., "communicate trends using dashboards" (VET AI Basics) (page 103) and "Use QGIS and Sankey diagrams for mapping" (HEI IS Framework) 57 are both mapped to **Use of digital tools for mapping/analysis**.
  - "Negotiate shared goals" (HEI Inter-org Relations) 67 and "Manage partner engagement" (VET Inter-org Relations) 102 are both mapped to **Stakeholder engagement & trust-building**.

3. Clustered overlaps into Core Transferable Competencies

- Once we had the long list of repeated skills, we **grouped them into seven umbrella categories** using a simple clustering software that covered all overlaps without being too granular:
  1. Stakeholder engagement & trust-building
  2. Use of digital tools for mapping/analysis
  3. Data analysis & interpretation
  4. Application of EU/international standards
  5. Project design & implementation
  6. Communication & reporting
  7. Ethics, compliance & responsible practice
- These categories reflect **thematic clusters** of skills that appear in multiple modules at both HEI and VET levels.

4. Verified presence in multiple modules

- For each competency, we checked that it **appears in at least two modules** (often more) and **at both EQF levels**.
- Example: **Communication & reporting** is in *every single VET module* and *every HEI module* (written reports, stakeholder presentations).

5. Cited exact module pages in the crosswalk

- In the table you saw, each cell contains the **module number** where the competency was explicitly stated in learning outcomes or assessment criteria.
- This way, someone can trace each crosswalk link back to the original syllabus text.

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The translated versions of D2.3 can be found at: https://symbiotech-project.eu/d23-the-symbiotech-training-implementation-requirement-plan

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