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To cite this article: Stylianos Yiatros *et al* 2025 *IOP Conf. Ser.: Earth Environ. Sci.* **1558** 012045

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Towards the enrichment of Construction VET courses for the Green and Digital Transition: The Buildskills Academy Paradigm

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Abstract. As the construction sector faces digital and green transitions, vocational education and training (VET) systems have struggled to keep pace. The BuildSkills Academy addresses this gap through a Europe-wide network focused on upskilling and reskilling of the construction workforce with certified transitional competencies. Central to this effort is the BuildEnrichedSkills Methodology (BESM), a structured framework that enhances VET courses across EQF levels 3–7 with green and digital skills. BESM involves a self-assessment tool, gap analysis for 38 construction professions and tailored course enrichment. Key gaps identified include limited training in life cycle assessment, nature-based systems, and digital risk modelling. This article presents two EQF level 6 pilot courses enriched through BESM, to be piloted by the Cyprus University of Technology. The first, *Bio-inspired Innovation and Design for Sustainable Engineering*, uses biomimicry and tools like the Copernicus Climate Atlas to teach climate-responsive design. The second, *Risk and Reliability in Health and Safety*, builds learners' capacity to assess structural uncertainty and human error through risk analysis techniques. These pilots show how BESM can equip learners with future-ready skills and support systemic change in construction education.

1. Introduction

The global construction industry is currently navigating a deep transformation, propelled by the imperatives of the green and digital transitions. These twin transitions call for an overhaul in the skills and competences of construction professionals, including those engaged in design, engineering, and site management. Despite this, vocational education and training (VET) programmes across Europe often remain anchored in legacy syllabi that do not prepare learners adequately for emerging environmental and technological challenges (Cedefop, 2020). In response to this misalignment, the Buildskills Academy Centre of Vocational Excellence (CoVE), represents a strategic effort to foster vocational excellence in the construction sector by addressing the urgent and growing need for transitional skills, particularly digital and green competences, to enable the sector's successful contribution to Europe's twin transition towards a climate-neutral and digitally advanced economy (BuildSkills Academy, 2024).

The need for an upgraded, future-proof skills base is profound. The construction sector is at the heart of the European Green Deal (European Commission, 2019) and the broader European Skills Agenda (European Commission, 2020), being responsible for approximately 40% of energy consumption and 36% of greenhouse gas emissions in Europe. Yet the sector faces significant structural challenges: an aging workforce, difficulties in attracting new talent, a fragmented VET landscape, and a substantial gap between the skills available in the labour market and those demanded by new digital technologies, sustainable construction methods, and circular economy principles (Cedefop, 2015).

In response to these pressing needs, twelve construction-related courses have been meticulously developed or enhanced using the *BuildEnrichedSkills* Methodology (BuildSkills Academy, 2024). This methodology, created by the BuildSkills Academy, is a structured, quality-assured approach that ensures the courses are aligned with labour market evolution and societal priorities. It supports the modernization of VET provision by embedding digitalization, sustainability, and innovative pedagogical practices into the learning design. The methodology also integrates feedback loops, industrial validation, and alignment with frameworks such as EQF (European Qualifications Framework)(European Union, 2018) and EQAVET (European Quality Assurance in Vocational Education and Training)(European Commission, 2024).

These twelve courses will be delivered by 6 VET Providers across Europe: Bosnia & Herzegovina, Bulgaria, Cyprus, Greece, Italy and Lithuania, aiming to support the construction workforce of tomorrow: from construction technicians to urban designers.

2. Literature Review

2.1. *The Importance of Green and Digital Skills in Construction VET*

The construction sector is increasingly influenced by global challenges such as climate change, lack of resources, and rapid technological development (Cedefop, 2022). As a response, the development of green skills in Construction Vocational Education and Training (VET) has become essential (ILO, 2019). Green skills encompass knowledge and practices related to energy efficiency, sustainable building materials, waste reduction, and environmental management, among others (United Nations Educational, Scientific and Cultural Organisation, 2017). These competencies enable construction professionals to contribute to more sustainable buildings and infrastructure, in line with current regulations and international commitments such as the European Green Deal (European Commission, 2019). Equipping learners with green skills not only prepares them to meet regulatory standards, but also encourages innovation in sustainable design and construction methods (WBL, 2022).

Therefore, the rapid digitalization of the construction industry demands a workforce proficient in modern technologies (Muench, S. et al., 2022). Digital skills, such as proficiency in Building Information Modeling (BIM), computer-aided design (CAD), and the LifeCycle Assessment studies, are now integral to the planning, implementation, and maintenance of construction projects. These tools improve project accuracy, enhance collaboration, and reduce costs and delays. Moreover, as digital tools become increasingly linked to sustainability, such as in energy monitoring systems. These skills often complement and enhance green practices.

Therefore, the future of Construction VET lies in the effective integration of both green and digital skills (UNESCO, 2021). Training institutions must adapt curricula to reflect industry demands, invest in upskilling trainers, and foster partnerships with companies to ensure practical, hands-on experience. Graduates equipped with this dual skill set will be more resilient and employable in a rapidly evolving sector. As a result, embedding green and digital

competencies into VET will not only strengthen the construction workforce but also contribute meaningfully to building a more sustainable and technologically advanced society (Rieckmann et al., 2017).

2.2. The construction sector in Cyprus

The construction sector in Cyprus has a significant role in the country's economy. In recent years, the industry is going through an interesting period of transformation and adaptation to changing market conditions (Centrarium, 2025). However, the sector faces persistent structural issues, including a shortage of skilled labour, reliance on outdated construction practices, and limited integration of digital and sustainable methods (Statistical Service of Cyprus, 2024). As a result, vocational education and training (VET) providers in Cyprus face increasing pressure to modernize curricula and delivery methods to meet the evolving needs of the labour market. Projects such as the BuildSkills Academy are especially relevant in this context, offering a structured and evidence-based methodology to address these skill gaps and support the country's transition toward a more sustainable, resilient, and digitally enabled construction sector.

3. The BuildEnrichedSkills Methodology (BESM)

To address the evolving challenges the construction industry is facing, the BuildSkills Academy created the Build Enriched Skills Methodology (BESM). This innovative framework is designed to enhance vocational education and training (VET) by integrating essential transitional skills into existing curricula. BuildSkills Academy represents a collaborative initiative involving 17 European partners with expertise in training and workforce development within the construction sector, aiming to bridge the skills gap in European construction.

The BESM directly addresses these challenges by providing a clear, structured framework that enables VET providers to adapt and modernize their courses to include essential green and digital skills, align training programs with industry and policy demands, ensure a high standard of education, incorporating innovative teaching methods and problem-based learning, empower educators with a step-by-step process to enrich courses quickly and effectively and finally support workforce development, equipping learners with job-ready skills for the evolving construction sector (BuildSkills Academy, 2024).

The courses are primarily targeted at individuals who hold a Bachelor's (1st cycle), Master's, or Diploma (2nd cycle) degree in civil engineering, architecture, architectural engineering, construction engineering, or building services engineering. Participants should possess a working knowledge of 2D and 3D design software, which will be utilised in the implementation of course assignments.

4. Pilot Course Enrichments at EQF Level 6

4.1 Bio-inspired Innovation and Design for Sustainable Engineering Solutions

The course contains 4 class days of 20 contact hours to provide a solid understanding of bio-inspired design for sustainable engineering solutions. Through a series of lectures and practical workshops, participants will learn the Why, What, and How of biomimicry through clear explanations and real-world examples. Students will explore biological systems and apply these principles to create innovative, sustainable designs while discovering tools to assess how their projects can use this approach. The course encourages critical thinking, creativity, and problem-solving through the analysis and solution of the pentagonal system in the context of sustainable

engineering, showing how Biomimicry Thinking can drive the next industrial revolution towards a regenerative, resilient future by changing our worldview, systems, and sources of inspiration.

Participants will develop a comprehensive understanding of the urgent need to address the environmental crisis through evidence-based tools, including the Copernicus Interactive Climate Atlas (<https://atlas.climate.copernicus.eu/atlas>), which supports climate monitoring and data-informed decision-making. The course emphasizes the role of bio-inspired engineering as a framework for sustainable innovation, equipping learners with the capacity to translate biological principles into engineering applications that address complex environmental challenges. Through experiential learning activities, including outdoor exploration, participants will identify structural and functional patterns in nature and use these insights to conceptualize bio-inspired

Table 1. Course Schedule: Bio-inspired Innovation and Design for Sustainable Engineering solutions.

Day	Session	Description of session
Day 1: Introduction To Biomimicry	Session 1 (1hr):	The environmental crisis, the current demand for sustainable solutions in construction and challenge-based learning
	Session 2 (2hrs):	Nature and Construction: A Historical Overview
	Session 3 (2hrs):	Terms, definitions and related fields of bio-inspired methodologies
Day 2: Biomimicry Thinking	Session 4 (2hrs):	Nature's design principles and the Biomimicry methodology & Assignment Brief
	Session 5 (4hrs):	Case studies: Biomimicry Thinking-Design Framework through different scales of application
	Session 6 (3hrs):	Exploring Sustainability through nature-inspired structural solutions
Day 3: Sustainability Assessment (LCA)	Session 7 (1hr):	LCA and its role for the evaluation of sustainability & Design Criteria
	Session 8 (2hrs):	Assessing Sustainability: Analysis of an LCA study on a bio-inspired innovation
Day 4: Assessment	Session 9 (3hrs):	Exam & Presentation day of the group project

engineering proposals. Additionally, they will gain proficiency in conducting life cycle assessment (LCA) studies to evaluate the environmental and social impacts of proposed solutions. The learners will be capable of applying system mapping and advanced design methodologies to develop and communicate robust, sustainability-oriented engineering outcomes grounded in nature-based strategies. Table 1 presents the 4-day schedule of the course.

According to the following diagram (Figure 1), the course's structure follows Biomimicry Thinking, from the identification of the design challenge, to the discovery of the biological strategies, to the emulation and at the final stage to the assessment process by using the suitable tools and methods for each stage.

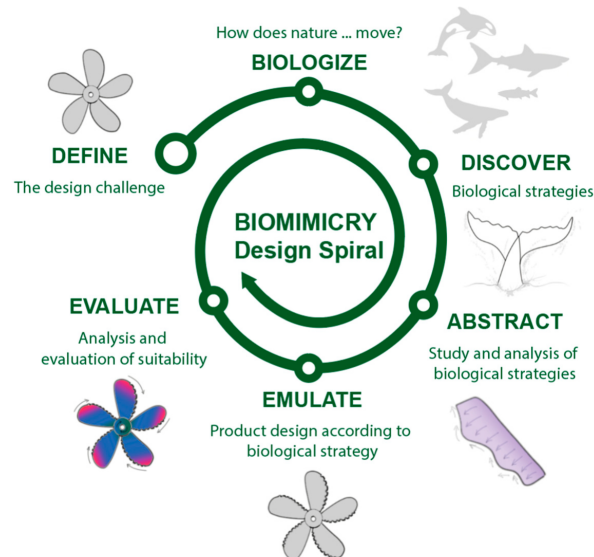


Figure 1. Biomimicry Design Spiral. (Aguilar-Planet, T., Peralta, E., 2024).

4.2 Risk and Reliability in Health and Safety

This course aims to provide knowledge in the principles of risk and reliability engineering applied in Health and Safety. Emphasis will be placed on practical applications across industries. This 4-day program of 16 contact hours offers a comprehensive exploration of risk and reliability in the context of health and safety within the engineering industry. During the meeting sessions, the learners will be introduced to the weekly topics and work individually or collaboratively on related challenges. The sessions will conclude with reflection and debriefing. The learners will be assessed via an appropriate combination of coursework, online quizzes, a project and a written exam.

The participants should have a background in engineering professions such as Civil engineers, Construction managers, Environmental engineers, Building Architects, Landscape Architects and engineer professionals with an interest in risk and reliability in Health and Safety. It emphasizes the critical role of human error mitigation and workplace safety, equipping participants with the knowledge and practical skills necessary to foster safer and more reliable working environments. Through a combination of lectures, real-world case studies, simulations, and hands-on exercises, participants will gain a deep understanding of risk assessment methods, reliability engineering, and human reliability analysis (HRA). The program also covers legal and regulatory frameworks, environmental considerations, and workers' welfare.

By the end of the course, participants will be able to define key concepts related to risk, human error, and reliability; identify various types of risks in health and safety settings and apply a range of tools and techniques for risk and reliability analysis. They will learn to conduct human error analyses, recognize patterns in workplace incidents, and evaluate the effectiveness of current risk mitigation strategies. The course concludes with practical risk assessment exercises

that enable participants to apply their knowledge in real-world scenarios. Upon completion, participants will be equipped to conduct comprehensive risk assessments, develop and implement strategies to reduce human error, and enhance human reliability in health and safety

Table 2. Course Schedule: Risk and Reliability in Health and Safety.

Day	Description
Day 1: Introduction to Risk and Reliability	<ul style="list-style-type: none"> - Definitions and concepts of risk and reliability - Risk types and uncertainty - Importance of health and safety - Basic statistical background
Day 2: Human Error and Reliability Analysis	<ul style="list-style-type: none"> - Human error types and failure modes - Decision-making and cognitive factors - Human Reliability Analysis (HRA) - Case study review
Day 3: Risk Assessment Methods and Tools	<ul style="list-style-type: none"> - Hazard identification and risk assessment techniques - Use of risk matrices and analysis tools - Applied scenarios
Day 4: Protocols, Strategies, Risk and Reliability in Health and Safety strategies	<ul style="list-style-type: none"> - Legal and regulatory frameworks - Integrated risk and reliability strategies in Health and Safety

practices. Table 2 presents the course's 4-day schedule.

5. Discussion

The two pilot courses demonstrate the capacity of the BuildEnrichedSkills Methodology (BESM) to successfully incorporate transitional skills into vocational education and training (VET). By integrating principles of sustainability and digital innovation, both courses advance the skillsets required for professionals to contribute meaningfully to the construction sector's green and digital transformation. The Bio-inspired Innovation and Design for Sustainable Engineering course introduces learners to biomimicry, climate-responsive design, and life cycle assessment, skills that directly support sustainable construction practices. Similarly, the Risk and Reliability in Health and Safety course equips participants with essential competencies in digital risk analysis, including risks related to climate change, and human reliability assessment, reflecting the growing need for data-driven approaches in ensuring workplace safety. These targeted skill enhancements not only address current sector needs but also foster adaptability and critical thinking, preparing learners for the complex challenges of a rapidly evolving industry.

Beyond content development, the courses also exemplify a meaningful pedagogical shift. BESM promotes a learner-centred model that combines theoretical instruction with applied, experiential learning, including case studies, simulations, and hands-on projects. This dual transformation strengthens the alignment between VET provision and real-world demands. Given the structured nature of BESM and its demonstrated impact, the methodology presents a sustainable pathway for systemic change in construction education. Its scalable framework can

support widespread curriculum enhancement across European VET institutions, enabling the construction workforce to acquire the forward-looking skills necessary for a climate-neutral, digitally advanced built environment.

6. Conclusion

The Buildskills Academy's BESM represents a promising paradigm for the systematic enrichment of construction VET programmes. Through the development and application of the BuildEnrichedSkills Methodology (BESM), the project addresses gaps in vocational education and training (VET) curricula by introducing structured, scalable, and evidence-based interventions. By embedding sustainability principles and digital competencies into existing courses, BSA equips learners with future-proof skills that align with both environmental imperatives and technological advancements. The integration of biomimicry, life cycle assessment, and digital risk modelling into VET courses illustrates how interdisciplinary, applied knowledge can elevate construction education and can face the current demands.

Moreover, the emphasis on real-world tools and context-specific challenges strengthens the relevance of training outcomes and fosters a culture of adaptability and resilience among learners. As the construction industry continues to evolve, frameworks like BESM are essential in guiding VET institutions, as it can offer a replicable model for systemic change, supporting a workforce that is not only technically competent but also capable of contributing meaningfully to a more sustainable and digitally-enabled built environment.

Acknowledgements

The authors would like to acknowledge the funding by the European Union and the support of the ERASMUS+ programme through Grant agreement number: 101104419 for the project Academy for Transitional Skills in the Built Environment (Buildskills Academy).

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