HUCO LABS

Collaborative **H**vet-**U**niversity-**Co**mpany **Labs** for Research

Collaboration model between VET and business operator in the joint implementation of dual training research paths (HUCO LABS-D.2.3)

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Glossary/List of abbreviations

AI – Artificial Intelligence
BVMW – *Bundesverband mittelständische Wirtschaft*
CAD – Computer-Aided Design
CAE – Computer-Aided Engineering
CAPA – Corrective and Preventive Actions
CMQ MSI – *Campus des Métiers et des Qualifications Microtechniques et Systèmes Intelligents*
CNAM – *Conservatoire National des Arts et Métiers*
COMAU – COMAU (industrial partner)
D2.1 – Deliverable 2.1 (*TRIComp Framework*)
D2.2 – Deliverable 2.2 (*Set of Training Modules*)
D2.3 – Deliverable 2.3 (*Collaboration Model between VET and business operator in the joint implementation of dual training research paths*)
D2.4 – Deliverable 2.4 (*Train the Trainer Programme*)
D3.1 – Deliverable 3.1
D5.1 – Deliverable 5.1 (*Quality Assurance Plan*)
D5.2 – Deliverable 5.2 (*Progress Quality Reports*)
D5.3 – Deliverable 5.3 (*Handbook for Training Implementation Quality Assurance*)
DHBW – *Duale Hochschule Baden-Württemberg*
ECVET – European Credit System for Vocational Education and Training
ECTS – European Credit Transfer and Accumulation System
EEA – European Education Area
EQAVET – European Quality Assurance in Vocational Education and Training
EQF – European Qualifications Framework
ERA – European Research Area
ESCO – European Skills, Competences, Qualifications and Occupations
ESJO – Groupe Scolaire Saint Joseph LaSalle higher education department
EU – European Union
FabLab – Fabrication Laboratory
GDPR – General Data Protection Regulation
HEI – Higher Education Institution
HUCO – HVET–University–Company
HUCO Labs – Collaborative HVET–University–Company Labs for Research
HVET – Higher Vocational Education and Training
IBL – Inquiry-Based Learning
IP – Intellectual Property
ITS / ITS Academy – *Istituti Tecnologici Superiori*
ITSAC – ITS Academy Cuccovillo Foundation

KPI – Key Performance Indicator
MoU – Memorandum of Understanding
PBL – Project-Based Learning
QA – Quality Assurance
QA&E – Quality Assurance and Evaluation
R&D – Research and Development
SC – Steering Committee
SME – Small and Medium-Sized Enterprise
SSMTP – partner abbreviation used in HUCO documentation
TRIComp – Transformation, Research and Innovation Competences Framework
TU – Training Unit
UPV – *Universitat Politècnica de València*
UX – User Experience
VET – Vocational Education and Training
WBL – Work-Based Learning
WP – Work Package

Executive Summary

Deliverable D2.3 defines the collaboration model through which the HUCO Labs training pathways are jointly implemented across Higher Vocational Education and Training (HVET), higher education, and company-based innovation environments. Building on Deliverable D2.1, which established the TRIComp Framework, and on Deliverable D2.2, which documents the integrated module architecture for the Italian EQF Level 5 and French EQF Level 6 pilot pathways, D2.3 translates the HUCO training offer into an operational model for delivery, governance, institutional cooperation, and quality assurance. In this sense, the deliverable provides the organisational backbone required to make the HUCO training architecture workable across institutions, sectors, and countries.

The rationale for this work lies in a structural challenge already identified in the HUCO project application: the development of research- and innovation-related competences for mid-level technicians cannot be achieved through curriculum design alone. It also requires robust forms of cooperation between training providers, universities, and companies. If technicians are to contribute meaningfully to applied research, digital transformation, continuous improvement, and sustainable industrial innovation, then learning must take place in hybrid environments that connect classroom teaching, laboratory work, company-based learning, supervision, and transnational collaboration. D2.3 responds to this challenge by documenting the institutional roles, governance structures, implementation processes, and delivery arrangements through which the two HUCO pilot pathways are organised and tested.

The deliverable therefore goes beyond an abstract cooperation concept. It presents the concrete organisational architecture of the HUCO ecosystem and shows how this architecture is operationalised in the pilot phase. In particular, it documents how the Italian EQF Level 5 pilot is embedded in the existing ITS Academy structure and how the French EQF Level 6 pilot is coordinated by CMQ MSI, delivered in practice by ESJO, and positioned within a CNAM-recognised Bachelor framework. It also specifies the transnational delivery elements of both pilots, including study visits abroad, foreign-teacher modules, online company-testimonial formats, and, in the French pathway, a one-month international internship abroad. In this way, D2.3 makes visible how the HUCO model is implemented through a structured and distributed cooperation arrangement rather than through a single institutional provider.

A central editorial and conceptual decision taken during the preparation of WP2 concerns the treatment of the recognition dimension. According to the application, Task 2.4 addresses procedures for joint implementation and recognition of learning outcomes, while D2.3 focuses on the collaboration model for the joint implementation of dual training-research paths. In the course of drafting the WP2 deliverables, however, the consortium concluded that the recognition interface is inseparable from the way modules are defined, mapped, and compared across

pathways. For this reason, the recognition dimension was integrated already into D2.2, where module architecture, learning outcomes, pathway mapping, partial equivalences, and bridging needs are specified. This did not reduce the importance of D2.3; rather, it clarified its role. D2.3 now concentrates more consistently on the institutional, procedural, and organisational logic that enables the delivery of those modules in practice.

This distinction is important because HUCO is not merely designing a conceptual framework for future collaboration. It is testing a concrete cooperative implementation model in two different national and institutional contexts. The deliverable therefore documents who delivers the pathways, who hosts the mobility elements, how company participation is organised, how higher education institutions contribute, how academic and operational governance are structured, and how communication, monitoring, and quality assurance are managed across the consortium. In this sense, D2.3 functions as the implementation-oriented counterpart to D2.2: where D2.2 defines the module architecture and its comparative logic, D2.3 defines the collaboration architecture that makes this training offer deliverable across real institutions and learning environments.

Substantively, the deliverable shows that the HUCO model is based on a distributed but coordinated ecosystem. HVET institutions provide the organisational and pedagogical framework for pathway delivery; higher education institutions contribute research expertise, specialised modules, and supervision capacity; and companies contribute real-world innovation environments, applied projects, mentoring, and work-based learning. These actors are linked through HUCO Innovation Labs, shared governance mechanisms, transnational delivery formats, and WP5-based quality assurance structures. The result is a collaboration model that supports permeability between vocational and higher education, strengthens the role of applied research in technician education, and creates a more operational connection between the European Education Area and the European Research Area.

D2.3 is therefore best understood as the organisational backbone of WP2. It builds on the competence architecture of D2.1 and the integrated training architecture of D2.2, interfaces with the Train-the-Trainer logic of D2.4, and provides the concrete implementation model required for pilot delivery, monitoring, and later sustainability. By clarifying the collaboration structures, delivery responsibilities, governance levels, and implementation processes of the HUCO training ecosystem, the deliverable creates the conditions under which the project's innovation-oriented pathways can be tested, refined, and potentially transferred to further institutional contexts beyond the initial pilots.

1. Introduction

This deliverable presents the collaboration model through which the HUCO Labs training pathways are jointly implemented across vocational education, higher education, and company-based innovation environments. Its purpose is to document how the HUCO training offer is translated into an operational cooperation architecture involving different institutional actors, governance levels, delivery settings, and implementation processes. The deliverable therefore occupies a central place within Work Package 2, which not only develops the competence framework and module architecture of the training offer, but also prepares the organisational, procedural, and institutional conditions required for piloting and later transfer. D2.3 must thus be read as part of the wider WP2 architecture and as the implementation-oriented counterpart to the module logic defined in D2.2.1.1 Purpose of the Deliverable

The purpose of this deliverable is to define the organisational framework that enables the joint implementation of the HUCO training pathways across different educational systems and institutional environments. The document establishes the structures, roles, and operational processes necessary to deliver collaborative training programmes involving Higher Vocational Education and Training institutions, universities, and industry partners. The organisational model supports the implementation of training programmes designed to develop research-related and innovation-oriented competences among mid-level technical professionals. By integrating vocational and academic learning environments with industrial innovation ecosystems, the HUCO model aims to strengthen the capacity of European education systems to respond to the twin transition towards digitalisation and sustainability.

1.1 Background and project context

The transformation of European industry towards digitalisation, sustainability, and innovation-driven production systems requires new forms of learning in technical education. Mid-level technicians are increasingly expected not only to operate technologies, but also to contribute to experimentation, process improvement, prototyping, digital modelling, and the implementation of innovation in real industrial settings. The HUCO Labs project addresses this challenge by developing a new training architecture that strengthens the interface between Higher Vocational Education and Training (HVET), higher education institutions, and companies. Its two pilot pathways, one at EQF Level 5 in Italy and one at EQF Level 6 in France, are designed to test how research- and innovation-related competences can be embedded within existing technical education structures and delivered in cooperation with industrial and academic partners.

This objective cannot be achieved through curriculum design alone. If the project aims to integrate applied research, challenge-based learning, company-based supervision, transnational teaching, and mobility elements into the training offer, then it also requires a

clearly defined collaboration model. The project application already anticipated this by including, within WP2, not only tasks on competence modelling and module design, but also tasks on pilot course architecture, recognition procedures, and the organisational model for joint implementation. D2.3 is the deliverable that responds to this implementation challenge. It shows how the HUCO pathways are institutionally organised, how responsibilities are distributed, and how the different actors involved cooperate in practice.

1.2 Purpose of the deliverable

In the original proposal logic, Deliverable D2.3 was conceived as the "Collaboration model between VET and business operator in the joint implementation of dual training research paths." This core purpose remains valid. The primary task of D2.3 is to define the organisational and procedural model that enables the delivery of the HUCO training pathways across institutions and sectors. It does so by specifying the institutional roles of HVET providers, higher education institutions, and industry partners; the governance and coordination structures connecting them; the implementation logic of the Italian and French pilot pathways; and the communication, quality assurance, and sustainability arrangements needed to support joint delivery.

At the same time, the drafting process of WP2 led to an important editorial clarification in relation to recognition. According to the application, Task 2.4 covers procedures for joint implementation and recognition of learning outcomes, while D2.3 provides the collaboration model. In practice, however, the consortium concluded that recognition is directly dependent on the module architecture itself: learning outcomes, equivalence, mapping logic, assessment evidence, and bridging arrangements are all defined at the level of modules and pathways. For that reason, the recognition interface was incorporated already into D2.2, where the Italian and French pathways are compared and their modules mapped in relation to each other. This decision did not replace the function of D2.3. Rather, it made the distinction between the deliverables more coherent: D2.2 now carries the integrated curricular and recognition logic, while D2.3 focuses more clearly on the collaboration and implementation architecture that makes those modules deliverable in practice.

This means that D2.3 should not be understood as a second curriculum document. Its function is different. Where D2.2 explains what the HUCO training architecture consists of, D2.3 explains how it is implemented jointly by real institutions, under real governance arrangements, in real teaching, laboratory, and company-based settings. It therefore provides the institutional and procedural layer without which the module design would remain abstract.

1.3 Scope and contribution of this document

Against this background, the present deliverable has four main functions. First, it defines the organisational architecture of the HUCO training ecosystem, including the role of HVET institutions, higher education institutions, companies, and HUCO Innovation Labs. Second, it documents the institutional and operational responsibilities through which the two pilot pathways are implemented in Italy and France. Third, it explains the governance, communication, quality assurance, and monitoring structures that support coordinated delivery across the partnership. Fourth, it outlines the sustainability and transferability logic through which the HUCO collaboration model is intended to continue beyond the pilot phase and beyond the funded project period.

The contribution of the document therefore lies not in repeating the content of the module handbooks, but in making visible the collaboration logic that connects them: who coordinates, who teaches, who supervises, who hosts, who validates, and how the different settings and actors are linked into one ecosystem. This is fully consistent with the broader goals of HUCO Labs, namely, to create a future-oriented training model for technicians that combines research, innovation, vocational learning, higher education, and industrial practice. D2.3 should therefore be read as the organisational backbone of WP2 and as a key bridge between module design, pilot implementation, and later sustainability within the wider HUCO ecosystem.

2. European Context for Collaborative Training Programmes

This chapter examines the European policy context that underpins the HUCO training model. It explains how the project aligns with current priorities concerning cooperation between vocational education, higher education, industry, and innovation ecosystems.

2.1 Integration of Vocational and Higher Education

European education policy increasingly emphasises closer cooperation between vocational education, higher education, and innovation actors in order to strengthen skills development, innovation capacity, and learner mobility. The European Education Area explicitly calls for deeper cooperation between higher education institutions, including joint curriculum development and common courses that make it easier for learners to move across systems and countries, while the wider EU policy framework also promotes stronger links between education, research, and innovation ecosystems (European Commission, 2020). The HUCO training model directly addresses these objectives by establishing collaborative learning environments that link HVET institutions, higher education institutions, and companies in shared pathway design and delivery. In practice, this is done through jointly developed modules, co-teaching by different partner types, shared laboratories and company-based learning environments, and transnational formats such as study visits, foreign-teacher modules, online company-

testimonial modules, and supervised mobility-based project work documented in the HUCO pathways and application.

2.2 Joint Programmes and Transnational Education

Transnational joint programmes and other forms of coordinated cross-border provision have become an important mechanism for strengthening cooperation between European education systems (European Commission, 2022). Current European higher education policy explicitly aims to facilitate deeper transnational cooperation, including the implementation of joint transnational educational programmes and activities, the pooling of capacity and resources, and, where relevant, joint degrees. The European Commission also links such cooperation to improved learning mobility, easier development of joint programmes, and more responsive educational provision for changing societal and labour market needs.

Within the HUCO model, joint implementation does not primarily take the form of a formal joint degree. Rather, it is organised through the coordinated delivery of modular training components across institutions and countries. In practice, this is implemented through jointly developed modules, study visits abroad, modules delivered by foreign teachers, online company-testimonial modules, mobility-based project work, and the shared involvement of HVET institutions, higher education institutions, and companies in supervision and delivery. In this way, HUCO operationalises transnational cooperation through modular pathway design and shared implementation formats rather than through a single integrated qualification award.

2.3 Research-Based Learning in Technical Education

Another important trend in European education policy is the integration of research and innovation competences into vocational and technical education. Mid-level technicians increasingly need to participate in innovation processes, technology transfer, and continuous improvement within industrial environments. In the HUCO competence model, this role is described in much more concrete terms. The TRIComp Framework positions EQF 5–6 technicians as professionals who operate at the interface of applied research, innovation ecosystems, and advanced technical environments, rather than as purely operational staff (Linscheid and Ehlers, 2025). Accordingly, applied research competence in the HUCO model includes the ability to formulate hypotheses, conduct structured experiments, develop and test prototypes, design and implement testing procedures, and interpret and communicate research findings.

The competence model also makes clear that these research-related abilities are inseparable from broader innovation competences. Mid-level technicians are expected to use digital tools across the full R&D cycle, including CAD/CAE applications, AI-assisted modelling, automated testing, and process simulation, while also integrating lifecycle thinking, sustainability considerations, and interdisciplinary problem-solving into development processes. In addition, the model highlights a growing expectation that technicians move beyond passive task execution

and contribute autonomously to problem identification, optimisation ideas, and improvement proposals.

The HUCO training pathways address this need by embedding applied research activities directly into vocational training programmes and by developing hybrid and interdisciplinary competence profiles for future technicians. This reflects the project application, which emphasises that technicians, if properly trained, can make a significant contribution to the continuous improvement of products, processes and technologies and can act as mediators of technology transfer between research and production. In this sense, the HUCO model redefines the technician not simply as an implementer of innovation, but as a practice-based co-creator of knowledge within industrial transformation processes.

3. Organisational Architecture

This chapter outlines the organisational architecture of the HUCO training ecosystem. It explains how the main institutional actors—HVET institutions, higher education institutions, and companies—interact within a shared framework for training delivery, applied research, and innovation-oriented collaboration.

3.1 Overview of the HUCO Training Ecosystem

The HUCO training ecosystem is built upon a collaborative structure linking educational institutions and industry partners through shared learning environments and joint innovation activities.

The ecosystem consists of three core components:

1. HVET institutions delivering vocational training programmes.
2. Universities contributing academic expertise and research-oriented learning modules.
3. Companies providing applied innovation environments and work-based learning opportunities.

These actors interact through a network of HUCO Innovation Labs, which function as collaborative training and research environments.

3.2 Role of HVET Institutions

HVET institutions play a central role in the implementation of the HUCO training pathways. They provide the primary organisational framework for the delivery of EQF Level 5 programmes and coordinate the integration of work-based learning with classroom-based instruction.

The Italian ITS Academy system illustrates this role particularly clearly. ITS programmes combine classroom learning with extensive industry participation and laboratory-based teaching. The training pathway described in the HUCO project includes a 2,000-hour programme structure, combining technical modules, laboratory training, and an 800-hour company internship.

Through this structure, HVET institutions ensure that vocational training remains closely aligned with industrial needs.

3.3 Role of Higher Education Institutions

Higher education institutions contribute academic expertise, research methodologies, and advanced theoretical knowledge to the HUCO training pathways. Their role is particularly important for the delivery of EQF Level 6 modules and for the integration of research-oriented learning activities. In the HUCO model, this contribution is not limited to general academic support; it is operationalised through co-design, co-teaching, research supervision, and the provision of specialised learning environments within the HVET–University–Company triangle.

Higher Education Institutions may provide specialised modules in areas such as:

- applied research methodologies, for example by teaching students how to define research questions, structure inquiry processes, document findings, and translate workplace challenges into applied research projects; the 5th-level pathway already includes a dedicated module on Applied R&D – Applied Research Methodologies, while the 6th-level pathway includes Research and Scientific Communication as part of its advanced curriculum;

- digital technologies and artificial intelligence, for example through input on AI readiness, simulation, data-related competences, and the use of digital tools in technical and industrial contexts; in the HUCO competence framework, these areas are explicitly linked to AIComp, DigComp, and the digital transformation domain, while pathway implementation includes modules and learning activities connected to digital validation, advanced design, and innovation-oriented technology use;

- sustainability and green innovation, for example by contributing expertise on systems thinking, circular economy strategies, environmental assessment, and sustainable product and process design; this is consistent with the competence model and is reflected in pathway modules such as Green Technologies and Circular Economy and Industrial Economics and Sustainable Innovation;

- innovation management, for example through academic input on value creation, project structuring, interdisciplinary collaboration, and the management of complex innovation

processes; in HUCO, this is supported both by the EntreComp-based competence mapping and by pathway elements such as project management, collaborative design, and research-based module development.

In addition, university researchers can supervise applied research projects conducted within the HUCO Innovation Labs. This supervision is envisaged in practical terms: researchers may help define the research challenge together with companies, guide students in the design of methods and review of results, and oversee pilot projects carried out in shared laboratories or during internships. The application specifies that research-based projects are to be supported by collaborative teams of HVET professors, university researchers, and industrial researchers, and that, in international internship settings, university researchers or PhD-level staff can form part of the scaffolding team overseeing implementation. The quality handbook also makes this operational model more explicit by describing co-created content, shared laboratories, structured workshops, and joint supervision arrangements between provider staff and company mentors.

3.4 Role of HUCO Innovation Labs

The HUCO Innovation Labs represent the central collaborative learning environments of the training ecosystem. In the project logic, they are not conceived as a single physical laboratory, but as a shared transnational ecosystem of learning, research, and innovation spaces described in the application as a “Technological European Village for Technicians”. Their core purpose is to make it possible for mid-level technicians to acquire R&D-related competences in authentic settings through the joint contribution of HVET providers, higher education institutions, companies, and research-oriented partners.

Operationally, these labs function as hybrid environments combining provider laboratories in HVET institutions or universities, company sites, and shared university–industry laboratories. The quality handbook explains that these settings are used to connect pedagogical aims with authentic production and research contexts, while ensuring compliance with health and safety, intellectual property, and data protection requirements. Their working logic is therefore based on co-designed projects, inquiry-based and project-based learning, structured supervision, and clearly defined deliverables, milestones, and review gates, so that students do not simply observe innovation processes but work on real or realistic technical challenges in a guided and assessable way.

The labs are operated jointly by the HUCO partnership. The documents distinguish three main actor groups involved in implementation: company-based trainers and industrial researchers, HVET and university teachers, and laboratory supervisors or technical staff. This means that the labs are not run by one institution alone; rather, they depend on the HVET–University–Company

cooperation model that underpins the whole project. In practical terms, partners contribute training environments, specialised equipment, teaching staff, industrial cases, and research supervision, while company representatives and university staff participate in co-design, mentoring, and project validation.

With regard to timing, the application states that the ecosystem is created during the project and that the pilot co-delivery phase starts in the third project year. At that stage, the two pilot pathways, EQF 5 in Italy and EQF 6 in France, begin testing selected training activities within the ecosystem, including study visits, in-house teaching by foreign staff, company testimonials, and, for the EQF 6 pathway, a one-month pilot internship in laboratories belonging to the newly established ecosystem. The pathway documents make this more concrete by linking implementation to the 2026–2027 school year and by identifying concrete learning formats such as prototyping spaces, technical workshops, simulated environments, inquiry-based laboratories, and industry-linked projects.

In terms of resources, the labs build on shared infrastructures, technological equipment, laboratories, trainers, and partner networks rather than on a single newly built facility. The application explicitly states that the ecosystem is intended to support the co-sharing of the catalogue training offer, infrastructures, technological equipment and laboratories. The pathway documents also point to concrete resource types used in implementation, including FabLab-type environments, prototyping facilities, digital rooms, provider workshops, and online industrial testimony formats that open access to real laboratories and production settings.

Sustainability is clearly planned. The application describes HUCO as a first step towards a European ecosystem that should continue beyond EU funding by expanding the network, attracting further organisations, disseminating the training model widely, and maintaining shared access to tools, learning resources, and collaboration structures. It also sets out a long-term logic of continuation through the HUCO ecosystem, the WE HUCO forum, open dissemination of multilingual materials, and the progressive involvement of additional stakeholders and organisations. In this sense, the Innovation Labs are designed not only as project-based pilot environments, but as the nucleus of a durable European cooperation structure for technician training in applied research and innovation.

3.5 Role of Industry Partners

Industry partners play a fundamental role in the HUCO organisational architecture. Their contribution is not limited to hosting students at a later stage, but begins already in the design phase of the training pathways. According to the HUCO quality handbook, companies are involved through short co-design workshops, in which workplace tasks and innovation challenges are translated into learning outcomes, activities, and assessment criteria together

with HVET and university partners. The same document also foresees a structured partnership logic with agreed roles, decision rights, meeting schedules, data-sharing procedures, and formal arrangements on supervision, facilities, health and safety, confidentiality, and intellectual property. In this sense, company participation is organised through recurring technical and governance formats rather than through ad hoc support only.

Companies also contribute directly to delivery. The application states that industrial researchers and company experts are part of the new HVET–HEI–Company cooperation approach and are expected to cooperate with teachers and professors in dual training pathways that combine classroom learning with applied research in work contexts. In operational terms, this includes company testimonials in online modules, participation in selected teaching activities, and the definition of practical constraints and expected outputs so that training remains aligned with real industrial practice. The handbook describes this as a co-delivery model in which company mentors work together with educational staff through joint planning, co-teaching, moderation meetings, and shared project reviews.

A further major contribution of companies lies in internships, applied projects, and access to authentic environments. The project application explicitly foresees internships and research projects proposed by companies, supported by collaborative teams composed of HVET professors, university researchers, and industrial researchers. For the EQF 6 pilot, internship teams are even specified as consisting of one school professor, one university researcher, and one company researcher. The same documents make clear that companies provide access not only to workplaces, but also to industrial laboratories, equipment, and real operational constraints, within the wider HUCO ecosystem of shared infrastructures and laboratories.

In the Italian HVET pathway, companies contribute a substantial portion of the training activities, ensuring strong alignment with industrial practice. This is visible not only in the general cooperation model of the pathway, but also in the broader ITS logic, where the curriculum is explicitly linked to company needs, advanced laboratories, and a large internship component. More generally, the HUCO evidence base underlines that close collaboration with companies should rely on co-designed projects, mutual feedback loops, and real-world application contexts, because these are essential to relevance and innovation-readiness.

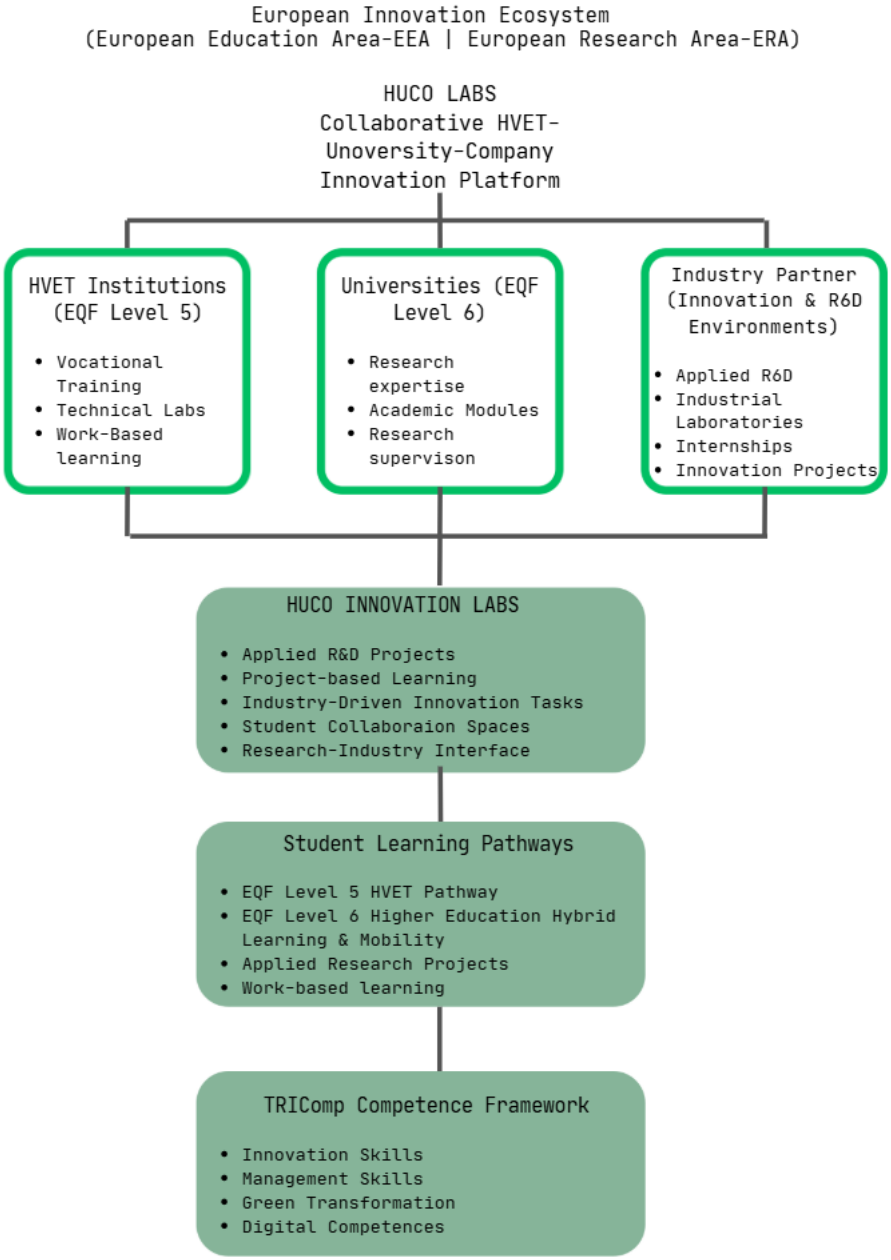

Figure 1- Organizational Ecosystem (authors` own elaboration)

Figure 1 illustrates the organisational ecosystem established by the HUCO Labs project. The ecosystem connects Higher Vocational Education and Training institutions, universities, and industry partners through collaborative innovation labs. These labs function as shared learning and research environments where students develop innovation competences through applied R&D projects and work-based learning.

4. Institutional Roles and Responsibilities

The successful implementation of the HUCO training pathways requires a clearly defined distribution of roles and responsibilities among the participating institutions. Because the training ecosystem integrates actors from different educational sectors and national systems, a transparent organisational structure is essential to ensure effective collaboration, accountability, and quality assurance. The following Figure shows formal overview of governance, delivery roles, learning environments, and quality assurance across the HVET–Higher Education–Company cooperation model.

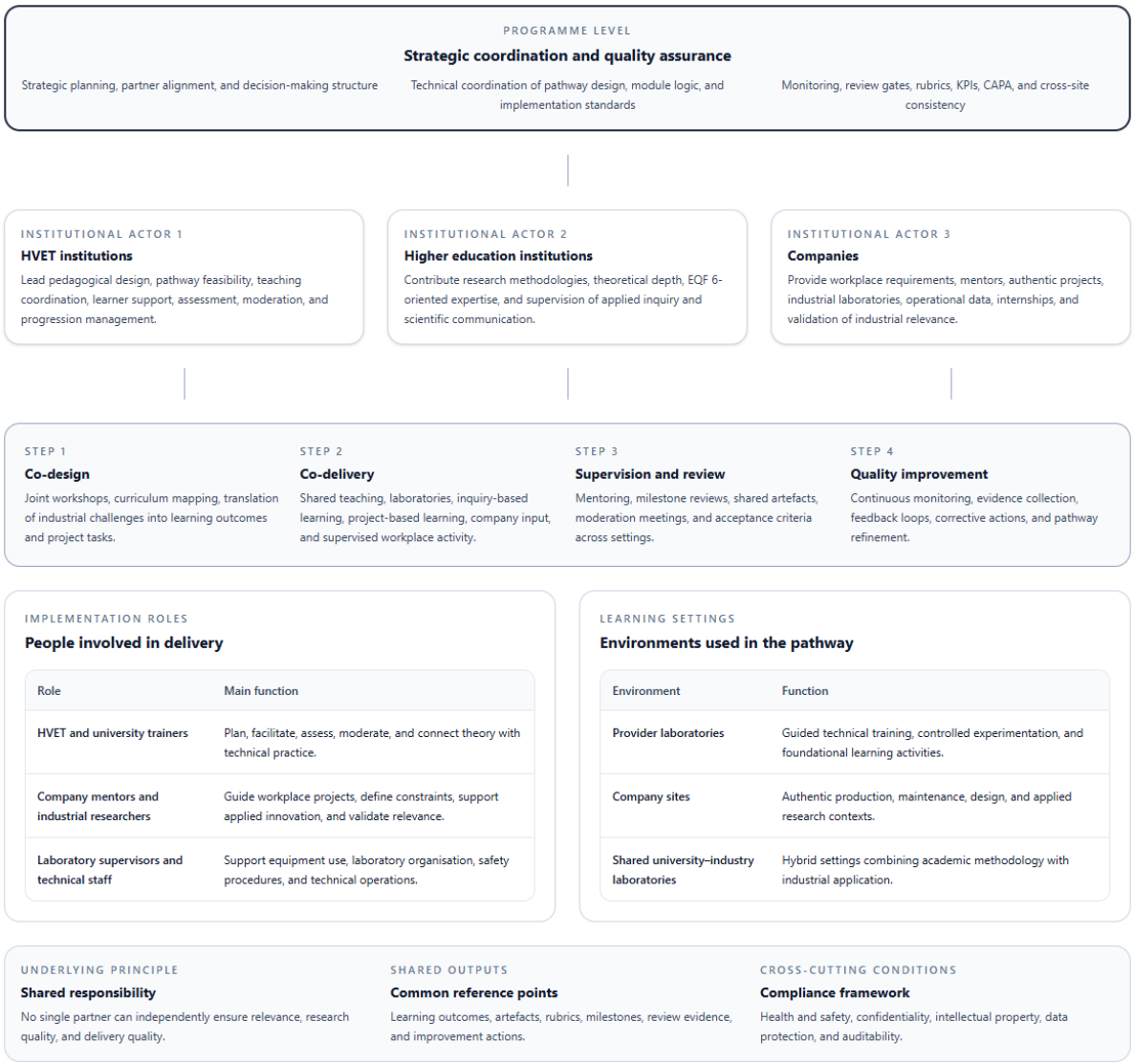

Figure 2-HUCO Training ecosystem: Institutional roles and collaboration logic in the HUCO pathways (authors` own elaboration)

Within the HUCO model, institutional responsibilities are distributed across three main categories of actors: Higher Vocational Education and Training (HVET) institutions, higher education institutions, and industry partners. Each actor contributes complementary expertise and resources that together enable the delivery of research-oriented training programmes combining vocational learning, academic knowledge, and applied innovation practice. At the same time, the model emphasises the importance of co-design, both between HVET institutions, universities, and industry partners, and among the consortium partners themselves, ensuring that curricula, learning activities, and project formats are jointly developed and continuously aligned.

In the Italian training pathway, however, the central HVET actor is one specific institution: the ITS Academy Cuccovillo Foundation. It provides the organisational framework for EQF Level 5 delivery and is responsible for coordinating curriculum implementation within the Italian regulatory context. In practice, this includes organising teaching schedules, managing student administration, coordinating work-based learning in companies, and contributing to the co-design and iterative refinement of training content and delivery formats together with academic and industry partners.

More specifically, the ITS Academy Cuccovillo Foundation acts as the primary institutional coordinator of the programme. It ensures that the curriculum complies with national standards while simultaneously integrating the innovation-oriented competences defined in the TRIComp framework. It also coordinates the integration of laboratory-based learning, technical modules, and the 800-hour company internship within the overall programme structure.

In addition to programme coordination, the ITS Academy Cuccovillo Foundation provides the technical learning environments required for practical training. These include specialised laboratories, workshop-based learning settings, and digital environments that support hands-on technical development. It also provides pedagogical supervision through instructors and tutors who guide students throughout the pathway and connect classroom learning, laboratory activity, and company-based experience. Higher education institutions contribute a complementary set of responsibilities within the HUCO organisational model. Their primary role is to provide academic expertise, research methodologies, and advanced theoretical knowledge that enrich the vocational training programmes. This contribution is particularly important for modules addressing applied research methods, innovation management, digital technologies, and sustainability.

Higher education institutions participating in the HUCO training ecosystem deliver specialised modules within the training pathways, particularly in areas where academic research expertise is essential. In addition, higher education researchers supervise and support applied research projects conducted by students within the HUCO Innovation Labs. This collaboration strengthens the connection between vocational education and research environments, enabling

students to develop competences relevant to both industrial innovation and academic research contexts.

Another important responsibility of higher education institutions lies in supporting the permeability between EQF Level 5 and EQF Level 6 programmes. By participating in the joint implementation of training modules, universities facilitate the recognition of competences acquired within vocational programmes and support students who wish to continue their education in higher education programmes.

Industry partners represent the third key institutional actor within the HUCO organisational architecture. Their involvement is essential for ensuring the practical relevance of the training programmes and for providing students with direct exposure to real innovation environments.

Companies participating in the HUCO ecosystem contribute in several ways. First, they are involved in the co-design of training modules, ensuring that the competences addressed within the curriculum correspond to current industrial needs. In practice, this was done through short co-design workshops and regular technical coordination meetings in which company experts, HVET providers, and university partners translated workplace tasks and industrial constraints into learning outcomes, module activities, and assessment criteria. This collaboration between educational institutions and companies strengthens the responsiveness of the training programmes to technological developments and labour market demands.

Second, industry partners provide work-based learning opportunities through internships, company projects, and applied research collaborations. Within the Italian pathway, for instance, students complete an extensive internship phase within partner companies, allowing them to apply the competences acquired during the programme to real production and innovation processes. While within the French pathway, students carry out more than half of their education and training in a company, allowing them to apply and develop the competences directly.

Third, companies contribute directly to training delivery by providing guest lecturers, technical experts, and company mentors. These professionals bring practical industry experience into the learning process and expose students to real innovation challenges.

In addition to these three core institutional actors, the HUCO organisational model also includes specialised roles related to academic supervision and programme coordination. Teaching staff from HVET institutions and universities collaborate in interdisciplinary module teams responsible for curriculum delivery, the pathway is delivered through a multinational "teaching corps" where instructors from different sectors (Academic/HVET/Industrial) and countries work in Mandatory Co-Teaching. These teaching teams coordinate learning objectives, teaching methodologies, and assessment procedures across institutions.

Research supervisors play a particularly important role in supporting applied research projects conducted within the HUCO Innovation Labs. They guide students in developing research questions, designing experiments, analysing data, and interpreting results within an innovation context.

Finally, overall alignment across institutions is ensured through the project's shared coordination and quality assurance arrangements. These support communication between partners, monitor implementation across sites, and provide the framework for applying the recognition procedures developed within the project, including the use of common European instruments such as the MoU, Learning Agreement, and Personal Transcript/Europass Mobility. Through this multi-layered distribution of responsibilities, the HUCO organisational model creates a collaborative training ecosystem in which vocational training institutions, universities, and industry partners jointly contribute to the development of innovation-oriented technical professionals.

5. Governance Model

The governance model of the HUCO training ecosystem provides the framework that enables effective coordination between the different actors involved in the joint implementation of the training pathways. Because the HUCO model operates across institutional, sectoral, and national boundaries, a structured governance approach is required to ensure transparency, accountability, and strategic coherence. The governance structure is based on a multi-level model that distinguishes between strategic governance, academic coordination, and operational programme management. Each level fulfils specific functions within the organisational framework while remaining closely interconnected with the other levels.

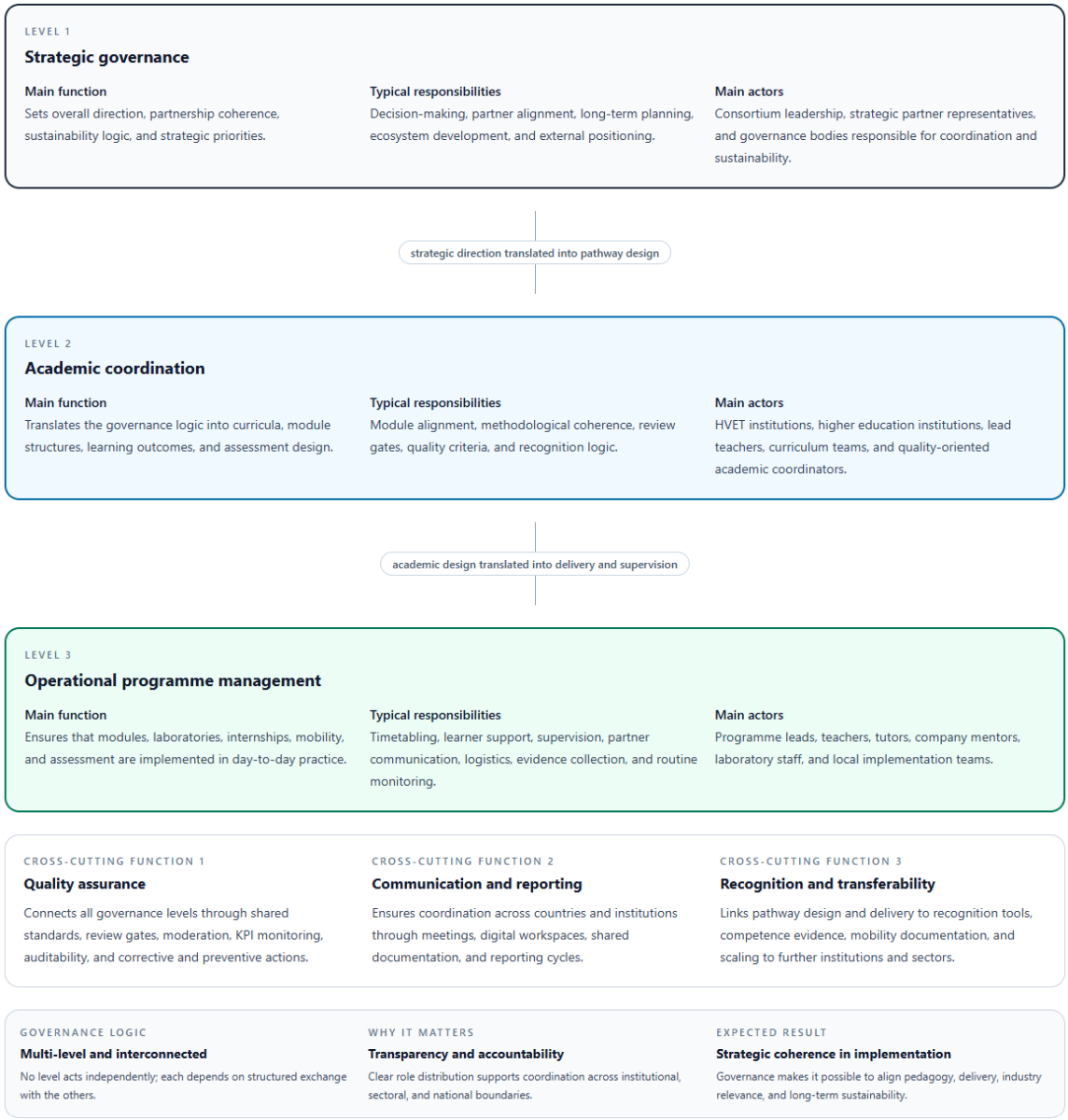

Figure 3- Overview of Governance levels within the Project (authors` own elaboration)

At the **strategic level**, governance is exercised through the project steering structures established within the HUCO Labs project. These structures provide overall strategic guidance and ensure that the training pathways remain aligned with the broader objectives of the project, including the development of innovation competences, the integration of applied research into vocational education, and the strengthening of collaboration between education and industry. Strategic governance bodies typically include representatives from the participating educational institutions and project partners. Their responsibilities include defining long-term development strategies for the training pathways, monitoring project progress, and ensuring alignment with European policy priorities such as the European Skills Agenda and the European Education Area.

While strategic governance provides overall direction, the academic coordination level focuses on ensuring the coherence and quality of the training programmes themselves. Academic coordination involves programme directors, module leaders, and academic representatives from the participating institutions. The primary objective of academic coordination is to ensure that the training modules are aligned with the competence framework defined within the project and that learning outcomes are consistently implemented across institutions. This requires continuous communication between teaching teams and regular coordination meetings to review curriculum implementation, teaching methodologies, and assessment procedures. Academic coordination also plays an important role in managing interdisciplinary collaboration between instructors from different institutions and sectors. Because many HUCO modules combine technical training with research and innovation competences, teaching teams often include instructors from vocational education institutions, university researchers, and industry experts. Academic coordination ensures that these different perspectives are integrated into a coherent learning experience for students. In this context, the programme also adopts a model of knowledge in-sourcing alongside physical mobility: international experts from partner regions deliver in-house modules directly to local pilot groups, thereby reducing barriers to internationalisation while maintaining the benefits of transnational expertise and exchange.

Another key aspect of academic governance concerns the recognition of learning outcomes across institutions. The HUCO model aims to facilitate permeability between vocational education and higher education pathways. To achieve this objective, academic coordinators work closely with institutional recognition authorities to ensure that learning outcomes obtained within one institution can be recognised by partner institutions.

At the **operational level**, governance focuses on the day-to-day management of the training programmes. Operational coordination involves programme administrators, mobility coordinators, and internship managers who are responsible for organising the practical aspects of programme implementation. These responsibilities include student admissions, scheduling of modules, organisation of internships, and coordination of digital learning activities. Operational coordinators also ensure that communication between institutions runs smoothly and that students receive the administrative support required for participating in transnational learning activities. An important component of operational governance concerns the coordination of internships and applied research projects conducted within companies. Internship coordinators collaborate closely with company mentors to ensure that work-based learning activities correspond to the learning objectives defined within the curriculum.

In addition to these formal governance structures, the HUCO organisational model emphasises the importance of collaborative communication mechanisms. Regular transnational meetings, online coordination meetings, digital collaboration tools, and joint workshops provide opportunities for continuous exchange between project partners. According to the application,

this communication structure includes seven face-to-face transnational meetings across the project duration, regular online meetings for implementation follow-up, the use of a shared BASECAMP repository, and additional bilateral coordination meetings where needed to address specific issues or delays. These mechanisms support the development of a shared understanding of the programme objectives, facilitate the exchange of best practices between institutions, and enable the early identification of challenges and the collaborative development of solutions.

Finally, the governance model incorporates **mechanisms for monitoring and continuous improvement**. Programme coordinators regularly collect feedback from students, instructors, and industry partners regarding the effectiveness of the training activities. This feedback is analysed within the governance structures and used to refine the organisational model and improve the training pathways over time. Through this multi-level governance framework, the HUCO project establishes a robust organisational structure that enables the joint implementation of innovation-oriented training programmes across institutional and national boundaries. The governance model ensures that the collaborative training ecosystem operates efficiently while maintaining high standards of academic quality and industrial relevance.

6. Implementation of the HUCO Training Pathways at Programme Level

The operational implementation of the HUCO training pathways is organised as a concrete pilot phase beginning in the third project year of the project. It is not conceived as a generic cooperation model, but as a structured and testable co-delivery arrangement between the two pilot providers in Italy and France and selected Alliance partners contributing through study visits, in-house teaching by foreign staff, online company-testimonial modules, and, in the French pilot, an international internship phase. The project concept explicitly states that the HUCO project will test the co-delivery phase through two pilot pathways, one at EQF Level 5 in Italy and one at EQF Level 6 in France, in order to experiment with Alliance cooperation in training delivery, the matching of research projects and student mobility, and the operational sharing of infrastructures and laboratories within the HUCO ecosystem (HUCO LABS Consortium, 2024).

At implementation level, the two pathways pursue the same overall objective, but they are organised in different formats. The French pilot is conceived as a compact and fully internationalised test case: it is designed as a one-year EQF 6 pathway, involves a test cohort of eight students, and combines local delivery with study visits abroad, modules delivered by foreign teachers, online European company-testimonial modules, and a one-month international internship abroad.

The Italian pilot, by contrast, is embedded in the regular architecture of an ITS Academy EQF 5 programme in Italy. More specifically, it is implemented as part of a biennial 2,000-hour pathway over two academic years, combining classroom-based modules, specialised laboratories,

inquiry-based practical activities, and an 800-hour curricular internship in a partner company. It involves twenty students and does not consist of a fully separate HUCO course; rather, selected HUCO activities are integrated into an existing national programme structure, especially through study visits abroad, modules delivered in house by foreign teachers, online European company-testimonial modules, inquiry-based laboratories, and the broader work-based learning logic of the ITS curriculum.

This difference in implementation format is built into the project design and reflects the fact that the two pilots are rooted in different institutional and national contexts. The French pathway is organised as a compact EQF 6 pilot that can be launched and completed within the project lifetime, whereas the Italian pathway is attached to a pre-existing ITS Academy structure with a longer duration, a larger cohort, and stronger integration into the provider's standard curriculum and funding model.

While the present document defines a structured collaboration and delivery model, the HUCO training pathways are not intended to operate as rigid or fully predetermined systems. In line with the project's pedagogical foundations, particularly Inquiry-Based Learning (IBL) and Project-Based Learning (PBL), implementation requires continuous contextual adaptation by trainers, mentors, and institutional partners. This includes responding to unforeseen challenges arising from company-based learning environments, learner diversity, and the evolving nature of applied research tasks. Informal learning processes, spontaneous problem-solving situations, and iterative adjustments to teaching strategies are therefore not deviations from the model but integral components of it.

6.1 Overall structure and timing of the pilot phase

The implementation phase of the HUCO training pathways starts in the third project year, after the completion of the co-design work in WP2. In practical terms, this means that pilot delivery begins in the 2026/2027 academic year. For the French pathway, this full academic cycle falls within the project lifetime. For the Italian pathway, the pilot also starts in 2026/2027, but because it is embedded in a biennial ITS Academy EQF 5 programme, the pathway continues beyond the formal end of the project. The application states this explicitly: the French 6th-level path is launched and completed during the project lifetime, whereas the Italian 5th-level path is launched during the project and completed after the project lifetime.

The operational implementation logic can be summarised as follows:

Table 1-Operational implementation logic

Dimension	French pilot (EQF 6)	Italian pilot (EQF 5)
Academic year of launch	2026/2027	2026/2027
Position in project	Starts in project year 3	Starts in project year 3
Pathway duration	1 year	2 years
Students involved	8 students	20 students
Status within project lifetime	Launched and completed within project lifetime	Launched within project lifetime, completed after project end
Institutional format	Stand-alone compact internationalised pilot	Embedded in existing ITS Academy programme structure
Study visits abroad	2	2
In-house modules delivered by foreign teachers	2	2
Online European company-testimonial modules	4	4
International internship abroad	1 month	Not foreseen as a separate HUCO pilot component

This means that the French EQF 6 pathway is implemented as a compact one-year pilot for 8 students, while the Italian EQF 5 pathway is launched in the same academic year for 20 students, but as part of a longer biennial national ITS curriculum. In both cases, the HUCO activities listed in the application had already been co-designed in the earlier project phase. For the French pathway, these comprise 2 study visits abroad, 2 in-house modules delivered by foreign teachers, 4 online modules with European company testimonials, and 1 month of internship abroad. For the Italian pathway, they comprise 2 study visits abroad, 2 in-house modules delivered by foreign teachers, and 4 online modules with European company testimonials.

6.2 Italian EQF 5 pathway: institutional implementation

The Italian pilot is implemented by ITS Academy Cuccovillo (ITSAC) and concerns 20 students in a two-year EQF Level 5 pathway. The application states that the pathway will start in the third project year, will be launched during the project lifetime, and will be completed afterwards because it is embedded in a standard ITS two-year structure. It also specifies a financing distinction: the project covers the HUCO-related activities for 10 students plus teachers/professors/testimonials, while the expenses for the other 10 students and 2 tutors are covered directly by ITSAC with its own funds.

Operationally, the Italian pilot remains primarily delivered by ITSAC within its own ITS curriculum. The pathway documents describe ITSAC as the main programme owner and pedagogical coordinator. The cooperation model states that HVET provides the pedagogical framework and tutoring, universities contribute theoretical foundations and applied research methodologies, and companies play a critical role by delivering at least 60% of the training through lectures, on-the-job activities, technical testimonies, real-world simulations, and access to industrial laboratories. The pathway also includes an 800-hour internship co-monitored by academic tutors and company mentors.

This means that the Italian pathway is locally delivered by ITSAC and its company network, and that the HUCO pilot adds international and Alliance-supported components to this already strongly dual and practice-based structure.

6.3 Italian EQF 5 pathway: Alliance-supported pilot activities

The Italian pilot integrates several transnational HUCO activities that have been developed and embedded within the pathway design. First, it includes two study visits abroad, each structured as five days of training, taking place in Spain at Universitat Politècnica de València (UPV) and in France at CMQ MSI. Second, the pathway includes two modules delivered in Italy by foreign teachers, with contributions from Duale Hochschule Baden-Württemberg (DHBW) and SSMTP. Third, it includes four online modules based on testimonials from European companies and supported through the HUCO partner network, including BVMW, in order to expose students to practical examples of R&D and innovation processes involving technicians.

Unlike the French pilot, the Italian pathway does not include a separate project-funded one-month international internship abroad as a distinct HUCO component. Instead, work-based learning is integrated through the ITS Academy structure itself, in which the curricular internship forms part of the regular national programme architecture.

The Italian HUCO modules are embedded in the two-year EQF 5 pathway coordinated by the ITS Academy Cuccovillo Foundation. They cover TU1 to TU24, together with two integrative inquiry-based laboratories and a set of four online modules with European company testimonials. Their operational delivery responsibilities can be described as follows.

TU1 – Basic ICT and Digital Security

This module is delivered at ITS and combines ITS-led instruction with structured company participation. The cooperation model assigns **30 hours** of theoretical foundations to the **ITS teacher** and **20 hours** to **company teachers**, who contribute real-case simulations and monitor classroom progress. Assessment is shared between **ITS teacher and company teacher**, and both theoretical and practical activities take place at ITS.

TU2 – Occupational Safety

TU2 is a clearly ITS-led foundational module. It is taught and assessed internally by an **ITS teacher acting as safety expert**, with **10 hours** of theoretical activities and **10 hours** of practical activities at ITS. The supervision model is internal and no company or university co-delivery role is specified in the surfaced module sheet.

TU3 – Technical English

This module is delivered by the **ITS teacher** and is co-designed with companies, which provide real-world simulations for international technical communication. The cooperation model states that industry experts are present during some simulated activities, but the main delivery responsibility remains with ITS. In operational terms, TU3 is therefore an ITS-delivered language-and-communication module with selected company-supported simulation input.

TU4 – Communication, Teamworking and Problem-Solving

TU4 is delivered at ITS by the internal pedagogical team. The surfaced assessment and workload tables show an **ITS teacher** as evaluator, with **10 hours** of lectures and **30 hours** of practical work at ITS. Its practical activities include teamwork, project coordination with digital tools, and crisis-management simulation. Operationally, it is an ITS-based transversal competence module without explicitly assigned external teaching responsibility in the surfaced section.

TU5 – Creativity, AI and Proactive Mindset

TU5 is one of the clearest transnational co-delivery modules in the Italian pathway. It is jointly designed by **ITS and DHBW**, with companies contributing real-world simulations. The cooperation model assigns **20 hours** to a **DHBW Professor**, co-teaching with the ITS professor, and **10 hours** to a **company teacher** for the application of creative AI and feedback on industrial product variants. Assessment is shared across **DHBW Professor**, **ITS Professor**, and, for the design-thinking project, a **company partner**.

TU6 – Technical Drawing & CAD Modelling

TU6 is delivered at ITS but in a clearly blended partnership format. The cooperation model assigns **40 hours** to the **ITS teacher**, **30 hours** to **CMQ** in co-teaching with ITS, and **50 hours** to **company experts**, who contribute theoretical and practical foundations, investigative support, and final feedback. Assessment is correspondingly mixed, involving **ITS teacher**, **company experts**, and **CMQ teachers**. Operationally, this is an ITS-based technical module with substantial external partner input and study-visit integration.

TU7 – Product Development and Advanced Design

TU7 is a compact professionalizing module taught at ITS with strong involvement from **SSMTP**. The surfaced assessment structure shows **SSMTP Teacher** and **ITS Professor** as the core evaluators, with **5 hours** of lectures and **15 hours** of practical activities delivered at ITS. The module is operationally focused on stage-gate documentation, co-design simulation, stakeholder feedback, and eco-validation. It is therefore best described as an ITS-hosted module with SSMTP-led specialist contribution.

TU8 – Materials and Production Technologies – MRP

TU8 combines university-led theoretical delivery with company-supported practical work. The workload table assigns **20 hours** of lectures to a **University Professor** and **40 hours** of practical activities to a **Company Expert and ITS tutor**. Assessment is shared between **University Professor** and **Company Expert**, with company-only responsibility for the sustainability audit. Operationally, TU8 is an ITS-based module that uses university expertise for conceptual foundations and company expertise for applied planning and procurement tasks.

TU9 – Industrial Automation

TU9 is one of the most company-driven modules in the first-year core. The cooperation model indicates joint design by **ITS, University and Companies**, with **50 hours** from a **University Professor** and **100 hours** from **company experts** for both theoretical and practical training. Assessment is also heavily company-based, with company experts leading most evaluation formats. In operational terms, TU9 is delivered at ITS laboratories, but with strong external industrial input and a highly applied automation focus.

TU10 – Mechanical Machining and CNC

For TU10, the module is positioned in the first year as a foundational technical unit, and the broader teaching model of the pathway indicates that machining-related modules are taught in ITS technical laboratories with strong practice orientation and partner-company relevance. TU10 is an ITS-hosted core technical module within the practically oriented workshop/laboratory strand of the pathway.

TU11 – Automated Production Systems

TU11 is clearly company-led in its operational logic. The cooperation model specifies joint design by **ITS, University and Companies**, but assigns **60 hours** of both theoretical and practical training to a **company expert**, with ITS providing tutoring during classroom training. The module's practical activities centre on robot-PLC integration, virtual commissioning, industrial network security, and multidisciplinary production-cell optimisation. Assessment is carried out mainly by **company experts**, with peers involved in the collaborative sprint element.

TU12 – Applied R&D – Applied Research Methodologies

TU12 is listed as a professionalizing first-year module and functions as the main entry point for applied research methodology in the Italian pathway. TU12 operates as the pathway's dedicated applied research methods unit within the ITS-hosted curriculum, aligned with the broader HUCO emphasis on inquiry-based and research-oriented learning.

TU13 – Prototyping, 3D Printing and Testing

TU13 is delivered at ITS technological laboratories with a clear university–company joint model. The module assigns **30 hours** of lectures to a **University Professor** and **60 hours** of practical activities to **University Professor and Company Expert** together. Assessment is divided across university and company actors, including iterative prototyping, stress testing, print optimisation, and stakeholder presentation. Operationally, TU13 is one of the most explicit examples of joint technical delivery in the Italian pathway.

TU14 – Design for Manufacturing & Concurrent Engineering

TU14 is company-led in both delivery and assessment. The workload structure assigns **15 hours** of lectures and **25 hours** of practical activities to a **Company Expert**, supported by an **ITS tutor**. Assessment is also company-led, including redesign challenge, concurrent engineering simulation, production-readiness review, and sustainability brief. Operationally, TU14 is an ITS-based module where the industrial partner provides the core applied expertise.

TU15 – Virtual Simulation and Digital Validation

The module is positioned as a professionalizing 40-hour unit in the first-year advanced-design strand. Given the surrounding module logic and the micro-credential evidence later in the document, TU15 supports simulation, virtual testing, and validation capacities as part of the ITS-based technical pathway.

TU16 – Ergonomic Simulation and Human-Centered Design

TU16 is company-led and ITS-hosted. The surfaced workload table assigns **15 hours** of lectures and **25 hours** of practical activities to a **Company Expert**, supported by an **ITS tutor**, and assessment is company-driven. The module focuses on ergonomic audit, interface redesign, and multidisciplinary UX workshop formats. Operationally, it is an ITS-based advanced-design module with direct industrial expertise at its core.

Integrative Module – Inquiry-Based Practical Laboratory 1

This integrative module is a non-ECTS laboratory format outside the standard credit-bearing curriculum. It is carried out entirely in the ITS FabLab environment and is assessed through a **Joint Validation Board** consisting of the **FabLab Manager**, a **University Professor**, and a **Company Expert**. The module culminates in a professional certification / open badge and operationally represents one of the clearest HUCO "lab" formats in the Italian pathway.

Webinar Series – "European R&D Excellence in the HUCO Model"

These four online modules are organised with the support of **BVMW** and are explicitly framed as industrial storytelling sessions rather than conventional lectures. Their function is to expose students to European manufacturing practices through company testimonials on the German Mittelstand, agile R&D and rapid prototyping, quality and statistical optimisation, and concurrent engineering in transnational collaboration. Operationally, these are network-supported online activities linking the Italian pathway to the wider HUCO ecosystem and to external industrial practice.

The second-year core modules TU17-TU20 will be structured more clearly after the first piloting year. The same goes for TU22.

TU21 – Lean Manufacturing and Process Sustainability

TU21 is strongly company-driven in the surfaced evaluation and workload tables. The module assigns **15 hours** of lectures and **15 hours** of practical activities to a **Company Expert**, with ITS tutoring support. Assessment is entirely or almost entirely company-led and centres on value-stream mapping, kaizen simulation, sustainability and waste audit, and KPI visual boards. Operationally, TU21 is an ITS-hosted lean-improvement module with direct industrial delivery logic.

TU23 – Industrial Economics and Sustainable Innovation

TU23 is a second-year professionalizing module with a strongly company-led delivery profile. The surfaced workload table assigns **15 hours** of lectures and **15 hours** of practical activities to a **Company Expert**, supported by an **ITS tutor**, and the assessment activities are likewise company-driven. The module operationally focuses on investment pitch, financial KPI testing, cost mapping, and triple-bottom-line analysis. It is therefore one of the clearest examples of company-led strategic/innovation training within the Italian pathway.

Integrative Module – Inquiry-Based Practical Laboratory 2

This second integrative laboratory is again positioned outside the standard credit-bearing pathway and is carried out entirely in the ITS FabLab. Evaluation focuses on professional certification and technical validation. The surfaced assessment structure refers to a **Lab Committee (University + Company)** and a **Joint Validation Board** consisting of **FabLab Manager, University Professor, and Company Expert**. Operationally, it is the most explicit example of a HUCO-style innovation-lab environment in the Italian pathway.

TU24 – Curricular Internship

TU24 is the 800-hour company-based work placement and constitutes the core work-based learning pillar of the Italian pathway. The module description states explicitly that it integrates

classroom and laboratory learning with real industrial practice and provides hands-on experience in R&D, production, quality, and automation settings. Operationally, TU24 is therefore delivered in partner companies, while remaining structurally embedded in the ITS programme as its major second-year internship component.

6.4 French EQF 6 pathway: institutional hosting and delivery responsibility

The French pilot is coordinated at partnership level by CMQ MSI, which entrusts one of its member institutions, Groupe Scolaire Saint Joseph Lasalle (ESJO), with the concrete implementation of the EQF Level 6 pathway. This is a coherent allocation of responsibilities, as ESJO is the teaching institution that deploys the French Level 6 programme in practice and brings established experience in industrially oriented higher-level training. The French pathway document further describes ESJO as part of the Saint-Joseph Group, specialised and recognised for its industrial training programmes, and notes its ongoing collaboration with CNAM Bourgogne Franche-Comté since 2016. In this way, partnership-level coordination remains with CMQ MSI, while operational delivery is anchored in an institution with direct pedagogical and implementation capacity for the pathway.

This is an important operational clarification. In the French pilot, the EQF Level 6 pathway is positioned within a CNAM Bachelor's degree in Electromechanical Engineering. CNAM, the *Conservatoire National des Arts et Métiers*, is a public higher education institution and provides the recognised degree structure, ECTS framework, and approval conditions for the programme. The pathway document also makes clear that changes to the degree structure remain under CNAM's authority and require CNAM approval.

At the same time, the operational delivery base of the HUCO pilot is ESJO, the higher education department of the Saint-Joseph Group. ESJO is described in the French pathway document as a provider specialised and recognised in industrial training, and as an institution that has collaborated with CNAM Bourgogne Franche-Comté since 2016. In practical terms, this means that CNAM provides the recognised higher education framework, while ESJO organises and delivers the pathway on the ground.

The module templates reflect this division of roles quite consistently:

- Degree and approval framework: CNAM defines the Bachelor structure and validates changes to module content or assessment arrangements.
- Operational teaching and supervision: ESJO appear repeatedly as the location for theoretical lessons, laboratory activities, assessment, and student supervision.

- Routine assessment responsibility: in several modules, the ESJO teacher is identified as the main evaluator for tests, project work, reports, or presentations.
- University involvement in selected activities: in some project-based modules, university participation is explicitly included in supervision or evaluation, which suggests a more targeted academic contribution rather than day-to-day routine delivery.
- Company involvement: the French handbook foresees company participation especially in the definition of practical challenges, mentoring, hosting, and, in selected cases, co-assessment. For example, the *Innovation Sprint* hosted by COMAU assigns the company a concrete role in defining the research topic, providing mentors, and contributing to report and presentation assessment.

Overall, the French pilot therefore combines CNAM as the recognised higher education and approval framework, ESJO as the main delivery institution, and companies as applied learning partners in selected project and mobility formats. This makes the implementation structure more differentiated than a simple "university-led" model, but also more precise and operationally credible.

Accordingly, the French EQF Level 6 pathway is situated within the recognised Bachelor framework of the Conservatoire National des Arts et Métiers (CNAM), but the HUCO pilot itself is delivered in practice by Groupe Scolaire Saint Joseph LaSalle (ESJO), under the overall coordination of the regional consortium CMQ MSI. Companies support this delivery model through project definition, mentoring, hosting, monitoring, and selected co-assessment activities. In other words, CNAM provides the recognised degree framework, whereas day-to-day delivery in the present pilot is organised by ESJO.

6.5 French EQF 6 pathway: local module delivery in 2026/2027

The French HUCO modules are placed in Year 3 / 2026–2027 of the pathway and consist of TU25 to TU31. Their operational delivery responsibilities can be described as follows.

TU25 – Introduction to Life Cycle Analysis and Eco-Design of Products

This module is delivered locally in France within the ESJO environment. The French module description assigns the theoretical lessons and assessment to ESJO, while the cooperation model describes the module as based on "HVET and Companies," with HVET providing the theoretical foundations and tutoring during classroom training, and companies monitoring classroom progress and supporting co-design and validation. The module therefore operates as

an ESJO-led teaching unit with structured company involvement in validation and real-scenario orientation.

TU26 – Computer Aided Design

This module is operationally delivered by ESJO. The module sheet assigns 30 hours of theoretical teaching, 20 hours of laboratory work, 6 hours of Fab Lab activity, and 4 hours of assessment to the ESJO-based delivery setting. Assessment is also organised through ESJO, with ESJO teachers identified as the evaluators. In the present module documentation, no specific company is named as a delivery or assessment partner for TU26. The company role therefore remains indirect at this stage and is not operationalised in the module sheet in the same explicit way as in some of the project-based modules.

TU27 – Research and Scientific Communication

TU27 is delivered through ESJO-based lectures, project work, tutoring, report supervision, and oral presentation assessment. The cooperation model states that HVET, in collaboration with the university, defines the theoretical framework and provides academic tutoring, while the company co-defines a scientific research issue applicable to reality. However, in the actual operational tables, the evaluators are ESJO teachers, and no concrete university teaching hours are specified. For the purposes of T2.5, TU27 is therefore best described as an ESJO-delivered module with company-supported problem framing and a conceptually foreseen, but not yet operationally quantified, university contribution.

TU28 – Innovation Sprint

TU28 is a one-week intensive challenge module and constitutes one of the most strongly internationalised elements of the French pilot. The pathway document states that the practical training session takes place within a host company abroad. The company welcomes the students, defines the project topic, provides coaches or advisors, and participates in the final assessment panel. HVET provides the online theoretical input on the stages of a marketing plan and the academic tutoring. In pedagogical terms, teachers and mentors act mainly as coaches rather than as traditional lecturers. This means that TU28 is not a conventional classroom module but a mobility-based intensive project format jointly implemented by the host company and the French HVET-side delivery structure.

TU29 – Industrial Design Jam

TU29 is designed as a one-week intensive project module in a hackathon format, meaning a time-bounded collaborative innovation challenge in which participants work intensively on a concrete problem and develop a prototype or solution within a short period. The module is based on a genuine R&D need identified by a partner company and focuses on the implementation of a KAIZEN continuous improvement project in industrialisation processes. KAIZEN can be

understood here as a structured continuous-improvement approach aimed at gradually improving efficiency, quality, and process performance through ongoing incremental change. Here, this takes the form of a 10-hour theoretical component covering KAIZEN-related methods, project management, and problem-solving, followed by a 25-hour practical component in which students define project specifications, plan implementation, prepare technical documentation, and present a prototype to the company. According to the module sheet, the company validates each stage of the work in order to ensure feasibility and support continuous adaptation.

The practical component centres on an intensive hackathon, where students work on a real industrial case. Companies define the challenge, validate project stages, and provide iterative feedback. The objective is to deliver both a set of specifications and a prototype that meets the company's needs. It is implemented as a co-designed module involving industry as well as Lithuanian and Spanish partners, combining academic structure with an applied, innovation-oriented project context.

TU30 – Digitalisation of the Design Function

TU30 is implemented in a Fab Lab format and focuses on 3D scanning, digital twins and industrial cybersecurity. The workload table places the theoretical element at ESJO and the practical component in the Fab Lab. In operational terms, ESJO is again the teaching base named in the module description. This module is therefore delivered locally in France in laboratory/Fab Lab environments under ESJO supervision.

TU31 – Professional Experience

TU31 is the company-based professional experience module. While company partners are already involved in other modules through project definition, mentoring, monitoring, hosting, and selected co-assessment, TU31 represents the most substantial and clearly formalised form of company-based learning in the pathway. The module description states that the professional experience must be validated jointly by the company tutor and the supervising teacher. Students are required to submit a report, and the supervising teacher provides the formal academic judgement on the quality of the activities carried out and the experience acquired. The workload table specifies 375 hours of work-based learning in a company. In operational terms, the module is therefore delivered in the company environment, supervised jointly by the company tutor and the ESJO supervisor, and academically validated by ESJO.

6.6 French EQF 6 pathway: mobility package and foreign partner contributions

The project defines the international component of the French pilot with a high degree of precision. The project covers the relevant expenses for 8 students, 1 tutor, and the necessary

teachers, professors and testimonials linked to the pilot activities (HUCO LABS Consortium, 2024).

First, the pilot includes two study visits abroad, each structured as 5 days of training. These study visits take place:

- in Italy at COMAU (Stellantis Group), and
- in Germany at DHBW

Second, the pilot includes a week where two modules are delivered in-house in France by foreign teachers, each also structured as 5 days of training. These foreign teachers are selected and made available by:

- UPV, and
- SSMTP

The foreign teachers of UPV and SSMTP will intervene in the TU29.

Third, the French pilot includes four online modules, organised with the support of BVMW, and based on testimonials from European companies that have implemented virtuous R&D processes involving technicians. These online modules are part of the formal pilot package and represent the European company-facing component of the curriculum (HUCO Labs Consortium, 2024).

Fourth, and most distinctively, the French pilot includes a one-month international internship abroad for all eight students. The application specifies the distribution exactly:

- 4 students for 1 month in Spain at UPV
- 4 students for 1 month in Germany at DHBW

For this internship model, the project explicitly tests a triadic cooperation approach of the HUCO ecosystem. The mentoring teams are composed of:

- 1 school professor,
- 1 university researcher, and
- 1 company researcher

6.7 Operational conclusion

The operational implementation of the HUCO training pathways is therefore based on a clearly identifiable division of responsibilities. In France, the pilot is coordinated by CMQ MSI,

operationally implemented by Groupe Scolaire Saint Joseph Lasalle / ESJO, embedded in a CNAM-recognised Level 6 framework, and supported by companies as hosts, coaches, mentors and co-assessors. Additional Alliance inputs come from COMAU and DHBW as study-visit hosts, UPV and SSMTP as providers of foreign-teacher modules, BVMW as organiser of the online company-testimonial modules, and UPV and DHBW again as hosts of the one-month international internships.

In Italy, the pilot is coordinated and delivered by ITS Academy Cuccovillo, with companies already strongly integrated into the local dual structure, and with additional Alliance-supported pilot elements contributed by UPV and CMQ MSI as hosts of study visits, DHBW and SSMTP as providers of foreign-teacher modules, and BVMW as organiser of the online company-testimonial modules.

In this sense, the HUCO pilot phase is operationally concrete: it specifies who delivers, who hosts, where the activities take place, how many students are involved, which parts are local and which are transnational, and which cooperation arrangements are actively tested during implementation. However, adaption might be necessary if unforeseen obstacles arise.

The following matrix summarises the operational delivery structure of the HUCO pilot phase, indicating which partners contribute to which elements of the training pathways, where the activities take place, and who holds the primary teaching responsibility.

Table 2-HUCO Module Delivery Matrix

Pathway	**Module / Activity**	**Lead Delivery Institution**	**Supporting Partner(s)**	**Location**	**Teaching / Supervision Responsibility**
EQF 6 – France	TU25 Introduction to Life Cycle Analysis and Eco-Design	ESJO	Industry partners	ESJO classrooms	ESJO delivers lectures and assessment; companies contribute to project validation
EQF 6 – France	TU26 Computer Aided Design	ESJO	Industry partners	ESJO laboratories / Fab Lab	ESJO provides theoretical teaching and supervises lab activities

EQF 6 – France	TU27 Research and Scientific Communication	ESJO	Industry partners	ESJO	ESJO supervises projects and assesses outputs; companies may contribute to defining applied research problems
EQF 6 – France	TU28 Innovation Sprint	Host company abroad	ESJO	International company location	Company mentors define challenges and coach students; ESJO provides academic tutoring
EQF 6 – France	TU29 Industrial Design Jam	ESJO	Industry partners	ESJO + company environment	ESJO provides theoretical framework; companies define R&D case and validate project phases
EQF 6 – France	TU30 Digitalisation of the Design Function	ESJO	Industry partners	Fab Lab / laboratory	ESJO supervises laboratory-based learning activities
EQF 6 – France	TU31 Professional Experience	Host companies	ESJO	Companies	Company tutors supervise internships; ESJO validates academic outcomes in line with degree requirements

EQF 6 – France	Study Visit 1	COMAU	CMQ MSI, ESJO	Italy	Industrial training visit and demonstration of R&D environments
EQF 6 – France	Study Visit 2	DHBW	ESJO	Germany	Training visit with focus on applied research and dual education
EQF 6 – France	Foreign Teacher Module 1	UPV	ESJO	France (in-house)	Visiting professors deliver specialised modules (knowledge in-sourcing)
EQF 6 – France	Foreign Teacher Module 2	SSMTP	ESJO	France (in-house)	Visiting professors deliver specialised modules
EQF 6 – France	Online European Industry Modules (4)	BVMW	HUCO partners	Online	European companies provide testimonials on innovation and R&D practices
EQF 6 – France	International Internship	UPV / DHBW + companies	ESJO	Spain / Germany	Triadic mentoring: school professor + university researcher + company mentor

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					R&D case and validate project phases
EQF 6 – France	TU30 Digitalisation of the Design Function	ESJO	Industry partners	Fab Lab / laboratory	ESJO supervises laboratory-based learning activities

7. Integration of Research and Innovation Activities

This chapter examines the integration of research and innovation activities within the HUCO training pathways. It describes how applied research is operationalised through curriculum design, laboratory-based learning, project work, and company collaboration, thereby enabling students to develop the competences required for participation in industrial R&D and continuous innovation processes.

7.1 Applied Research as a Core Learning Component

A central objective of the HUCO training pathways is the systematic integration of applied research and innovation activities into vocational education and training activities. The project recognises that mid-level technicians increasingly play an active role in industrial innovation processes. Consequently, the training programmes are designed not only to transmit technical knowledge but also to develop the competences necessary for participation in research and development (R&D) activities.

The training modules developed within the HUCO project include dedicated components related to applied research methodologies, data analysis, digital modelling, and innovation processes. These modules enable students to understand the principles of research design, experimentation, and iterative development processes within industrial environments.

In the Italian EQF Level 5 pathway, for example, a dedicated module on Applied R&D – Applied Research Methodologies introduces students to problem formulation, experimental design, and the evaluation of technical solutions in production contexts. By integrating these competences within technical modules rather than treating them as isolated subjects, the HUCO model ensures that research skills are directly connected to practical engineering and manufacturing challenges.

Examples of modules that embed applied research and innovation activities include:

- **Italian EQF 5 pathway:** TU12 *Applied R&D – Applied Research Methodologies*; TU13 *Prototyping, 3D Printing and Testing*; TU15 *Virtual Simulation and Digital Validation*; TU17 *Statistical Methods and Process Optimization*; *Inquiry-Based Practical Laboratory 1*; *Inquiry-Based Practical Laboratory 2*; TU24 *Curricular Internship*

- **French EQF 6 pathway:** TU27 *Research and Scientific Communication*; TU28 *Innovation Sprint*; TU29 *Industrial Design Jam*; TU30 *Digitization of the Design Function*; TU31 *Professional Experience*

Applied research activities within the HUCO Labs inherently involve uncertainty, incomplete information, and evolving problem definitions. As such, learners are expected not only to apply existing knowledge but also to develop the capacity to navigate ambiguity and adapt to changing conditions.

This dimension reflects the TRIComp understanding of Future Skills as dispositions to act in complex and dynamic environments, where solutions cannot always be predefined.

7.2 Project-Based Learning and Innovation Projects

Applied research activities within the HUCO training pathways are primarily implemented through project-based learning formats. In these formats, students work on complex technical challenges that require the integration of knowledge from multiple disciplines. Typical project formats include the design and prototyping of new mechanical or digital components, the optimisation of production processes, the implementation of digital monitoring or automation systems, and the development of sustainable manufacturing solutions. Projects are often conducted in collaboration with industry partners and may involve access to real production data, industrial equipment, and company facilities. The use of project-based learning ensures that students develop not only technical knowledge but also competences in interdisciplinary collaboration, problem-solving, and innovation management. This is reflected in a number of concrete modules in both pathways.

In the **Italian EQF 5 pathway**, the most relevant examples are:

- **TU13 – Prototyping, 3D Printing and Testing**, which combines prototyping, testing, simulation, and joint university–company evaluation.

- **TU15 – Virtual Simulation and Digital Validation**, which focuses on simulation and digital validation as applied technical project work.
- **TU17 – Statistical Methods and Process Optimization**, which addresses data-based optimisation and process improvement.
- **TU21 – Lean Manufacturing and Process Sustainability**, which links process optimisation with sustainability-oriented improvement.
- **TU22 – Green Technologies and Circular Economy**, which addresses sustainable manufacturing solutions.
- **Inquiry-Based Practical Laboratory 1 and 2**, which are explicitly built around project-based and inquiry-based work in the FabLab and culminate in prototype development, technical documentation, simulation, and industrial-readiness validation.
- **TU24 – Curricular Internship**, which places students in R&D, production, quality, and automation settings and explicitly includes continuous improvement and innovation projects.

In the **French EQF 6 pathway**, the strongest examples are:

- **TU28 – Innovation Sprint**, a one-week project-based challenge hosted by COMAU in which students work on a real innovation topic and develop an innovative product concept and market strategy.
- **TU29 – Industrial Design Jam**, a one-week project module based on a real company need, where students define specifications, manage planning, and present a working prototype to the partner company.
- **TU30 – Digitization of the Design Function**, which uses FabLab-based work on 3D scanning and digital twins and is explicitly oriented towards digital artefacts, simulation, and technical solutions for company needs.
- **TU31 – Professional Experience**, which is the major company-based professional module and embeds applied work in real industrial environments.

7.3 Role of HUCO Innovation Labs

The HUCO Innovation Labs function as central platforms for integrating education, research, and industrial innovation activities. In the project, these labs are not defined as a fixed set of separately named units, but as a shared ecosystem of partner laboratories, company environments, and university–industry learning spaces within the wider HUCO Labs ecosystem. In practical terms, the main environments are:

- ITS Cuccovillo FabLab (Italy) – organised by the ITS Academy Cuccovillo Foundation; used for the two Inquiry-Based Practical Laboratories; equipped for rapid prototyping and digital validation; designed as an open innovation space with 3D printers, laser cutters, CNC tools, and joint evaluation by FabLab manager, university professor, and company expert.

- ESJO/Fab Lab learning environment (France) – organised within the Groupe Scolaire Saint Joseph LaSalle (ESJO) pathway structure; used in modules such as TU26 Computer Aided Design and TU30 Digitization of the Design Function; combines theoretical teaching, laboratory work, and Fab Lab-based practical activities.

- COMAU industrial learning environment (Italy) – organised by COMAU as industrial partner; used for the French mobility-based Innovation Sprint and for study visits; provides real company-based innovation challenges, mentoring, and access to authentic industrial contexts.

- Partner university / provider laboratories and company sites across the ecosystem – organised jointly by the participating HVET institutions, universities, and companies; these include provider laboratories, company sites, and shared university–industry laboratories used for teaching, applied research, mobility, and co-delivery. The quality handbook explicitly presents these three environment types as the core delivery settings of the HUCO dual model.

Overall, the HUCO Innovation Labs are therefore best understood not as a single laboratory or a closed list of laboratories, but as a distributed ecosystem of shared infrastructures and partner environments for training, research, mobility, and innovation. At project level, this ecosystem is organised by the HUCO partnership as part of the “Technological European Village for Technicians,” while concrete local delivery is ensured by the respective host institutions and company partners.

Within these environments, students work under the supervision of:

- academic researchers,

- vocational training instructors,

- and industry mentors.

This triadic supervision structure reflects the overall HUCO collaboration model linking HVET institutions, universities, and companies.

The Innovation Labs also serve as experimentation environments where new pedagogical formats, digital learning tools, and innovation methodologies can be tested and refined.

7.4 Collaboration with Industry R&D Departments

An important element of the HUCO organisational model is the direct collaboration between students and company research and development environments. In the French pilot, this is documented most explicitly through the one-week Innovation Sprint hosted by COMAU and through the one-month company-based internship for all eight students, supervised jointly by a school professor, a university researcher, and a company researcher. In addition, the French pathway includes four online modules with testimonials from European companies and two five-day study visits abroad, one of them at COMAU in Italy and one at DHBW in Germany, which further expose students to industrial innovation practice.

In the Italian pilot, company collaboration is embedded primarily in the regular ITS work-based learning structure and in selected company-led or company-supported modules. The clearest example is TU24, the 800-hour curricular internship, which places students in real industrial environments related to R&D, production, quality, and automation and explicitly includes participation in continuous improvement and innovation projects. In addition, the Italian pathway includes four online modules with European company testimonials and a range of modules co-delivered or assessed by company experts, although the pathway document does not provide a full named list of all internship host companies.

This collaboration strengthens the relevance of the training programmes by ensuring that students encounter applied research and innovation not only in simulated classroom settings, but also in authentic company contexts through internships, project work, company-hosted challenges, testimonials, and laboratory cooperation.

8. Digital Infrastructure

This chapter examines the digital infrastructure underpinning the HUCO training ecosystem. It focuses on the digital environments and tools that support transnational collaboration, online learning delivery, competence documentation, and the coordination of shared research and innovation activities across partner institutions.

8.1 Role of Digital Learning Environments

Digital infrastructure plays a critical role in enabling the transnational collaboration that characterises the HUCO training ecosystem. Because the training pathways involve institutions located in different countries, digital platforms are essential for facilitating joint learning activities, knowledge exchange, and programme coordination. In this context, the integration of Virtual Labs—already available within the partner network—extends the digital infrastructure towards transnational co-working environments. These Virtual Labs function not only as platforms for remote access, but as “digital sandboxes” in which teachers, researchers, and students from different countries can collaborate in real time on shared industrial challenges.

The HUCO digital infrastructure supports three main functions:

- delivery of digital learning modules,
- management of competence portfolios and micro-credentials,
- coordination of collaborative learning and research activities.

The integration of Virtual Labs further strengthens these functions by enabling scalable access to shared digital learning and collaboration environments across partner institutions. In the HUCO model, these environments support hybrid prototyping, the simulation of complex processes prior to physical implementation, and continuous synchronous collaboration between teachers, researchers, company mentors, and students. At project level, digital collaboration is supported through common virtual workspaces and coordination tools, while the specific technical platform(s) used for Virtual Lab access and interaction should be specified in the final implementation description.

8.2 Digital Learning Platforms

The training pathways incorporate hybrid learning models that combine face-to-face instruction with digital learning formats. Digital learning platforms enable students to access training materials, participate in online lectures, and collaborate with peers from partner institutions.

Typical digital learning components include:

- online lectures delivered by international experts,
- webinars on research and innovation topics,
- digital workshops on emerging technologies,
- collaborative project platforms.

These digital learning activities complement laboratory-based teaching and enable broader participation across institutions.

8.3 Competence Portfolio Systems

To support the recognition of learning outcomes across institutions, the HUCO model incorporates a digital competence documentation system based on micro-credentials issued via the Europass Platform and linked to the ESCO framework. In addition, the quality model foresees the use of an e-portfolio to store evidence, artefacts, assessment records, and other documentation related to achieved competences. Together, these digital tools allow students to document and showcase the competences acquired during their training and support transparency and recognition across institutional contexts.

The competence portfolios record achievements related to:

- technical modules,
- applied research projects,
- internships,
- and transversal competences such as teamwork or innovation skills.

These digital records support the transparency of learning outcomes and facilitate recognition procedures between institutions.

8.4 Micro-Credentials and Digital Badges

Another important component of the digital infrastructure is the implementation and testing of micro-credentials as a European certification scheme for specific learning achievements beyond the core qualification. In the HUCO model, these micro-credentials are issued through the Europass Platform, linked to the ESCO framework, and stored in a personal digital wallet. In addition, for students participating in mobilities abroad, the project foresees the use of Europass Mobility and related recognition tools such as the MoU, Learning Agreement, and Personal Transcript to document validated competences acquired during mobility-based modules or placements. Examples include certifications related to digital technologies, sustainability competences, specialised software tools, and innovation-oriented skills. Micro-credentials enhance the flexibility of the training pathways and support more individualised and transparent learning trajectories across institutional contexts.

9. Implementation and Coordination Processes

This chapter outlines the implementation and coordination processes through which the HUCO training pathways are organised and delivered. It explains how partner institutions cooperate across the different stages of curriculum planning, module preparation, training delivery, monitoring, and recognition.

9.1 Operational Workflow for Training Delivery

The implementation of the HUCO training pathways follows a structured operational workflow involving several stages of coordination between partner institutions.

A key operational role is played by trainers, mentors, and company supervisors, who act as mediators between structured learning objectives and real-world implementation contexts.

Their responsibility includes adapting learning activities in real time, supporting learners in unexpected situations, and facilitating reflection on both successful and unsuccessful outcomes. This “ad hoc” pedagogical responsiveness is essential to ensure the relevance and effectiveness of the training pathways.

The typical workflow includes the following phases:

1. Joint curriculum planning: Partners define the structure of the training programme and allocate modules to participating institutions.
2. Module preparation and coordination: Teaching staff from different institutions coordinate learning objectives, teaching methods, and assessment criteria.
3. Training delivery: Modules are delivered through a combination of classroom teaching, digital learning, laboratory work, and work-based learning.
4. Monitoring and evaluation: Programme coordinators collect feedback from students, instructors, and industry partners.
5. Recognition of learning outcomes: Learning achievements are documented and recognised according to the procedures defined in Deliverable D2.3.

9.2 Coordination between Institutions

Because the HUCO training pathways involve institutions from different national systems, effective coordination mechanisms are essential.

Coordination takes place at multiple levels:

- Strategic coordination within the project governance structure,
- Academic coordination between programme directors and teaching staff,
- Operational coordination between administrative units responsible for student mobility and programme management.

Regular coordination meetings and digital collaboration platforms ensure continuous communication between partners.

9.3 Management of Joint Learning Activities

Joint learning activities represent a key element of the HUCO training ecosystem, but in the project these activities are operationalised through clearly defined transnational formats rather than through generic exchange events. In the French EQF 6 pilot, these include two five-day study visits abroad, one in Italy at COMAU and one in Germany at DHBW, two five-day in-house modules delivered by foreign teachers from UPV and SSMTP, four online modules with testimonials from European companies organised with the support of BVMW, and a one-month international internship for the eight participating students, with four students in Spain at UPV and four in Germany at DHBW. In the Italian EQF 5 pilot, the same transnational logic is implemented through two five-day study visits abroad, one in Spain at UPV and one in France at CMQ MSI, two five-day in-house modules delivered by foreign teachers from DHBW and SSMTP, and four online modules with testimonials from European companies organised with the support of BVMW. Beyond the two pilot pathways, the project also foresees two online Training of Trainers courses for around 30 participants and the 1st WE HUCO Forum as a wider European exchange and networking activity.

10. Quality Assurance and Monitoring

This chapter outlines the quality assurance, monitoring, and evaluation architecture of the HUCO training pathways. It describes how existing institutional quality frameworks are complemented by the project-specific quality model developed in WP5 in order to support consistency, accountability, and continuous improvement across partner institutions and countries.

10.1 Alignment with Institutional Quality Assurance Frameworks

The HUCO training pathways operate not only within the existing quality assurance frameworks of the participating institutions and national education systems, but also within a project-specific quality assurance model developed in WP5. In particular, Deliverable D5.3 provides a

concrete framework for training implementation quality assurance, aligned with recognised European reference frameworks such as EQF, EQAVET, ECTS/ECVET, and Europass.

This WP5 quality model is based on a number of core elements:

- a tripartite governance structure involving strategic coordination, a technical group, and a quality assurance function;
- shared learning outcomes, common artefacts, rubrics, and review gates, so that assessment remains traceable and comparable across sites;
- Key Performance Indicators (KPIs) aligned with the EQAVET Plan–Do–Check–Act cycle, covering planning quality, facilitation quality, assessment literacy, project quality, engagement, safety, and compliance;
- continuous improvement mechanisms based on Corrective and Preventive Actions (CAPA), annual review, internal and external monitoring, and evidence-based change control;
- and formal collaboration arrangements through MoUs, data-sharing procedures, supervision rules, health and safety provisions, intellectual property clauses, and data protection requirements.

The organisational model therefore ensures that all HUCO modules are embedded in existing institutional quality systems, while at the same time being guided by a common HUCO quality framework developed in WP5 to support consistency, auditability, and transferability across institutions and countries.

Quality assurance within the HUCO model does not rely solely on compliance with predefined procedures but also recognises the importance of flexibility and iterative improvement.

Variations in implementation, arising from different institutional, industrial, or learner-specific contexts, are expected and systematically integrated into monitoring and evaluation processes.

The capacity to manage uncertainty and to learn from deviations is therefore considered a core quality dimension, both at system level and as a competence to be developed by learners.

10.2 Monitoring Procedures

Continuous monitoring of the training programmes is organised through a structured review cycle defined in WP5 rather than through ad hoc feedback collection. Operational data such as gate decisions, incidents, and artefact records are collected as they occur; monthly summaries are prepared for programme leaders, quarterly summaries for the Community of Practice, and annual summaries for external review and accreditation. Internal monitoring combines short lesson observations during delivery, dual marking and moderation at important review gates,

reconciliation meetings where assessors differ, and dual-site quality audits carried out twice a year on a shared sample of evidence such as project charters, protocols, review minutes, and acceptance reports. External quality is supported through peer review and industry panels, while tracer studies are used to examine longer-term relevance and workplace transfer.

In practical terms, the actors involved are the programme leaders, the quality assurance function, trainers and assessors involved in moderation, partner sites participating in cross-site audits, and external reviewers and industry representatives contributing to external quality review. The handbook also requires each KPI to specify what is measured, which evidence source is used, how often data are collected, what decision rules apply, and who is responsible for follow-up, so that monitoring remains comparable across institutions and company sites. Monitoring results are visualised through three practical dashboards: a delivery dashboard, a quality dashboard, and a compliance dashboard.

10.3 Evaluation Mechanisms

In addition to continuous monitoring, periodic evaluation activities are conducted to assess the overall performance of the training pathways. In the HUCO quality model, evaluation is organised through a staged review cycle: monthly summaries are prepared for programme leaders, quarterly summaries are discussed within the Community of Practice, and annual summaries feed into external review and accreditation processes. Twice a year, partner sites also carry out dual-site quality audits on a shared sample of evidence, including project charters, protocols, review minutes, and acceptance reports. The actors involved include programme leaders, the quality assurance function, trainers and assessors participating in moderation, partner institutions involved in cross-site audits, and external reviewers and industry representatives contributing to peer review and industry panels.

Evaluation criteria include achievement of learning outcomes, relevance of training modules for industry needs, effectiveness of collaboration between institutions, satisfaction of students and companies, assessment reliability, partner engagement, and the transfer of learning into practice. The results are documented through shared dashboards and review procedures and are used to trigger corrective and preventive actions (CAPA), annual programme refinement, and, where necessary, change-control procedures for pathway improvement.

11. Sustainability and Transferability

This chapter outlines how the HUCO model ensures sustainability and transferability beyond the project lifetime, by defining its long-term implementation logic, governance responsibilities, and mechanisms for scaling and replication across different institutional and national contexts.

11.1 Long-term implementation logic

The HUCO organisational model is designed for continuation beyond the funded project period, but this continuity does not rely on one single mechanism. Instead, it combines three complementary sustainability logics: continued pathway delivery within the partner institutions, consolidation of the HUCO ecosystem, and post-project coordination through a dedicated sustainability structure. The application explicitly presents HUCO as a first step towards a wider European ecosystem for research-oriented technician training, intended to reduce fragmentation and create more systematic cooperation between HVET, higher education institutions, research actors, and enterprises.

At institutional level, long-term implementation is secured differently in the two pilots. In Italy, the EQF 5 pathway is embedded in the regular ITS Academy structure and is funded by ITSAC with its own funds; it starts during the project but continues beyond the formal project lifetime as part of the biennial ITS programme architecture. This gives the Italian pathway a particularly strong continuity logic, because the HUCO modules are not conceived as a stand-alone pilot only, but as part of an existing provider structure. In France, the EQF 6 pilot is launched and completed within the project lifetime under the coordination of CMQ MSI, with implementation entrusted to Groupe Scolaire Saint Joseph LaSalle, but its results are intended to function as a replicable model for further uptake in the French and wider European context.

At ecosystem level, sustainability is linked to the consolidation of the HUCO Labs ecosystem, conceived as a shared European network of laboratories, infrastructures, training providers, universities, and companies. The application states that this ecosystem is expected to grow progressively and that at least four new villages connected are foreseen by the end of the project. The underlying logic is that single institutions cannot easily provide such a broad and multidisciplinary R&D learning environment on their own, whereas the ecosystem makes shared access to laboratories, equipment, and expertise possible across borders.

11.2 Responsibilities, timing, and sustainability mechanisms

Responsibility for sustainability is not left implicit. The application foresees the establishment of a HUCO Sustainability Board, composed of one representative from each partner, with the task of defining the sustainability strategy and the related action plan to be implemented during and after the project. Associated and supporting partners may also be invited to participate, which gives the sustainability logic a broader stakeholder base than the core consortium alone.

The timing is also clearly staged. A sustainability plan with a long-term strategy is to be co-designed from the beginning of the project, progressively updated during implementation, and shared and validated by M35. The application distinguishes between Phase I: project lifetime and

Phase II: post-project period. During Phase I, the main tasks are to establish the ecosystem architecture, sign the consortium agreement, test the pilot activities, and launch the first WE HUCO Forum. During Phase II, the partners are expected to monitor how the project results are adopted, replicated, and integrated into the relevant training offers of the participating countries, while maintaining stakeholder contact and updating the project website and social media channels.

The WE HUCO Forum plays a particularly important role in this logic. It is not only a dissemination event, but the main instrument for enlarging and reinforcing the ecosystem by attracting new training providers, companies, regional development agencies, and other stakeholders interested in dual training, innovation, and research.【turn15file15】 The first forum is designed and implemented in WP3 under the responsibility of ITSAC, with all partners contributing; the application also states that annual editions of the HUCO Forum are intended to continue after the project and to serve as the main moment for disseminating monitoring data and strengthening the community around the HUCO model.

11.3 Transferability and scaling potential

The transferability of the HUCO model rests on several concrete features already built into the project design. First, the training offer is modular and embedded in existing pathway structures, which makes it easier to adapt selected HUCO elements to different institutional contexts rather than requiring full system replacement. Second, the model is supported by a project-wide cooperation architecture between HVET institutions, universities, and companies, which is intended to be formalised through consortium agreements, ecosystem road maps, and recognition arrangements.

Third, the project explicitly aims to create replicable models. The application states that the French EQF 6 pilot and the Italian EQF 5 pilot are intended not only as local tests, but as pilots with wider exploitability in other systems and countries. This is reinforced by the dissemination logic: HUCO results are to be made available through a multilingual website, newsletters, webinars, open materials under Creative Commons licences, and other international platforms, so that external institutions can reuse both the training content and the organisational approach.

The transferability logic is particularly strong in the Italian context, where ITSAC intends to disseminate the results through the wider ITS network; the application highlights the potential relevance of the model for the broader Italian ITS system and links it to current national reforms encouraging networks between ITS, companies, universities, and research centres. More broadly, the project also aims to strengthen European-level dialogue through partners such as EURASHE and CEA-PME, and to support future expansion through regional, national, and European funding opportunities identified for the post-project period.

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Annex A: HUCO Training Pathways Implementation Roadmap (2026–2027)

The operational pilot phase of the HUCO training pathways takes place during the academic year 2026–2027, following the completion of the curriculum design and module development work carried out in Work Package 2. The timeline below illustrates the sequencing of the main training, mobility, and collaboration activities implemented during the pilot phase, integrating both the EQF Level 6 French pathway and the EQF Level 5 Italian pathway. These pathways reflect a research-based, innovation-oriented pedagogical model aligned with the TRIComp competence framework and the objective of training "Innovation Enablers" capable of contributing to Industry 5.0 challenges.

Phase 1 – Programme Launch

September – October 2026

Activities include:

- launch of the French EQF Level 6 pilot pathway (8 students) at ESJO (CNAM Bachelor in Electromechanical Engineering)
- launch of the Italian EQF Level 5 pilot pathway (20 students) at ITS Academy Cuccovillo
- introduction to the HUCO learning model and the TRIComp competence framework
- onboarding activities, including team-building, role orientation sessions, and initial company testimonials
- start of the first classroom, laboratory, and inquiry-based modules
- organisation of the first online European company-testimonial sessions coordinated by BVMW

The Italian pathway additionally includes preparatory and alignment activities to ensure a homogeneous entry level, as well as the launch of foundational modules in ICT, safety, communication, and technical design.

Phase 2 – Core Training and Project Modules

October 2026 – January 2027

During this phase, the main technical, methodological, and project-based modules are delivered.

French pathway (EQF Level 6):

- TU25 Life Cycle Analysis and Eco-Design
- TU26 Computer Aided Design
- TU27 Research and Scientific Communication
- TU28 Innovation Sprint (preparation phase)
- integration with existing CNAM modules and apprenticeship-based professional experience

Italian pathway (EQF Level 5):

- delivery of first- and second-year ITS curriculum modules, including:
    - CAD, automation, CNC, and production systems
    - applied R&D methodologies and prototyping
    - virtual simulation and digital validation
    - statistical methods and process optimisation
- implementation of inquiry-based practical laboratories (integrative modules)
- continued company-based training activities and industry-led teaching (minimum 60% involvement of professionals)

At the same time, in-house modules delivered by foreign teachers take place, supporting knowledge in-sourcing and transnational teaching:

- UPV and SSMTP in the French pilot
- DHBW and SSMTP in the Italian pilot

Phase 3 – International Study Visits

February – March 2027

Short-term mobility activities are organised for both pilot groups.

French pilot:

- study visit at COMAU (Italy)
- study visit at DHBW (Germany)

Italian pilot:

- study visit at UPV (Spain)
- study visit at CMQ MSI (France)

These visits allow students to explore different industrial innovation environments, applied research infrastructures, and collaboration models within the HUCO Alliance. They complement the strong internationalisation dimension of the programme, which combines physical mobility with transnational collaborative learning.

Phase 4 – Innovation Challenge and Applied R&D Projects

March – May 2027

During this phase:

- the Innovation Sprint (TU28) takes place in an international company environment
- students work on real industrial innovation challenges using research-based and iterative approaches
- interdisciplinary and project-based learning is intensified across both pathways
- in the French pathway, TU29 Industrial Design Jam is implemented as an applied innovation project
- in the Italian pathway, integrative inquiry-based laboratories and applied R&D modules continue, focusing on prototyping, validation, and process optimisation
- additional online company-testimonial modules are delivered with BVMW

Across both pathways, projects emphasise experimentation, continuous improvement, and the application of innovation, digital, and sustainability competences in real-world contexts.

Phase 5 – International Internship and Programme Completion

May – July 2027

The final phase focuses on work-based learning, competence validation, and programme completion.

French pilot:

- one-month international internship abroad:
    - 4 students at UPV (Spain)

- 4 students at DHBW (Germany)

- internships are embedded in the broader apprenticeship structure (minimum 10 months company experience required for degree validation)

Italian pilot:

- continuation and completion of the 800-hour curricular internship within partner companies
- development of final project work linked to real industrial challenges
- preparation for final assessment and diploma awarding

Internships in both pathways are supervised through the HUCO triadic mentoring model, involving:

- a school professor (HVET)
- a university researcher
- a company mentors

Cross-Cutting Features of the Pilot Phase

Across all phases, the HUCO implementation roadmap is characterised by:

- strong integration of TRIComp competences into all modules
- co-design and co-delivery between HVET institutions, universities, and companies
- a balance between classroom learning, laboratory work, and applied research in industrial contexts
- extensive use of active pedagogies (project-based, inquiry-based, and challenge-based learning)
- a combination of physical mobility and transnational collaboration formats
- certification of learning outcomes through ECTS and micro-credentials

This roadmap illustrates how the HUCO training ecosystem operationalises a multi-level, transnational, and research-based learning model, ensuring that students progressively develop into “Innovation Enablers” capable of contributing to industrial transformation and sustainable innovation in Europe.