

## Strategic insights into Micro-Credentials in Technical Higher Education: European experience, educational perspectives and challenges for Ukraine and Moldova in the field of transport and logistics

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### Abstract

This study offers a comprehensive analysis of the development, implementation, and strategic relevance of micro-credentials in technical higher education, with particular focus on their application in the transport and logistics sector. Drawing on a cross-country review of European practices, the research examines micro-credentials as flexible, modular learning instruments designed to enhance competence-based education and address evolving labour market needs shaped by digitalization, green transition priorities, demographic changes, and the shift toward a skills-first economy.

A comparative review of institutional and policy approaches highlights multiple national trajectories across Europe. Germany demonstrates structured quality assurance through ASIIN certification procedures; Italy showcases decentralized, institution-driven models; Poland implements emerging national guidelines; while Romania applies a content-focused approach, integrating micro-credential-like modules within formal programmes to reinforce targeted competencies and improve student readiness for sector-specific demands. Together, these examples illustrate the variety of mechanisms for credit allocation, assessment, and digital recognition that support the broader adoption of micro-credentials.

The research also emphasizes their strategic importance for the transport and logistics sector, as a field defined by technological dynamism, international operations, process-oriented organizational structures, and the need for continuous workforce upskilling. Micro-credentials in this domain cover specialised areas such as supply chain logistics, digitalisation processes, rail and maritime operations, transport systems infrastructure, and sustainable mobility. Industry-based models, including Maersk's blockchain-secured digital badges and DHL's competency-oriented training, further demonstrate how targeted micro-learning supports professional development and aligns employee skills with operational requirements.

For Ukraine and Moldova, the study identifies emerging regulatory definitions, institutional pilots, and early implementation efforts across universities. Moldova has introduced formal definitions of micro-qualifications and established credit ranges, while Ukraine demonstrates initial integration of micro-credential elements through elective modules, professional certificates, and non-formal learning recognition. At the same time, both systems face challenges, including the absence of harmonised national frameworks, fragmented recognition mechanisms, and limited digital infrastructure for verification and portability.

Overall, the findings indicate that micro-credentials represent a flexible and scalable mechanism for modernizing technical higher education, strengthening the link between educational institutions and industry, and enhancing workforce readiness. Their strategic potential is especially significant for countries undergoing structural transformation, such as Ukraine and Moldova, where alignment with European standards and the need for rapid skills adaptation remain essential.

Keywords: Micro-credentials; Technical Higher Education; Transport; Logistics; Labour market; Competence-based learning; Lifelong learning.

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## **1 Micro-credentials as a strategic tool for skills development in transport and logistics**

The transport and logistics sector is undergoing profound structural transformation driven by digitalisation, automation, sustainability imperatives, and the growing complexity of global supply chains. These dynamics reshape professional competence profiles and challenge traditional higher education programmes by delivering timely, targeted skills aligned with labour-market needs. Core competences increasingly include digital literacy, data-driven decision-making, logistics process optimisation, regulatory compliance awareness, and adaptive capacity in rapidly evolving operational environments (World Economic Forum, 2025; OECD, 2023; OECD, 2025). As these skills continuously evolve in response to technological innovation and sustainability-oriented transport policies, education systems require agile instruments capable of addressing emerging competence gaps. Micro-credentials respond to this demand by offering short, outcome-based learning units that enable the acquisition of job-relevant competences without full-degree enrolment, a particularly suitable model for professionals who must update specialised operational or digital skills while remaining active in the workforce (University of Wollongong, 2025; Universidad Rey Juan Carlos, 2025; University of Antwerp, 2025a).

The strategic relevance of micro-credentials is reinforced by their growing adoption in both industry-led and university-based initiatives. Major logistics corporations such as DHL and Maersk invest in structured learning pathways to strengthen competences in freight operations, logistics management, and digital supply chain solutions. In parallel, higher education institutions integrate micro-credentials into academic provision to address sector-specific competence needs, ensuring alignment between defined learning outcomes and real operational challenges.

In this context, the present study, conducted within the framework of the Erasmus+ CBHE project ISDEGO (ISDEGO Project 2025), applies a comparative policy and institutional analysis of micro-credential implementation in Germany, Italy, Poland, Romania, Ukraine and Moldova in order to identify transferable practices for technical higher education in transport and logistics.

## **2 Worldwide framework and practice of micro-credentials in technical higher education**

Worldwide practices in the development of micro-credentials reflect a systematic shift in technical higher education towards flexible, competence-oriented, and labour-market-responsive learning models (Nuffic 2022). Across different countries, micro-credentials are increasingly embedded within formal higher education systems as short, targeted learning units with clearly defined learning outcomes, transparent assessment procedures, and strong institutional responsibility. These practices collectively shape an emerging worldwide framework for micro-credentials, combining global quality principles with national and institutional specificities.

Across worldwide practices, a clearly defined policy context emerges as a critical prerequisite for the sustainable development and recognition of micro-credentials. Policy frameworks increasingly focus on standardisation, transparency, and quality assurance to ensure comparability and portability across institutions and countries (Council of the European Union, 2022a; European Commission, 2025; MICROBOL Project, 2022a). A common format for documenting micro-credentials is considered essential for clearly communicating their value. Constitutive elements typically include the title, issuing institution, learning outcomes, workload, level, and assessment methods. These elements support transparency and recognition within and beyond national education systems.

Among the analysed cases, New Zealand represents one of the most advanced and systemically developed national approaches to micro-credentials. The New Zealand model is characterised by the formal embedding of micro-credentials within the national education and training system and by their explicit orientation towards clearly identified skills gaps. Micro-credentials are designed in close cooperation with industry and aligned with labour market needs, which enhances their relevance and credibility. The New Zealand experience demonstrates how micro-credentials can be systematically integrated into national qualification frameworks while preserving flexibility and responsiveness to changing skills demands (New Zealand Qualifications Authority, n.d.).

International initiatives illustrate how such policy frameworks are operationalised in practice. Projects focused on micro-credentials contribute to defining core issuing elements and supporting higher education institutions in the processes of designing, implementing, awarding, and recognising quality-assured micro-credentials. A prominent example is the ARISA initiative, which delivers micro-credentials focused on artificial intelligence knowledge and skills, outlines a comprehensive approach based on compliance with European and international standards, emphasising transparency, portability, and employability (ARISA Project, 2025).

Within this framework, micro-credentials are defined as outcomes-based and assessable learning units, typically corresponding to a limited workload (often within the range of 1–15 ECTS), owned by learners and designed to be stackable and portable. Recognition is closely linked to quality assurance mechanisms and transparency tools, including Certificate Supplements that document both mandatory and optional elements. Alignment with national and international qualification frameworks is further supported by digital tools enabling automated comparison and cross-border validation.

Across Germany, Poland, Italy and Romania, micro-credentials are being integrated into higher education systems through nationally specific regulatory and institutional logics, yet common structural patterns are evident.

In Germany, strong institutional autonomy combined with rigorous quality assurance safeguards academic legitimacy and alignment with established qualification frameworks, though complex accreditation traditions may constrain rapid scalability and flexibility (ASIIN; Hochschulrektorenkonferenz). Poland and Romania demonstrate more emergent and innovation-driven approaches, where universities deploy modular, competence-based formats to strengthen labour-market relevance; however, incomplete recognition frameworks, limited standardisation, and evolving policy environments restrict portability and cross-institutional acceptance (National Centre for Recognition and Equivalence of Diplomas). Italy represents a university-led model embedded within lifelong learning strategies and closely aligned with national qualification structures, ensuring formal credibility but occasionally reducing design flexibility and administrative agility (ProcToGo Project Consortium). Collectively, these trajectories reveal a shared tension between flexibility and regulation, the centrality of quality assurance for trust-building, and ongoing challenges in achieving systemic recognition, interoperability and scalable implementation of micro-credentials across European higher education systems.

Overall, worldwide frameworks and practices demonstrate that micro-credentials represent a strategically significant, scalable and adaptable instrument for skills development in technical higher education, capable of bridging formal qualification systems with rapidly evolving labour market needs while simultaneously exposing systemic governance and recognition challenges that require coordinated policy responses. While shared principles such as quality assurance, transparency, and labour market orientation are evident across countries, national contexts shape distinct implementation models and challenges. These experiences collectively highlight both the potential and the structural complexity of integrating micro-credentials into higher education systems, providing a solid foundation for further development in applied and technically intensive sectors such as transport and logistics.

### **3 Design and Implementation of Micro-Credentials in Freight Transport and Logistics**

In the transport and logistics sector, micro-credentials play a particularly strategic role due to the dynamic and multidimensional changes shaping this field. Ongoing digitalisation and automation of logistics processes, the introduction of new regulatory requirements, increasing sustainability obligations, and the growing complexity of global supply chains generate continuous demand for rapid skills acquisition and updating. In this context, traditional long-cycle educational programmes often prove insufficient to respond promptly to the needs of industry. Micro-credentials, by contrast, offer modular, targeted, and rapidly deployable learning solutions that enable professionals to supplement specific competences within a short timeframe, making them especially suitable for freight transport and logistics.

The design of micro-credentials in this sector is characterised by a strong orientation towards clearly defined professional competences (Nuffic, 2022; ProcToGo Project Consortium, 2023). Typical thematic areas include cross-border road transport within regulatory frameworks, supply chain logistics and digitisation, transport infrastructure, the application of transport management systems (TMS) and warehouse management systems (WMS), the transportation of dangerous goods, and the implementation of sustainable transport solutions. This thematic breadth demonstrates that micro-credentials can be structured to reflect the full spectrum of freight transport and logistics activities, ranging from operational functions to strategic management.

The delivery of micro-credentials in this sector is predominantly characterised by flexibility and digital accessibility. Most programmes are offered online or in hybrid formats, enabling working professionals to combine learning with employment and facilitating international participation. Universities such as Cranfield University (United Kingdom), University of Wollongong (Australia), Royal Roads University (Canada), Oregon State University (United States), Universidad Rey Juan Carlos (Spain), University of Antwerp (Belgium), and Trinity College Dublin (Ireland) exemplify this approach by offering modular micro-credentials in logistics, supply chain management, transport systems, maritime logistics, humanitarian logistics, transport modelling, and transport innovation (Cranfield, 2025; Royal Roads University, 2025; Oregon State University, 2025a; Trinity College Dublin, 2025). These programmes differ in scope and workload, ranging from short introductory modules worth a few ECTS credits to more comprehensive learning pathways that may be accumulated and recognised as part of certificate or master's degree programmes.

Assessment practices within university-based micro-credentials emphasise the verification of applied competences. Learners are evaluated through competence-based assessment methods focused on problem-solving, case analysis, system optimisation, and strategic decision-making in logistics and transport contexts. Transparent assessment criteria and clearly documented learning outcomes enhance the credibility and academic legitimacy of micro-credentials and support their recognition by employers and educational institutions.

Industry-initiated micro-credentials further demonstrate effective models of design, delivery, and assessment in freight transport and logistics. Large international logistics companies increasingly integrate micro-credential elements into their internal training and professional development systems. For example, DHL has introduced the Certified Supply Chain Specialist (CSCS) programme, which awards micro-credentials for completing modular training in areas such as warehousing, transportation, supply chain security, occupational safety, and warehouse management systems (WMS). These micro-credentials are embedded within broader corporate development strategies that include internal training centres, e-learning platforms, and graduate programmes.

Similarly, Maersk applies micro-credential principles within its internal digital learning ecosystem, issuing digital certificates and blockchain-secured badges. Micro-credentials such as MPACT Foundations for All and Artificial Intelligence and Machine Learning – Foundations document employees’ competences in efficiency enhancement, digital transformation, and data-driven decision-making. Designed to be shareable on professional platforms, they increase transparency and support career development both within and beyond the organisation. Another example is GEODIS, which has implemented innovative training in the field of dangerous goods transport certified under the IATA CBTA framework. Although not formally branded as open badges, this training model meets key micro-credential criteria by being modular, measurable, competence-based, and globally recognised.

Overall, the analysed practices demonstrate that micro-credentials in freight transport and logistics combine outcome-based design, flexible delivery formats, and competence-oriented assessment within structured quality assurance frameworks. The integration of examples from both higher education institutions and leading logistics companies confirms that micro-credentials represent a robust and scalable instrument for responding to rapidly evolving skills demands in freight transport and logistics. They enhance the adaptability of education and training systems, support lifelong learning, and strengthen alignment between academic provision and labour market needs.

The findings of the analysis of worldwide practices in freight transport and logistics are synthesised into a Design-Delivery-Assessment (DDA) framework, as presented in Table 1.

Table 1. DDA framework for micro-credentials in freight transport and logistics.

Dimension	Analytical focus	Key characteristics in freight transport and logistics
Design	What is designed and how	Micro-credentials are designed as competence-based, outcome-oriented and modular learning units addressing clearly defined skills gaps in freight transport and logistics. The content focuses on operational, digital, regulatory and sustainability-related competences, including supply chain management, transport systems, route optimisation, TMS/WMS operation, maritime and humanitarian logistics, sustainable transport planning, dangerous goods handling and cybersecurity. Design principles emphasise modularity, stackability, alignment with professional tasks, and compatibility with academic qualification frameworks and ECTS-based workload allocation (ProcToGo Project Consortium, 2023).
Delivery	In which formats and for whom	Delivery is predominantly organised in online and hybrid formats, enabling flexible participation by working professionals, managers and specialists in the logistics and transport sectors. Micro-credentials are offered on a part-time basis, often over short periods or one–two semesters and may be accumulated into broader learning pathways or integrated into graduate certificates and degree programmes. Digital learning environments facilitate international access and support lifelong learning strategies in freight transport and logistics.
Assessment	How learning outcomes are confirmed	Assessment is competence-based and focused on verifying the practical application of knowledge in real-world logistics and transport contexts. Methods include problem-solving tasks, case studies, system analysis and optimisation assignments, and evaluation of transport and supply chain solutions. Transparent assessment criteria, documented learning outcomes, and digital certificates or badges ensure credibility, recognition and acceptance of micro-credentials by both higher education institutions and industry actors.

The DDA framework highlights that the effectiveness of micro-credentials in freight transport and logistics depends on the internal coherence between design, delivery, and assessment. Competence-based design ensures relevance to sector-specific challenges, while flexible delivery formats enable participation of working professionals and support lifelong learning strategies. At the same time, competence-oriented assessment and transparent certification mechanisms are critical for building trust among employers and for ensuring labour market recognition. The analysis demonstrates that fragmentation between these dimensions may limit the value of micro-credentials, whereas their integrated implementation strengthens their role as a strategic instrument for skills development in rapidly evolving transport and logistics systems.

#### 4 Integrating Micro-Credentials in Technical Higher Education for Freight Transport and Logistics: Challenges in Ukraine and Moldova

The development of micro-credentials in Ukraine and Moldova takes place within predominantly degree-oriented regulatory and institutional environments. Existing accreditation and qualification systems are largely structured around full academic programmes, which constrains the formal integration, accumulation, and recognition of short-cycle, modular, and outcomes-based learning components. In technically regulated domains such as freight transport, logistics management, and transport infrastructure engineering, verified and transparent confirmation of competences is essential for professional practice and labour market mobility, thereby creating structural barriers in the absence of systematic micro-credential adoption.

Institutional capacity constitutes an additional limiting factor. Not all higher education institutions possess sufficient expertise in competence-based curriculum design, digital delivery models, or structured assessment aligned with national qualification frameworks. Mechanisms for the recognition of prior learning and for stacking micro-credentials into coherent educational pathways remain underdeveloped. Furthermore, cooperation between universities and freight transport stakeholders is still evolving, which restricts the alignment of micro-credentials with operational, technological, and regulatory sectoral requirements (Verkhovna Rada of Ukraine, 2017; Ministry of Education and Science of Ukraine, 2022).

In Moldova, although infrastructural disruption is less acute, similar systemic challenges persist regarding regulatory flexibility, recognition mechanisms, and institutional readiness. The gradual modernisation of freight and logistics systems, together with increasing alignment to European standards, necessitates structured upskilling of professionals. Micro-credentials can serve as a scalable instrument for strengthening technical capacity and enhancing the responsiveness of higher education to sectoral transformation (National Qualifications Agency, 2024). By supporting targeted competence formation and accelerated requalification, micro-credentials contribute to the renewal and upgrading of human capital in freight transport and logistics. In both Ukraine and Moldova, their systematic integration into national education and training systems represents not only an educational innovation but also a strategic mechanism for enhancing resilience, interoperability, and the long-term sustainability of transport and logistics systems.

To synthesise the outlined regulatory constraints, institutional limitations, and sectoral transformation dynamics, a structured analytical model is required. The Extended DDACP framework presented in Table 2.

Table 2. Extended DDACP Framework for Micro-Credentials in Freight Transport and Logistics.

Dimension	Strategic Orientation	Key Elements	Analytical Focus
Design	Competence-based, NQF/EQF-aligned architecture supporting sector modernisation and sustainable transport transition	What is designed and how	Modular, outcome-oriented units addressing multimodal freight planning, TEN-T interoperability, ITS integration, digital logistics coordination and sustainable transport engineering; explicit alignment with SDG 11 principles (resilience, environmental performance, inclusive and sustainable urban freight systems) (Comi et al. 2023); stackable structure with transparent ECTS allocation.
Delivery	Flexible, digitally enabled lifelong learning for sector professionals	In which formats and for whom	Short-cycle, online/hybrid formats targeting engineers and logistics specialists; rapid upskilling aligned with infrastructure transformation and freight corridor reconfiguration; industry-linked implementation.
Assessment	Transparent and interoperable competence validation	How learning outcomes are confirmed	Competence-based evaluation through modelling, optimisation and system analysis tasks; clearly defined outcomes; digital certificates/badges ensuring recognition and portability.
Challenges	Structural and institutional implementation constraints	Systemic and institutional barriers	Degree-oriented regulation; limited integration into qualification frameworks; uneven institutional readiness; insufficient university–industry coordination; fragmented recognition mechanisms.
Perspectives	Human capital reinforcement and freight system resilience	Long-term strategic and sectoral impact	Support for multimodal development, digitalisation and SDG 11-oriented sustainable mobility; enhanced TEN-T alignment; strengthened adaptability and competitiveness of freight transport systems.

To synthesise regulatory constraints, institutional limitations, and sectoral transformation dynamics, a comparative analysis of national implementation models is presented in Table 3.

Table 3. Key Differences in the Implementation of Transport and Logistics Micro-Credentials Across Selected EU Countries, Moldova, and Ukraine.

Aspect	EU Countries (Germany, Poland, Italy, Romania)	Moldova	Ukraine
Policy Framework	Comprehensive, EU-aligned national guidelines for higher education and adult learning	Regulated by the Education Code, National Qualifications Framework (NQF), and Adult Training Regulations	Evolving National Qualifications Framework; ongoing reforms to align with EU standards
Digital Tools	Widely implemented; examples include Open Badges, blockchain pilot projects, and Europass integration	Limited adoption; no connection to Europass	Pilot initiatives, including MOOCs and institutional certificate programmes

Workload (ECTS)	2–19 ECTS per module; stackable into larger programs	5–60 ECTS per course; flexible modular structure	Variable; 4–36 ECTS in elective pathways; 4 – 6 ECTS (National Qualifications Agency, 2024; Semigina et al., 2024)
Quality Assurance & Recognition	ASIIN-accredited and EQF-aligned; strong validation by employers and industry stakeholders	Modular programs require formal authorization; limited external QA	Institutional QA mechanisms; no national registry; recognition practices under development
Transport/Logistics Focus	Specialized modules of 3–6 ECTS, focusing on sector-specific competencies	Adult training programs up to 30 ECTS, covering practical skills	Elective modules linked to urban transport, sustainability, and SDG-oriented topics

Table 3 summarises key differences in micro-credential implementation across selected EU countries, Moldova, and Ukraine. The comparison underscores the strategic need for flexible, interoperable, and sector-aligned micro-credential frameworks in transitioning economies.

Following the identification of key implementation differences, Table 4 presents a responsibility allocation model within the Extended DDACP framework, connecting strategic orientation, key functions, and institutional actors.

Table 4 illustrates how design, delivery, assessment, challenges, and perspectives of micro-credentials can be operationalised in Ukraine and Moldova. It shows that effective integration relies on clearly defined institutional roles. This structured allocation facilitates both short-term implementation and long-term strategic embedding of micro-credentials within evolving transport systems.

Table 4. Responsibility Allocation Model within the Extended DDACP Framework.

DDACP Dimension	Key Function	Primary Institutional Actor	Supporting Actors	System-Level Orientation
Design	Competence definition aligned with freight system transformation	Technical Universities	Industry, Transport Ministry	Alignment with SDG 11 objectives, TEN-T interoperability and digitalisation priorities, ensuring adaptive flexibility and structured responsiveness to infrastructure transformation, corridor reconfiguration and evolving demand for specialised freight transport competences.
Delivery	Flexible modular implementation	Universities	Digital providers, Industry	Workforce adaptability, lifelong learning
Assessment	Competence validation & recognition	Universities + QA Agency	Industry, Qualification Authority	Transparency, cross-border portability
Challenges	Regulatory adaptation	Ministry of Education	Qualification Authority	Framework integration
Perspectives	Long-term sectoral embedding	Transport Ministry + Universities	Industry	Human capital resilience & system sustainability

Integrating micro-credentials into technical higher education for freight transport and logistics in Ukraine and Moldova requires a dual focus: overcoming systemic and institutional constraints while leveraging modular, stackable, and digitally supported educational designs. The evidence-based frameworks presented in Tables 3 and 4 provide a practical roadmap for policymakers and universities to enhance resilience, interoperability, and sustainability in freight transport systems, ensuring that micro-credentials serve as adaptive mechanisms for workforce development and sectoral modernisation.

## 5 Conclusions

The analysis confirms that micro-credentials constitute a structurally significant instrument for modernising technical higher education in freight transport and logistics. Drawing on comparative international experience and diverse European implementation models, the study shows that, despite differences in regulatory frameworks and institutional autonomy, effective systems are grounded in shared principles: clearly defined learning outcomes, robust quality assurance, transparent workload allocation, and reliable digital recognition mechanisms. Evidence from global university and industry practice further demonstrates that short, competence-oriented learning units successfully develop specialised expertise in multimodal planning, supply chain optimisation, digital logistics systems, maritime and rail operations, and sustainable mobility engineering, while strengthening workforce adaptability and alignment between operational requirements and competence validation.

For Ukraine and Moldova, integrating micro-credentials into technical higher education is both a strategic necessity and an institutional challenge. Although emerging regulatory definitions and pilot initiatives indicate positive momentum, systemic constraints remain, including fragmented recognition procedures, limited digital verification infrastructure, and insufficient harmonisation with national qualification frameworks. Overall, micro-credentials should be understood not as supplementary tools but as adaptive mechanisms embedded within broader sectoral transformation, supporting accelerated upskilling, reinforced university–industry cooperation, and enhanced interoperability within European educational and transport systems. For structurally transforming countries such as Ukraine and Moldova, their systematic institutionalisation represents a strategic pathway toward resilient and sustainability-oriented freight transport and logistics systems.

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