TOWARDS AN INDUSTRY-ACADEMIA COLLABORATION FRAMEWORK FOR THE DEVELOPMENT OF DIGITAL GEOSPATIAL SURVEYING MICRO-CREDENTIALS

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Abstract

The geospatial surveying sector is undergoing rapid digital transformation, intensifying demand for advanced digital skills amid widespread workforce shortages and declining education pathways. Micro-credentials have emerged as a flexible solution for targeted, industry-aligned upskilling, yet their effective development requires structured collaboration between Higher Education Institutions and industry. This paper proposes a conceptual framework for designing Digital Geospatial Micro-Credentials through an Industry–Academia Collaboration model, synthesising multidisciplinary literature and preliminary action research. The framework integrates key drivers, collaborative patterns, and outputs, offering a foundation for future validation and enabling responsive approaches to developing digitally skilled geospatial professionals.

Introduction

The Architecture, Engineering & Construction (AEC) sector is currently undergoing a major digital transformation. Known as Construction 4.0, this paradigm shift is seeking to enhance efficiency, productivity, sustainability, safety, and collaboration (Build Up, 2024). In a study of Construction 4.0 adoption in Australia, Siriwardhana et al. (2025) identified the integration of several key technologies including BIM, IoT, digital twins, AI, AR/VR, Blockchain, Robotics, 3D Printing, Big Data and Drones. EU policy initiatives such as public procurement mandates are attempting to overcome the challenges associated with Construction 4.0 which include high initial investment, training needs, and resistance to change (Build Up, 2024). The geospatial surveying sector is also undergoing a profound transformation driven by digitalization. Traditional methods are being replaced by advanced technologies such as LiDAR, UAVs (drones), AR/VR, GNSS, and cloud-based GIS platforms. These tools enable faster data collection, higher accuracy, and real-time processing, allowing surveyors to deliver dynamic, interactive spatial models rather than static maps. To integrate effectively with Construction 4.0, modern geospatial surveyors need strong digital skills, spatial awareness, geodetic knowledge, interdisciplinary collaboration and proficiency in advanced tools like reality capture, GIS software, and data management systems (Trimble, 2025).

Geospatial Skills Shortages

The challenges associated with the rapid digital transformation of the geospatial sector is further exacerbated by a significant skills shortage which has existed for many years, with de Róiste (2014) and Masum et al. (2017) highlighting this issue in Ireland, New Zealand, Australia, and the United States. This problem persists with the most recent report from the Society of Chartered Surveyors in Ireland (SCSI) suggests a continued shortage of land surveyors in Ireland (Murphy, 2023), with both Site Engineers and Setting Out Engineer listed on Irish Government's Critical Skills Occupations List (DoETE, 2024). Martin (2024) suggests that the significant deficit in the number of geospatial professionals in Ireland is due to several factors including a lack of knowledge of geospatial surveying as a discipline, that it is not a protected professional title and the declining number of secondary students entering education programmes. Similarly, the global geospatial industry is facing a critical shortage of skilled surveyors due to an aging workforce and insufficient new entrants (Trimble, 2025). This is further compounded by a decline in surveying education programmes, with the SCSI and the Council of European Geodetic Surveyors as recently as October 2025 expressing *"serious concern over the trend of various universities across Europe closing their educational programmes related to land surveying."* They continue by stating that *"future professionals must have access to high-quality, innovative education and training."*

Higher Education & Micro-Credentials

The higher education sector is also facing growing challenges due to rapid technological change, evolving professional needs in the workplace and the digital transformation of society (Urem et al., 2025). This has expedited the demand for short, targeted, flexible upskilling/reskilling beyond traditional degrees (Walsh Shanahan & Organ, 2022; Islam, 2025). Employers are increasingly seeking immediately applicable digital skills, pushing Higher Education Institutes (HEIs) toward workforce-aligned modular learning (Urem et al., 2025). Micro-credentials, which are defined differently across contexts but share common goals: upskilling and reskilling to meet rapidly changing digital skill demands, provide an opportunity to address such challenges. They are short, flexible, industry-aligned learning units that can stack toward higher qualifications, supporting lifelong learning through competency certification (Moore et al., 2025). In this regard, both Islam (2025) and Walsh Shanahan & Organ (2022) emphasize the potential for developing micro-credentials in collaboration between academic institutions and industry stakeholders to guarantee workforce alignment, ensure relevance and uptake, meet market needs and foster innovation.

Opportunities in Digital Geospatial Education

Siriwardhana et al. (2025) advocates for the integration of Construction 4.0 concepts such as digital surveying technologies into formal education through collaboration between industry and academia. The potential benefits of industry-academic collaboration (IAC) for geospatial education are also highlighted by de Róiste (2014: 187), who states that it is: *"likely to lead to a greater professionalization and therefore a wider recognition of both the industry and those working in it. The benefits of gaining a qualification (after* employment*) or re-skilling in emerging areas need to be sold to both employees and their organisations."* This is confirmed by Cox (2025) who highlights the shift from traditional classroom-based models to flexible, hybrid, work-integrated learning pathways that align with industry needs. Trimble (2025) also cites the potential of IAC with an emphasis on micro-credentials, and continuous professional development to prepare a digitally skilled geospatial workforce.

Towards a Conceptual Framework?

The rapid digital transformation taking place within geospatial surveying sector, coupled with a significant skills shortage and a decline in formal education programmes, points towards a need for the development of upskilling opportunities for existing professionals within the AEC industry. Through a systematic literature review of 56 peer-reviewed articles on micro-credentials in HE published between 2015 and 2021, Ahsan et al. (2023) found that micro-credentials enhance employability through alignment with market needs, improving graduate employability and bridging skills gaps. They also suggested that micro-credentials be co-designed with industry to ensure relevance and acceptance, thus confirming the importance of IAC. According to Iatrellis et al. (2024), this trend highlights the need for structured, sustainable frameworks to support micro-credential programs and adapt to the changing educational landscape. With micro-credentials gaining traction as a potential solution in delivering enhanced digital skills, this research seeks to establish if an IAC framework for micro-credential design can effectively close the digital geospatial skills gap. This will be achieved by adopting a conceptual research design aimed at synthesizing existing theoretical and scholarly perspectives to create a new Conceptual Framework (CF) for the development of Digital Geospatial Micro-Credentials via IAC, based upon ongoing action research which is being led by South East Technological University (SETU) and KOREC Group, a geospatial surveying services provider in Ireland. In building a CF for multidisciplinary phenomena (i.e. digital geospatial surveying, micro-credentials and IAC) linked to different bodies of knowledge, the approaches proposed by both Jabareen (2009) and Waller (2022) have been adopted in the present study (as outlined in Table 1).

Table 1: Development of a Conceptual Framework

Present Study	Jabareen (2009)	Waller (2022)
Review of Multidiscipline Literature	Mapping sources Extensive reading and categorizing of selected data	Review: literature/themes/ theory
Main Concepts Arising	Identifying, naming, deconstructing & categorizing concepts	Reflect: what are the main concepts/issues?
Relationships and Integration	Integrating concepts	Relationships: what are their relationships?
Reflection & Synthesis into CF Diagram	Synthesis, resynthesis, and sensemaking	Reflect: does the diagram represent it sufficiently?
Validation of CF	Validating the conceptual framework	Review: check it with theory, colleagues, stakeholders, etc.
Revision of CF	Rethinking the conceptual framework	Repeat: review and revise it to see if something better occurs

The intention of this paper and associated conference presentation is to encourage a review, validation and revision of the framework as a work in progress to ascertain *"whether the proposed framework and its concepts make sense not only to the research but also to other scholars and practitioners" (Jabareen (2009: 54).* The paper is structured to reflect the work of both Jabareen (2009) and Waller (2002), with a Literature Review (multidisciplinary literature and main concepts arising), followed by the Development of Conceptual Framework (integration and synthesis into diagram). It is anticipated that further validation and revision of the CF will take place as the research progresses in future. The aim of the CF is to integrate currently disconnected bodies of knowledge—digital geospatial surveying, micro-credential design, and industry–academia collaboration—into a coherent model that can guide HEIs and industry partners in the structured co-development of digital geospatial micro-credentials.

Literature Review

Utilizing relevant scholarly and industry sources, the following review seeks to understand the underlining issues relating to the geospatial surveying profession, the role of micro-credentials in higher education and the nature of Industry-Academia Collaboration (IAC), leading to the identification of the main concepts arising.

Geospatial Surveying

Geospatial (land) surveying is the science of collecting, analyzing, and presenting spatial information about natural and built environments. Surveyors measure land and sea areas to map boundaries, features, and terrain for purposes such as GIS, construction, and legal disputes. The field is highly technological, using GNSS, LiDAR, drones, and 3D modelling across three main pathways: land, engineering (setting out buildings & infrastructure), and hydrographic (marine) surveying (RICS, 2023). Geospatial professionals are defined by de Róiste (2014) in terms of acquiring, integrating, analyzing, interpreting, presenting, managing, and distributing spatial and temporal information, as well as developing related equipment, software, and services. A major study of geospatial skills in the UK identified "Surveyors" as one of six geospatial occupational subgroups with an emphasis on capabilities including land surveying, field surveys, topographic surveys, use of survey instruments and advanced technologies such as LiDAR (Frontier Economics, 2020). In terms of the Land Surveying profession, CICES (2023) defines the core specialist competences as follows:

1. Undertake and produce topographic surveys using appropriate methodologies and controls
2. Proficient use of surveying instruments (including total stations, GNSS, laser scanners, levels, utility mapping tools, photogrammetry & drones)
3. Understand Geometric Principles
4. Geospatial Data Processing & Deliverables

According to Frontier Economics (2020), typical job titles include Land Surveyor, Utility Surveyor, Hydrographic Surveyor, and Site Engineer, spanning sectors such as Architecture, Engineering and Construction (AEC), geographical information, environmental services, land administration and management, cultural and natural heritage and renewable energy.

In discussing the evolution of the surveying profession, Masum et al. (2017) note the significant impact of technology from the introduction of electronic instruments in the 1960s to GPS in the 1990s and more recent advances with laser scanning and photogrammetric data capture. Geospatial skills encompass a broad range of technologies, including spatial modelling, surveying, Global Positioning Systems (GPS), Geographic Information Systems (GIS) as well as traditional cartography techniques (de Róiste, 2014). Digital transformation of the geospatial surveying sector is continuing at pace, with reality capture (SLAM and 3D laser scanning); cloud-based data management and AI & automation being the key technologies driving change (Trimble, 2025). Recent industry surveys have confirmed that digital skills are in highest demand for geospatial technology professionals, including data capture/collection; data processing & analysis; and data visualization (Frontier Economics, 2020). Siriwardhana et al. (2025) emphasizes that workforce skills are a critical enabler for successful Construction 4.0 adoption, arguing that digital transformation in construction requires a shift from traditional skill sets to advanced competencies such as digital literacy, data analytics, computational and parametric modelling, programming, and AI integration.

Status of Geospatial Education Programs in Ireland

The current offering of geospatial related education in Ireland is dominated by post-graduate programmes (NFQ Level 9) in GIS/Geoinformatics at University College Dublin, University College Cork, Maynooth University and Technological University of Dublin. In terms of full-time undergraduate programmes, there is a 1-year full-time Level 5 Certificate in Geospatial Technology delivered by Cork ETB, while the long-running full-time BSc (Hons) in Geospatial Surveying (Level 8) at TU Dublin was paused in September 2024. At present, TU Dublin is developing a Geospatial Survey Technician apprenticeship, a 2-year Level 6 qualification, in collaboration with the SCSI (Martin, 2024). This shift towards geospatial education programmes at Level 5, 6 and 9 points to a significant gap in educational opportunities at Level 7 and 8. With an ongoing lack of new students entering geospatial education programmes, it is suggested that HEIs focus on providing new upskilling/CPD opportunities for current professionals in industry (Masum et al., 2017; de Róiste, 2014). *"CPD is particularly important in a field that is so deeply influenced by technological innovation. Developments in GNSS, laser scanning, drone-based photogrammetry, and remote sensing continue to reshape workflows and methodologies. Without structured and accessible professional development pathways, there is a risk that skills gaps will widen and sector growth will be constrained" (Cox, 2025: 3).*

The main concepts arising from geospatial literature include skills & competencies, digitalization, key stakeholders, industry needs, skills shortage & gap, opportunities for HEIs, and the potential for IAC.

Micro-Credentials in Higher Education

Micro-credentials present the higher education sector with an opportunity to address the market's demand for flexible upskilling; *"as employers and job seekers become more aware of employment-enhancing micro-credentials programs, demand for such short-term upskilling opportunities is expected to increase" (Yildirim et al., 2025: 538).* A relatively recent innovation in the education landscape, micro-credentials are short, focused, quality assured learning programs that concentrate on specific competencies and skills. They are modular, portable, stackable, and are validated through transparent, reliable assessment and quality assurance (Islam, 2025; Moore et al., 2025; Pawilen et al., 2022). Micro-credentials are offered by diverse providers including universities, commercial entities, and professional bodies. This versatility enables micro-credentials to serve both formal education and workplace learning (Moore et al., 2025).

Table 2: Micro-Credential Categories

	Skill Credential	Micro-Credential Module	Short Learning Programme
Learning Effort/Time	1-25 hours 0 ECTS	25-150 hours 1-5 ECTS	150-1500 hours (stacked)
Award & Assessment	Open Badge Non-Formal Learning	Formal Learning with Assessment	Formal Learning with Assessment
Quality Assurance	None	Often External QA	Always External QA
Learning Outcome	Specific Competence	Acquisition of Learning Outcomes	Career Progression Goals
Pathway	N/A	Often Mapped to Qualification Framework	Always Mapped to Qualification Framework

Both employers and learners place significant value on the validation of micro-credentials for workplace recognition, with traditional academic credentials seen to be more trusted (Ashcroft et al., 2021). Walsh Shanahan and Organ (2022), suggest that the use of ECTS can help to standardize workload and recognition of micro-credentials, recommending a minimum of 5 ECTS for formal recognition. Indeed, Ahsan et al. (2023) found substantial evidence of research which examines integration of micro-credentials into formal curricula. Micro-credentials can function as standalone, credit-bearing courses or be integrated into formal qualifications. Sargent et al. (2023) found that they may appear as optional or compulsory components within traditional programs or as stackable micro-credentials, where multiple related short courses combine to form a recognized award (e.g., Graduate Certificate). Qualifications incorporating micro-credentials include traditional certificates, diplomas, and degrees. This trend reflects growing interest in modular learning pathways that allow learners to accumulate credits toward larger qualifications (Sargent et al., 2023). Micro-credentials are typically categorized in terms of learning effort/time, learning outcomes, assessment methods, quality assurance and pathways to further learning, with 3 categories identified as outlined in Table 2 (Camilleri et al., 2022; Walsh Shanahan and Organ, 2022; Urem et al., 2025). Iatrellis et al. (2024) identified the critical roles and responsibilities of key stakeholders within the micro-credentialing ecosystem as follows:

- **HEIs:** design, develop, and deliver micro-credentials; ensure academic standards, industry relevance, and quality assurance.
- **Industry Partners:** identify workforce skills and co-design micro-credentials; provide practical training opportunities.
- **Regulatory Bodies:** accredit and recognize micro-credentials; ensure consistency, quality and alignment with national frameworks.
- **Students and Learners:** provide feedback to refine relevance and effectiveness; participate in content co-creation for career and educational goals.
- **Quality Assurance Agencies:** evaluate programs against standards; recommend continuous improvement, shaping evaluation criteria.
- **Professional Bodies:** advocate for recognition and validation within industries.

For HEIs, micro-credentials offer several benefits, according to Pawilen et al. (2022): increase visibility and build their brand, attract diverse learners through unique and alternative courses, and appeal to these individuals to enroll in their formal education programs. Ahsan et al. (2023) identified several challenges associated with implementing micro-credentials in higher education including student acceptance, institutional readiness, technology gaps, employer recognition, logistical complexity and quality assurance. Employer awareness of micro-credentials is still low but growing, with traditional academic credentials remaining more trusted. Key factors influencing employer acceptance include industry validation, alignment with job needs, prior experience with credential issuers, and the issuer's reputation, credibility and quality assurance (Ashcroft et al., 2021). This presents a significant opportunity for higher education to lead in this area, with Yildirim et al. (2025: 552) stating that *"this shift could enable more flexible learning pathways, responsive curriculum design, and stronger alignment with lifelong learning and workforce development priorities."*

The main concepts arising from the micro-credentials in higher education literature include nature & categories of micro-credentials, development of skills & competencies, addressing industry needs & rapid digital transformation key stakeholders, course development/curriculum design, opportunities for HEIs, and the potential for greater IAC.

Industry-Academia Collaboration (IAC)

Aligning academic curricula with industry needs has long been a challenge for both educators and practitioners (Mahalingam, 2024), with Ahmed et al. (2022) suggesting that bringing in industry experts to assist in developing the curriculum can help to bridge this gap. Both Karanja and Malone (2022) and Mahalingam (2024) suggest that the co-creation of a curriculum with industry can prove beneficial in terms of improving the quality and relevance of academic programmes, whilst equipping graduates with the skills and knowledge required by industry. The most important outcomes of collaboration with industry were identified by Valiente Bermejo et al. (2022) as bridging the gap between academic education and industry requirements, enhanced graduate employability and strengthened research partnerships. Real, structured partnerships are more effective in driving innovation, with previous research demonstrating that open and networked innovation strengthens the potential of participating organizations (Esangbedo et al., 2024). From a digitalization perspective, Akash and Venuraj (2024) note the importance of IAC in terms of integrating state-of-theart technologies into the educational curriculum, an area where HEIs are often found to be lacking.

According to Esangbedo et al. (2024), IAC has been widely studied across different countries, including the UK, USA, and Japan. *"IAC is trending as a strategic framework necessary to bridge the increasing gap between the academic programmes and the emergent requirements of the industry" (Akash and Venuraj, 2024: 3).* A review of literature indicates a variety of frameworks, under various guises, focused on collaboration between academia and industry for curriculum development. These frameworks emerged from a number of different disciplines including business (Mahalingam, 2024); Software Engineering Ahmed et al., 2022); Sustainable Development Goals (Akash and Venuraj, 2024); Manufacturing Engineering (Valiente Bermejo et al., 2022); Information Technology (Junaini et al., 2008); and Industry 4.0 (Esangbedo et al., 2024). Mahalingam (2024) developed the industry-driven curriculum (IDC) framework which focuses on bridging the gap between academic curricula and industry requirements through frequent workshops. Key activities on the framework include identifying industry needs, mapping competencies, gap analysis on learning outcomes, course content, schedule of activities and assessment strategies, and developing a competency-based curriculum. Regular follow-up and updates post-workshop are essential in maintaining engagement with industry, whilst also demonstrating the incorporation of feedback can enhance trust and collaboration throughout the process (Mahalingam, 2024). An Academia-Industry Collaboration Plan (AIC) engineering process model is presented by Ahmed et al. (2022), which suggests that effective communication and collaboration in the early stages of engagement is critical for the transformation of proposals into practical applications, leading to a clearly defined "Finalized Collaborative Agreement." Akash and Venuraj (2024) proposed a framework for IAC which aligns student skill development with real-world requirements. It emphasizes dynamic, iterative collaboration between educational institutions and industry to continuously improve and adapt curricula, incorporate emerging technologies, upskill faculty, thereby enhancing relevance, employability, and responsiveness to evolving market demands. Valiente Bermejo et al. (2022) presents a model for university-industry collaboration in curriculum design and delivery, specifically applied to manufacturing engineering courses. A core element of this model are regular workshops with industry partners in developing, teaching, evaluating and improving the course. An Academic-industry smart synergy model was proposed by Junaini et al. (2008) with industry input in terms of market demand and curriculum development being seen as important to delivering relevant educational programs and a competent workforce. According to Esangbedo et al. (2024) research on IAC generally falls into three categories: Drivers (factors that motivate collaboration), Patterns (how collaborations are structured) and Outputs (results and impacts of collaboration). It is evident that collaboration between industry and academia in curriculum design can lead to significant benefits for both parties. To ensure strategic alignment, the reviewed IAC frameworks suggest that regular communication, collaboration and feedback is essential to ensure the development of competencies, curriculum, content, and assessment which leads to relevant courses that deliver the skilled graduates required by industry.

The main concepts arising from the IAC literature include addressing rapid digital transformation and industry needs, bridging the skills gap, collaboration and communication, key stakeholders, curriculum design and opportunities for HEIs.

Developing the Conceptual Framework

Having identified the main concepts arising from literature, the next stage in the development of a CF involves identifying relationships and integrating concepts, followed by reflection and synthesis inro a CF diagram. It is evident from the main concepts arising that there are a number of overarching concepts that cut across the three domains including digital transformation, skills shortages and educational gaps, micro-credentials for flexible learning and IAC as an enabling mechanism.

Relationships and Integration

The main concepts arising from each of the three literature topics were reviewed and analyzed using a matrix, allowing for identification of relationships between geospatial surveying, micro-credentials and IAC. Jabareen (2009: 54) suggests that *"this phase reduces the number of concepts drastically and allows us to manipulate to a reasonable number of concepts."*

Table 3: Integration of Concepts

Drivers (factors that motivate collaboration)	**Patterns (how collaborations are structured)**	**Outputs (results and impacts of collaboration)**
Digital Transformation & Construction 4.0	Industry-Academic Collaboration	Opportunities for HEIs
Decline in Geospatial Education	Active Engagement from Key Stakeholders	Benefits for Industry
Evolving Needs of Geospatial Profession	Key Stages/Activities	Digital Geospatial Micro-Credentials
Changing Landscape for HEIs	Curriculum Design/Course Development	Upskilling of Geospatial Profession

The matrix was developed by listing all identified concepts from each literature strand and grouping them based on conceptual proximity. Concepts were iteratively merged, eliminated, or re-named to achieve parsimony, consistent with Jabareen (2009). Through this analytical process, concepts were refined and integrated using the three categories of IAC research as identified by Esangbedo et al. (2024, namely: Drivers (factors that motivate collaboration), Patterns (how collaborations are structured) and Outputs (results and impacts of collaboration). These three categories form the basis for integration as they are widely used in IAC studies and enable the structured organization of complex multi-stakeholder processes. This led to the integration and refinement of concepts as evidenced in Table 3 below.

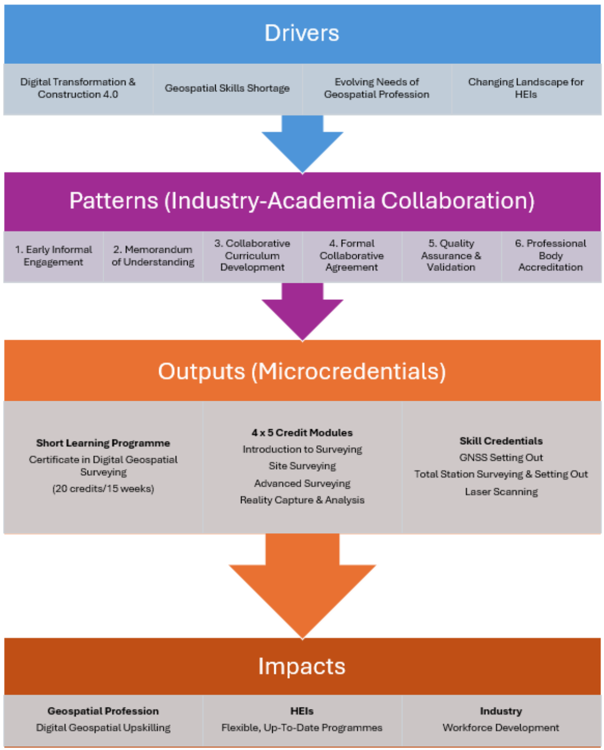
Reflection and Synthesis

Utilizing the information in Table 3, along with reflecting upon a number of Conceptual Frameworks considered as part of the literature review for both IAC and micro-credentials, this stage sought to synthesize this information into a visual representation of the emerging CF. The framework illustrates how sector-level drivers—such as Construction 4.0 digitalisation, geospatial skills shortages, evolving professional expectations, and shifts within HEI create a clear need for structured Industry–Academia Collaboration (IAC). These forces collectively shape a six-stage collaboration pathway that includes:

1. **Early Informal Engagement:** initial conversations between industry partners and the HEI where needs, interests, and emerging skill gaps are explored; builds trust and determines if collaboration is worthwhile.
2. **Memorandum of Understanding:** once mutual interest is established, partners formalise intentions through a non-binding agreement. This clarifies roles, expectations, and broad collaboration objectives without locking in detailed commitments.
3. **Collaborative Curriculum Development:** industry and HEI teams work together to design curriculum content, define competencies, shape assessments, and ensure learning aligns with real-world technologies and workflows. This stage is central to ensuring relevance and authenticity.
4. **Formal Collaborative Agreement:** partners move from intent to commitment through a binding agreement covering governance, responsibilities, IP considerations, resource inputs, scheduling, and shared oversight of teaching and assessment.
5. **Quality Assurance & Validation:** the collaboratively designed programme undergoes internal HEI QA processes; external assessor review, NFQ alignment and institutional approval, ensuring academic integrity and compliance.
6. **Professional Body Accreditation:** to review and endorse the programme or micro-credentials, confirming industry recognition and signalling credibility to learners and employers.

From these collaboration patterns emerge tangible outputs, including a 20-credit Certificate in Digital Geospatial Surveying (NFQ Level 7), four 5-credit modules, and skills-focused micro-credentials (e.g., GNSS, Total Station, Laser Scanning). These outputs impact across three domains: upskilling the geospatial profession, enabling HEIs to remain flexible and current, and strengthening industry workforce development. The proposed micro-credentials will be underpinned by competencies drawn from established geospatial frameworks (e.g., CICES competencies). Assessment is expected to follow practice-based tasks focused on data capture, processing accuracy, and applied problem-solving. A blended delivery model is envisaged, combining online preparation with equipment-based practical sessions co-delivered by KOREC Group staff. Evaluation in later phases of the research will consider indicators such as learner uptake, completion, employer recognition, and evidence of workplace application. These assumptions are preliminary but outline the pedagogical direction supporting the proposed IAC-driven micro-credential design.

Figure 1: Emerging Conceptual Framework



Future Work

The CF presented reflects the first iteration of a dynamic and ongoing collaborative process between SETU and KOREC Group. Currently, the IAC is at the Collaborative Curriculum Development stage, with an outline of the micro-credentials (output) in place. It is anticipated that the IAC CF will act as a catalyst for further development of both the framework and the micro-credentials with additional research involving:

- Validation focus groups with SETU & KOREC staff
- Interviews with surveyors/employers for input
- Cross-checking with existing frameworks

It is anticipated that empirical research will lead to the validation of a more robust IAC framework which might have applicability in other AEC contexts/professions.

Conclusions

This paper addresses the urgent challenge posed by the rapid digital transformation of the geospatial surveying profession and the lack of flexible educational pathways to develop required digital competencies. Existing literature on geospatial skills, micro-credentials, and Industry–Academia Collaboration (IAC) highlights a persistent misalignment between evolving industry needs and traditional higher-education provision. In response, this study develops a conceptual framework for Digital Geospatial Micro-Credentials, grounded in multidisciplinary evidence and iterative action research between an Irish HEI and a Geospatial Surveying Services Provider. In terms of a novel contribution, the framework synthesises three previously disconnected domains: (1) digital and professional changes in geospatial practice, (2) micro-credentials as agile, workplace-aligned learning mechanisms, and (3) IAC frameworks that emphasise co-design and continuous feedback. Structured around a Drivers–Patterns–Outputs logic, it clarifies the motivations for collaboration, the mechanisms through which it should occur, and the expected impacts on workforce development. This integration contributes a coherent framework that addresses skills shortages, curriculum relevance, and the need for adaptive educational offerings. Limitations include its basis in secondary literature and early-stage partnership activity, requiring further empirical validation, as well as its initial grounding in the Irish geospatial context, which may affect broader applicability. Future work should test the framework in additional sectors, regions, and educational systems to strengthen generalisability. Next steps involve validating and operationalising the framework through co-design workshops, practitioner interviews, focus groups, and pilot micro-credential evaluation. These activities will refine framework components and identify enabling conditions for effective IAC in digital skills development, with potential extensions to national qualification systems, accreditation processes, and European micro-credential initiatives. In conclusion, this study offers a significant first step toward addressing the digital geospatial skills gap through a structured, collaborative, and evidence-based approach to micro-credential design. By integrating previously siloed literatures, the framework provides a foundation for developing relevant, responsive, high-quality upskilling opportunities aligned with the realities of a digitally transformed AEC sector, with further refinement expected as the research progresses. Future work will operationalise and empirically evaluate the pedagogical dimensions of the framework, including competency mapping, assessment design, delivery modality, and indicators of success such as uptake, completion, employer recognition, and workplace impact. These activities will strengthen the framework's validity and ensure its practical applicability in addressing digital geospatial skills shortages, with the potential to address wider challenges relating to the integration of Construction 4.0 technologies into formal education through collaboration between industry and academia.

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