

Transformative TVET for the building and construction sector

Embracing digitalization, greening and migration trends



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Short summary

Future-proofing skills for a sustainable and inclusive construction industry

There is an urgent need to expand the skilled workforce and promote green practices in the building and construction industry. The sector, currently employing approximately 7 per cent of the global working population, accounts for over a third of global energy demand (UNEP, 2025).

The digitalization of technical and vocational education and training (TVET) is creating new opportunities to improve sustainability, access, safety and relevance. At the same time, migration is reshaping labour markets, increasing the importance of skills recognition, ethical recruitment and responsive TVET systems. Persistent gaps in infrastructure, curriculum modernization and trainer competence – particularly in low-resource contexts – continue to pose major challenges.

This publication examines the transformation of TVET for construction through intersecting lenses of digitalization, greening and migration. Drawing on insights from the Bridging Innovation and Learning in TVET (BILT) Expert Group, case studies and literature from Africa, Asia and the Pacific, and Europe, it analyses trends and provides recommendations for making TVET more inclusive, future-focused and resilient. These recommendations integrate cross-cutting insights and pathways for aligning standards, delivery, partnerships and workforce planning in construction-related training.

TVET leaders and industry stakeholders are encouraged to innovate and collaborate to address rapidly evolving industry needs and broader global challenges.



34%
of global
greenhouse gas emissions
come from the
building and construction
sector.

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Acronyms and abbreviations

AI	Artificial intelligence
AQRF	ASEAN Qualifications Reference Framework
AR	Augmented reality
ASEAN	Association of South-East Asian Nations
BILT	Bridging Innovation and Learning in TVET
BIM	Building information modelling
ETSD	Ecological transition and sustainable development
EU	European Union
EQF	European Qualifications Framework
GDP	Gross domestic product
ILO	International Labour Organization
IoT	Internet of Things
ISCED	International Standard Classification of Education
MCs	Micro-credentials
NDCs	National determined contributions
nZEB	Nearly zero energy buildings
R&D	Research and development
RE2020	Environmental Regulation 2020 (France)
RPL	Recognition of prior learning
SDGs	Sustainable Development Goals
SMEs	Small and medium-sized enterprises
STEM	Science, technology, engineering and mathematics
TVET	Technical and vocational education and training
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNEVOC	UNESCO's International Centre for Technical and Vocational Education and Training
VR	Virtual reality
WIL	Work integrated learning
XR	Extended reality

Glossary

Bio-sourced materials	Materials derived from renewable biological sources, such as plants, animals and microorganisms, used as sustainable alternatives to conventional construction materials.
Building information modelling (BIM)	A digital representation of physical and functional characteristics of a building. BIM serves as a shared knowledge resource about a facility, forming the backbone for digitalization of the construction industry.
Circular construction ecosystem	A system that aims to maintain the value of construction materials and products for as long as possible while minimizing waste and resource use through recovery, reuse and recycling.
Digital twin	A virtual representation of a physical building or construction project that serves as a real-time digital counterpart allowing for monitoring, analysis and optimization.
Green skills	Abilities needed to adapt products, services and processes to meet environmental demands and regulations driven by climate change. These include both technical and cross-cutting, transversal competencies.
Life cycle assessment	An analysis that examines the environmental impacts, particularly global warming potential, resulting from all stages of a building's lifecycle, including construction, usage and end-of-life.
Micro-credentials (MCs)	A documented learning achievement that verifies what the trainee knows, understands or can do. It is based on assessment against clearly defined standards and issued by a trusted provider. MCs have standalone value but can also build upon, complement or contribute to other MCs, including through recognition of prior learning.
Nearly zero energy buildings (nZEB)	Buildings with extremely high energy performance ratings where the small amount of energy required is largely covered by renewable sources.
Recognition of prior learning (RPL)	A process that evaluates an individual's non-formal and informal learning to determine the extent to which they have achieved the required learning or competency outcomes. RPL is also referred to as accreditation of prior learning or validation of informal/non-formal learning.
Sustainable construction	Construction practices that promote environmental sustainability by minimizing resource consumption, using eco-friendly materials and reducing waste throughout the building's lifecycle.
Technical and vocational education and training (TVET)	Comprises of education, training and skills development relating to a wide range of occupational fields, production, services and livelihoods.
Work-based learning	All learning that occurs in a real work environment, equipping individuals with the skills needed to obtain, retain and advance in employment. Common forms include apprenticeships, internships, traineeships and on-the-job training.

Introduction

This publication is the result of a collaborative process by the Bridging Innovation and Learning in TVET (BILT) Expert Group, comprising professionals from diverse regions and backgrounds within the construction and technical and vocational education and training (TVET) sectors.

The BILT project is funded by the German Federal Ministry for Education (BMBF) and implemented by UNESCO-UNEVOC with support of the German Federal Institute for Vocational Education and Training (BIBB). The target groups of the BILT project are stakeholders in TVET: policy makers at ministries and national bodies, labour market partners, TVET providers and researchers. BILT focuses on new qualifications and competencies ensuring that TVET remains relevant for individuals, economies and societies.

Over a series of thematic working group sessions, online meetings and peer exchange activities, the Expert Group analysed how digitalization, greening and migration are reshaping the construction industry, and the associated skills demands. These engagements were supported by extensive desk-based research, including reviews of national and regional policies, literature and real-world case studies. Draft findings were discussed and refined through collaborative feedback loops, ensuring the final report reflects a synthesis of practical insights and strategic foresight across Africa, Asia and the Pacific, and Europe.

This publication proposes approaches to facilitate the dual transition (green and digital) in the building and construction sector, structured around three key themes:

- 1 Digitalization:** The integration of digital technologies in TVET delivery to equip trainees with the skills needed for an increasingly digitalized industry.
- 2 Greening:** The development of competencies for sustainable construction practices to address climate change challenges.
- 3 Migration:** Addressing the opportunities and challenges presented by the mobile nature of the construction workforce, particularly across borders.

By examining these themes and drawing on examples from Africa, Asia and the Pacific, and Europe, this report provides insight and practical recommendations for policymakers, TVET providers and industry stakeholders to ensure TVET systems effectively prepare workers for the future of the construction industry. Additionally, gender equality and inclusiveness are critical cross-cutting priorities that must underpin all efforts to modernize TVET systems.

This publication explores the transformation of TVET in the building and construction sector through eight core chapters. Following this Introduction, Chapter 1 provides an overview of the construction sector's economic relevance across Africa, Asia and the Pacific, and Europe; Chapter 2 examines workforce dynamics, focusing on recruitment, retention and training strategies; Chapter 3 provides a overview of the current situation in each of the three focus regions; Chapters 4, 5 and 6 are the core of the report, analysing the three central themes of digitalization, greening and migration in TVET for construction and includes regional case studies; Chapter 7 explores cross-cutting trends and synergies between these themes; and finally Chapter 8 presents actionable recommendations for stakeholders at policy, institutional and industry levels.

1. The building and construction sector

The building and construction sector plays a crucial role in global economic development and urbanization. In many countries, it is a major source of employment, employing approximately 7 per cent of the total global workforce, or 220 million people (ILO, 2019). The sector covers a large array of professions including in engineering, architecture, construction management and surveying, and trades such as welders, plumbers, carpenters, scaffolders, electricians, machine operators and plasterers, along with many unskilled workers. It also requires support services from material and equipment manufacturers and suppliers, lawyers, accountants, medical workers and insurance practitioners.

Recent reports confirm that the global construction industry has experienced substantial growth, with the market size increasing from \$15.19 trillion in 2023 to \$15.97 trillion in 2024, reflecting a compound annual growth rate of 5.1 per cent (PR Newswire, 2024). Countries such as Brazil, China, India and Saudi Arabia are driving much of this expansion, with rapid urbanization and population growth creating sustained demand for construction labour (Business Research Company, 2024).

In developing countries, the building and construction industry contributes an average of 5 to 9 per cent of gross domestic production (GDP) (ILO, 2025). In 2023, the sector contributed approximately 6 per cent of GDP in the Asia-Pacific region and approximately 9 per cent in Europe where it employs around 12.5 million people (ILO, 2025). In terms of infrastructure spending, several African nations allocated substantial shares of their GDP to construction in 2022, with Nigeria at 9.4 per cent, Zimbabwe at 25 per cent and Ethiopia at 32.8 per cent (ILO, 2025).

Several trends are currently influencing the sector, with the World Employment and Social Outlook Trends 2023 (ILO, 2023a) identifying climate adaptation, sustainable infrastructure and construction, and retrofitting arising from the drive for net-zero, as likely key drivers of growth in the next five years. Additionally, in the digital space, innovative construction techniques and advances in artificial intelligence (AI) and robotics are expected to reduce labour and material costs, likely impacting the sector (ILO, 2023a). The demographic imbalance in the working-age population across the world, as well as effects of conflicts and drought, also continue to impact the sector, creating the need for a migration of skills across geographical boundaries (UN, 2024).

As these trends reshape the construction sector, traditional job functions and worker activities are undergoing constant transformation. Education and training systems must evolve to support it, integrating green and digital competencies into TVET while also adapting to support migrant workers through credential recognition, language training and integration initiatives. Such efforts will equip workers to contribute to a greener and more digitally driven construction sector, while also ensuring decent working conditions.

2. The workforce: Recruitment, retention and training

With the world population expected to rise from approximately 8.2 billion in 2024 to 9.7 billion people by 2050, the existing infrastructure urgently needs to be expanded (UN, 2024). Funding the required infrastructure expansion is expected to cost in excess of \$2 trillion annually (IEA, 2024). Technology is being deployed as a key tool for accelerating delivery and ensuring greater efficiencies across the entire construction process.

Environmental concern and the need to limit the negative impact construction has on it requires additional investment. The Paris Agreement,¹ enforced in 2016 and ratified by 196 countries, paves the way for limiting global warming and reducing greenhouse gas emissions (UNFCCC, 2015a). The Agreement includes national determined contributions (NDCs) to align country-level efforts with the global goals (UNFCCC, 2015b). Construction sector carbon emission mitigation issues are present in 80 per cent of existing NDCs, however, only 18 per cent have quantifiable targets and many do not report specific financial commitments (UNEP, 2025). Recent studies suggest an additional \$2 trillion annually is needed for the sector to reach the net zero emission objective set for 2050 (Lewis, 2024).

TVET has been identified as a critical way to scale up provision of the required skills and competences to meet these challenges. Promoting excellence and inclusion in TVET not only strengthens recruitment and retention but also facilitates the integration of migrant workers, accelerates training and upskilling for a green and digital transition, and fosters stronger engagement with industry.

2.1 Recruitment and retention

The construction industry is labour-intensive and faces significant workforce challenges including a shortage of skilled workers due to retirements, difficulties attracting younger talent and a male-dominated image that hinders the recruitment of women. The industry also suffers from a poor reputation, with jobs often perceived as physically demanding, dirty and dangerous. Additionally, its capacity for innovation and productivity is seen as limited, largely due to a labour market dominated by small and medium-sized enterprises (SMEs) and a subcontractor-based labour structure.

These factors overshadow the creative and technological construction-related careers that could be attractive to new talent. The demand for new skills and roles to support the green and digital transition is rising and could present an opportunity for the industry's future sustainable competitiveness (European Commission, 2023). Addressing new skills and anticipating future workforce needs will contribute to developing staff retention and a culture for lifelong learning and continued education.

According to professional representatives,² the need to attract and retain employees could encourage companies to commit to training, such as expanding apprenticeship schemes and improving recognition of prior learning (RPL) (Beaupère et al., 2020). Some companies have already introduced more varied training policies where they engage workers on skills development pathways and use training and RPL as a career management tool (Beaupère et al., 2020). Their approach is linked to the objectives of building loyalty and professionalization, which are reflected in the development or upskilling of employees' technical competences and skills (Beaupère et al., 2020). However, with the exception of compulsory health and safety training, the development of in-company upskilling strategies remains insufficient in many countries (Beaupère et al., 2020).

In addition, the role of migration in rebalancing workforce availability worldwide needs to be incorporated into any strategy for the future of the construction sector. Demographic trends and the unequal distribution of work necessitate the need for regulatory safety mechanisms for migrants and the provision of decent jobs with formal contracts for all workers. The promotion of bilateral cooperation between destination countries and countries of origin should be encouraged to improve skills harmonization and consistency across countries and regions. So far, little has been done to address major challenges including restrictive migration policies in developed countries, a lack of bilateral agreements for skilled workforce mobility and insufficient involvement of TVET in both origin and destination countries to equip migrants with the necessary skills.

¹ The Paris Agreement, <https://unfccc.int/process-and-meetings/the-paris-agreement>.

² Representatives of the French Building Federation, www.ffbatiment.fr/organisation-ffb/the-french-building-federation.

In focus 1: Recruitment

Byggföretagen: initiative for company-led higher TVET, Sweden

In Sweden, if an urgent upskilling need arises for a specific role – for example construction site managers or climate specialists – government funding is made available for company-designed TVET programmes to train the required number of people. Funding is provided for three years initially, with the possibility of extension if the demand is still ongoing. Trainees attend a two-year blended delivery programme with at least 25 per cent of time spent onsite, which equips them with new skills, particularly managerial and financial.

The initiative has been especially successful in attracting adult workers including women, unemployed labourers and industry changers (from transport or retail sectors, for example) into the sector. The employment rate post-qualification is 90 per cent.

Source: Byggföretagen, <https://byggforetagen.se>.

2.2 Training and upskilling

Cutting-edge technological innovation and ecological industrial improvements require not only investment and regulatory frameworks but also – first and foremost – capacity and skill. This applies equally to both companies rapidly adapting to changing market demands and technological shifts, and to TVET institutions needing to upgrade their training provisions accordingly. There are two main drivers required for this: work-based learning, and full qualifications and micro-credentials.

Work-based learning

In-company training and, more specifically, training directly on construction sites, not only reinforces the acquisition of skills relevant to the real world but also ensures a smoother transition into employment post training. In Germany, for instance, many apprentices having undertaken the dual system of academic and work-based training, get hired in the companies where their apprenticeship took place. In other national contexts, such as in France, the aspiration to have a higher number of apprentices stems from various research

showing that apprenticeships guarantee a more rapid entry into the labour market compared to campus-based training (Lopez and Sulzer, 2016).

In addition, work-based learning and apprenticeships should, ideally, enhance TVET institutions' capacity to modernize their teaching methods. Technological advancements should be conveyed at TVET centres where the theoretical notions are taught, while companies or company training centres provide practical application. Following this notion, Germany's dual system aligns the vocational school curriculum with an industry training framework plan. Inter-company training (ÜLU)³ plans are then developed in-line with this industry training framework plan.⁴ However, in many national settings work-based learning presents challenges. In several African and south-east Asian countries construction companies are reluctant to support apprentices or TVET trainees on construction sites due to health and safety concerns and lack of regulatory guidance for on-site learning. Ultimately these obstacles have led to the development of different approaches for company involvement in learning processes.

In focus 2: Work-based learning

Centre for excellence in construction: Promoting TVET-industry cooperation on sustainable/green products, Republic of Moldova

Construction companies in the Republic of Moldova are involved in designing and running training courses for different categories of users – teachers, youth and sector employees. The companies promote technological solutions for energy efficiency, passive (low energy) houses, renewable energy production, thermal insulation and naturally sourced materials. The companies also support the development of new skills for passive solar design, modular wooden buildings, heat pumps and building retrofitting.

³ ÜLU is German for Überbetriebliche Lehrlingsunterweisung (inter-company apprentice training in English).

⁴ In Germany, as part of the training modernization process of 19 different construction trades, both digitalization and sustainability have been introduced as important cross-cutting aspects. The new training framework plan incorporates modern technologies such as digital and satellite-based measurements into civil engineering. In addition, special attention is given to sustainability, for example through training content focused on energy efficiency, conversion and deconstruction.

Durban University, Work Integrated Learning (WIL): Reproducing the workplace environment on campus, South Africa

The WIL initiative in South Africa has proved to be a vehicle to producing adaptive, competently skilled graduates that are prepared for the global landscape. Trainees have the opportunity to work in real-life business settings located on campus where they gain knowledge of current software and technology used in infrastructure development within the South African context. WIL supports the development of a sense of awareness of workplace culture, enhances trainees' transversal skills⁵ and supports them in managing their future career aspirations. WIL also increases student awareness of global challenges and industry issues, encourages entrepreneurship and highlights the positive impact infrastructure development has on the socio-economic climate of South Africa through real-life problems.

Ara Education Charitable Trust (AECT): Building work training opportunities through stakeholder dialogue, New Zealand

AECT is a collaborative platform where industry, government agencies and schools join forces to create work and training opportunities for school leavers. The initiative, based in the South Auckland area, provides support to encourage school leavers into the construction sector. As a result, the initiative has helped grow a local skilled workforce and ultimately increased household income in the region. The initiative offers career guidance, skills training, real-life work experience, help in obtaining a driving licence and other assistance needed to secure employment. This support has led to contract work, apprenticeships and full-time positions.

Sources: Centre for excellence in construction, <http://ccc.md>; Durban University, www.dut.ac.za; Ara Education Charitable Trust, www.araskills.org.nz/ara-education-charitable-trust.

Full qualifications and micro-credentials

An emerging priority is how to align and integrate full qualifications with smaller, stackable packages of skills delivered through micro-credentials (MCs). Globally there is broad consensus on the potential for MCs to boost workforce employability and facilitate alignment of labour demand and supply. MCs provide recognition for flexible, portable and stackable sets of new skills, enabling workers to adapt more easily to labour market demands, support career transition, address upskilling need and even facilitate recognition of informal prior learning.

Some critical studies, however, point to potential pitfalls. Wheelahan and Moodie (2021), for example, caution that MCs should not replace full TVET programmes as they lack the structured progression of knowledge and skills acquisition (organized in educational levels and broad competency sets) that full programmes provide. Nussbaum (1999) and Sen (1999) argue that the goal of education is to educate citizens and not just train workers. With this in mind, TVET centres should include, in addition to technical skills, the development of literacy and numeracy skills, transversal skills and citizenship skills (UNESCO, 2015). MCs should be used to prioritize delivery of targeted sets of work-based skills

and be seen as complementary additions to an individual's core knowledge base, enhancing their profile to meet specific labour market needs rather than as foundational qualifications. In addition, the increased demand for MCs, often due to individuals taking responsibility for their own training, should not diminish or obscure employers' responsibility to invest in the upskilling and reskilling of their employees.

Full qualifications and MCs play complementary roles in developing green workforce capabilities. Standards-based full qualifications embed sustainability within a broader framework of occupational knowledge, cross-trade collaboration and problem-solving. They foster systemic change by ensuring trainees not only acquire technical skills but also understand the wider rationale for sustainable practice (Clarke et al., 2020). In contrast, MCs and modular skill bundles offer agility, enabling the rapid development of targeted competencies in response to emerging needs. These can be developed by private providers and, in some cases, are formally recognized within national frameworks. While MCs provide speed and flexibility, full qualifications offer depth and integration; in practice, the most effective strategies combine the two, balancing immediate labour-market requirements with long-term capability building.

⁵ Transversal skills, sometimes referred to as soft skills or core skills, are a collection of situation-independent, general, transversal competencies such as critical thinking, problem-solving and social skills.

Another important aspect is the trust and market value given by stakeholders to credentials that serve as portable markers of an individual's competencies in the labour market. This aspect is fundamental for both full qualifications and MCs and varies substantially depending on context and location. It should be noted, however, that while the impact of full

qualifications on labour market employability is widely documented with higher levels of education correlating to greater opportunities to find quality jobs (Céreq, 2017; Dupray and Barret, 2019), the real value impact of MCs has not yet been documented and there is currently no data available to measure it.

In focus 3: Micro-credentials

Many national and supranational policy bodies are developing MC frameworks⁶ and promoting them as tools to help workers acquire the skills needed to adapt to the green and digital transformations of the labour market. For example:

Quick Train Canada: Short-cycle education and skills training, Canada

Quick Train Canada is an initiative that offers short-cycle education and skills training through accredited partner colleges across Canada. The programme is designed to help individuals quickly gain new skills and MCs in various fields, providing a competitive advantage in Canada's evolving economy. The courses cover a wide range of topics – many of which are developed together with the construction industry – including 3-dimensional visualization for the built environment, advanced building performance simulation and advanced topics in geo-spatial analysis. These programmes are particularly beneficial for those looking to update their skills or transition into new career paths without committing to long-term education.

SkillsFuture Singapore: Lifelong learning, Singapore

SkillsFuture Singapore is a government initiative aimed at promoting lifelong learning and skills mastery among Singaporeans. It encourages individuals to take ownership of their skills development and pursue continuous education. A key feature of SkillsFuture Singapore is a credit provision to pay for a wide range of approved skills-related courses, many of them offered in MC formats.

Sources: Quick Train Canada, <https://quicktraincanada.ca>; SkillsFuture Singapore, www.skillsfuture.gov.sg.

⁶ For examples see positive statement on MCs issued by Australian Government (COAG Skills Council, 2019) and the EU recommendation on MCs for lifelong learning (Council of the European Union, 2021).

3. Regional overview

The transformation of TVET systems in the construction sector manifests differently across regions, shaped by distinct labour market dynamics, demographic pressures, infrastructure needs and regulatory landscapes. While countries vary widely, common challenges emerge within each region, providing context for the thematic analysis that follows.

The analysis in this chapter draws on a synthesis of recent global and regional assessments including: ILO's World Employment and Social Outlook: Trends (ILO, 2023a); UNEP's Global Status Report for Buildings and Construction (UNEP, 2024; 2025); and the World Bank's World Development Report 2023: Migrants, Refugees, and Societies (World Bank, 2023).

3.1 Africa

Africa presents a dual reality of immense potential and systemic constraint. Rapid urbanization, population growth and increased infrastructure investment offer significant opportunities for economic and skills development. Yet formal TVET systems often remain underfunded and underutilized, with informal apprenticeships still dominating in many regions (Ismail and Mujuru, 2020). This approach limits access to structured upskilling and modern training.

Policies relating to greening and digitalization are gaining traction, particularly under the African Union's Continental TVET Strategy and Agenda 2063, which call for integrating sustainability and digital transformation into national training systems, however, implementation is patchy (African Union Commission, 2014; 2022). High internet costs, poor digital infrastructure and limited uptake in STEM (science, technology, engineering and mathematics) education all hinder progress (Foresight Africa, 2025; UNESCO-UNEVOC, 2022).

At the same time, the region is experiencing growing intra-African and outward migration flows driven by unemployment, instability and climate impacts. These factors heighten the urgency for scalable, flexible TVET systems that can absorb large youth cohorts and support both domestic labour markets and skills portability.

3.2 Asia and the Pacific

The Asia-Pacific region spans high-tech economies and developing nations, creating wide disparities in TVET capacity. Countries such as Australia, Japan and New Zealand are pushing digital construction and green infrastructure, requiring advanced TVET offerings. Yet in much of South-East Asia and the Pacific, formal upskilling pathways are uneven, with many workers being trained through traditional or informal methods. Training systems often struggle to match the pace of change, with industry experts in Malaysia, for example, reporting a digital divide between trainers and trainees, with trainees struggling to acquire access to the digital tools and resources they need for the training (Nguyen et al., 2024). In Viet Nam, socio-cultural and habitual resistance to change, as well as high costs of software and hardware, have been identified as restrictive barriers in construction digitalization. In addition, climate impacts are affecting the region. In the Pacific Islands the growing challenge of poor-quality building stock and rising climate pressures are driving an urgent need for retrofit and resilience training.

The construction sector in developed nations in the region relies heavily on migrant labour from lower-income countries, contributing to a drain on local skill development capacity in lower-income countries. Cross-border mobility is high, with circular and temporary migration schemes increasingly prevalent. These initiatives create both opportunities and vulnerabilities – particularly in recognition of credentials and equitable access to lifelong learning. On the positive side, such schemes can help address acute labour shortages, strengthen remittance economies and expose workers to more advanced construction practices. However, they also bring risks including precarious employment conditions, limited access to upskilling opportunities and challenges in ensuring the portability and recognition of skills across borders. In addition, migrant workers often face language barriers, inconsistent workplace safety standards and restricted pathways to stable employment or long-term integration.

3.3 Europe

Europe benefits from mature TVET frameworks and strong policy support, particularly through EU mechanisms including: the Green Deal that integrates green skills into TVET curricula; the Digital Europe Programme and European Skills Agenda that drives digitalization and digital skills development; and mobility initiatives such as Europass and the European Qualifications Framework (EQF). Challenges remain, however, for example, several European countries including Germany, Italy, Moldova and Georgia report shortages of trainers and slow curricula adaptation to digital technologies. A lack of data to support technological integration is also frequently raised as an issue by industry experts. In addition, the post-COVID-19 pandemic construction boom intensified skills shortages, especially in northern and western Europe, and many countries have become increasingly reliant on migrant workers from eastern Europe, Africa and the Middle East. Migrants are often employed in low-paid or informal roles, facing barriers to upskilling and credential recognition.

Meanwhile, rapid regulatory shifts – such as mandatory building performance standards – are pressuring training providers to modernize curricula and expand MC offerings. Ageing workforces and declining enrolment in vocational streams also add to long-term concerns. Nevertheless, the region shows promising examples of responsive training ecosystems, particularly where industry, government and education providers collaborate on green and digital transitions.

The following three chapters explore how the themes of digitalization, greening and migration intersect and influence the transformation of TVET in the construction sector. While each theme is explored in detail, it is important to note their overlap: digital technologies enable greener construction methods and remote learning access for migrants; migration patterns influence the supply and diversity of skills required; and sustainability mandates shape the skills TVET institutions must prioritize across all regions.

4. Digitalization in TVET for construction

To meet the growing global demand for new or upgraded infrastructure, the supply of material resources and technology has expanded rapidly. The development of human capacity, however, is lagging behind. In Africa, a large proportion of youth remain unskilled, while Europe and Asia and the Pacific face the challenge of skilled yet aging workforces. As a result, the role of TVET in equipping individuals with essentials skills is more critical than ever.

To meet this challenge, several international agencies, including UNESCO (2022) and ILO (2020; 2021a), have developed policies and guidelines on the pedagogy of digital TVET, many of which have now been adopted by countries worldwide. In the building and construction sector, however, significant opportunities remain to expand the application and utilization of digital TVET.

4.1 Technology driving positive change

The integration of technology into TVET delivery is being shaped both by digital innovation in teaching, training and learning, and by the broader digitalization of operations and processes within the building and construction industry itself. In addition to improving education quality and aligning it with industry need, technology also makes learning more accessible, affordable and flexible, making it better suited to the diverse needs and schedules of trainees. Emerging digital technologies influence the entire TVET process, from curriculum development and review, to learning support services, quality assurance, and assessment and certification.

Digital TVET delivery is also shaped by trainer competence and the availability and sophistication of training facilities and equipment.

Digital tools are enhancing resource and design efficiency and providing automation of various construction processes that can help reduce the sector's negative environmental impacts. These tools are also being used to improve supply chain processes to optimize resource utilization and enhance lifecycle monitoring for buildings.

In addition, digital tools are having a positive impact on teaching and remote learning as outlined in more detail below.

Digital tools and services for teaching

Digital tools for TVET delivery use virtual representations of work processes, equipment and operational environments that allow trainees to interact with work situations and practice solving complex tasks in a controlled environment. They make it possible to gain hands-on experience on heavy, expensive and potentially dangerous machinery and equipment in relative safety and for a fraction of the cost. A leading example of new technology is extended reality (XR) which uses 3-dimensional models to immerse trainees in the equipment environments. XR encompasses virtual reality (VR), augmented reality (AR) and mixed reality.

Other digital technologies available for teaching are outlined in Table 1.

Table 1: Digital technology for teaching

Building information modelling (BIM) technologies	Used to provide training on reducing conflicts and wastage at the design and construction phases. BIM is also used to optimize designs for energy, water and material usage, and to foresee causes of potential future delays, which can then be addressed early.
Digital twin	This technology models buildings during their entire lifecycle and enables trainees to gain hands-on experience in risk-free settings on equipment across all aspects of construction.
Drone technology	Used to provide aerial views of construction project sites and areas not easily accessible to trainees without their direct exposure to potential hazards on site.
Internet of Things (IoT)	Used to collect and analyse data from various connected devices to instruct trainees on control and optimization of equipment usage, tracking worker movements and improving site safety. IoT champions smarter construction processes by monitoring resource usage – such as energy, fuel and water – in real time and also shuts off supplies when faults are detected.
Robotics	Used to demonstrate and automate labour-intensive tasks to improve safety and efficiencies and achieve consistency in output standards.

Source: Rudge, 2024.

In addition, the impact digital tools are having on improving language translation for learners and reducing language barriers faced by many migrants, cannot be overstated. A growing range of AI-based language translation tools now make both text and audio course materials more accessible for workers whose first language differs from that of the course instruction.

With vast amounts of capital being invested in infrastructure development, combined with the growing need for interaction between various stakeholders, more complex information and reporting throughout the lifecycle of construction projects is required. The use of BIM – encompassing design, construction and operations – has the potential to serve

as the backbone of the industry's digital transformation, integrating software, drones and other unmanned equipment into a connected system.

Digital delivery through distance learning

Digital technology improves access to training and assessment regardless of location, equipment or staff availability. The technology includes AI and non-AI based tools such as software for tele-conferencing so trainees can communicate in an interactive way, online platforms for teacher-student interaction, spaces for sharing resources and performance monitoring.

In focus 4: Digital delivery

Various initiatives, multiple regions

At the Durban University of Technology, South Africa, video and audio materials and online tutorials have been translated to support teaching and learning for those facing language barriers. This has enabled integration of online measurement and planning software into the training programmes offered for trainees.

At the **Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development in Ghana**, TVET programmes are delivered through a blended mode (in-person and remote learning), utilizing online presentations and AI tools to generate content.

TVET's digital transformation for teaching building and construction **in Malaysia** has seen the introduction of e-learning platforms, digital workshops and advanced technologies such as BIM. Alongside improving TVET delivery, digitalization is also helping increase trainees' skills and knowledge in greening construction.

In Moldova, e-Learning creation, including learning objectives, content structure, storyboarding, scripting, assessment design and multimedia integration, are incorporated in TVET using virtual classrooms.

At the Centre de Formation des Apprentis (CFA) schools in France, pilot projects using AR in woodwork workshops provide training on handling machinery as well as paint application and coating. Furthermore, the pilot adopts the creation of avatars and use of AI to provide interpretations for trainees struggling with the local language.

In New Zealand, Epic Learning Limited, with support from ConCOVE, are piloting AI-generated assessment systems to reach previously underserved learners. This has been achieved by developing AI models specifically trained for assessment generation, while also ensuring the modules meet the requisite ethical standards.

Sources: Durban University of Technology, www.dut.ac.za; Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development, <https://aamusted.edu.gh>; CFA Schools, www.cfadubatiment.fr/btp-cfa-aix; Epic Learning, <https://epiclearning.co.nz>.

4.2 Impact of emerging technology

In addition to strengthening TVET delivery and supporting the sector's green transition, digitalization is enhancing the construction sector's appeal as an employer by improving training environments and fostering greater inclusivity. Some specific impacts include:

Providing job-ready skills: simulated site training can enhance trainee confidence and better prepare them for real-life work.

Closing the gender and accessibility gap: the introduction of practice areas for training that are safer, less reliant on physical strength and cleaner than traditional building sites are increasing inclusivity in the industry, particularly for women and persons with disabilities. In Nigeria, for example, the National Board for Technical Education (NBTE) operates the Open Distance and Flexible eLearning (ODFeL) programme that has increased women's enrolment in skills trainings from which they were previously excluded due to cultural and religious limitations (NBTE, 2025).

Improving efficiencies, productivity and quality

outcomes: emerging technologies provide simulated hands-on learning situations, which allow trainees to hone their skills before going out into real-life situations. This helps minimize material wastage and time loss for workplace learning. For example, in New Zealand, AI-generated assessments – developed by Epic Learning Limited and supported by ConCOVE (see In focus 4) – have improved the quality of learning outcomes.

Improving access to lifelong learning: formal training is now accessible beyond the confines of a physical location, meaning increased accessibility and opportunities for lifelong learning. In the case of Nigeria's ODFeL programme, training has become more accessible to women who were previously discouraged from entering male-dominated professions due to cultural norms that discourage mixed-sex learning (NBTE, 2025). This can be further supported by the possibility of stackable MCs.

Supporting student-centred learning: dynamic and flexible teaching methods allow and encourage trainees to learn at their own pace and utilize different teaching styles. Trainees can also undertake and stack MCs to attain their desired competency level, a method used by Digi-CVET in Germany and IATC in Australia. Digital learning platforms that allow customized language selection provide further opportunities for inclusion of non-native speakers.

Improving safety: trainees are exposed to low-risk training environments through the use of technology as opposed to real-life hazards present on building and construction sites. Not only does this improve safety during training but it also helps trainees identify hazards and risks in the virtual space so that they are prepared when they enter real-life work environments.

Enhancing collaboration and synergy: trainees gain access to diverse training resources while strengthening cooperation between industry and training institutions. Digital resources – both personnel and practical – can be accessed by trainers and trainees in various locations, therefore providing knowledge that would otherwise have only been available to those in the locality. Such collaboration enhances regional cooperation towards development of joint standards and assessment processes.

Developing specializations: more digitally-friendly practice areas are opening up in the sector, allowing for specialization in different stages of construction: design, site work or post-construction. This improves the attractiveness of the sector, challenging the misconception that working in construction is physically challenging, dirty and hazardous.

4.3 Challenges in implementing digital solutions

While digitalization is a key driver of change in TVET for the sector, challenges relating to curriculum modernization, trainer training, industry participation and access to essential technology remain. The sector's growing adoption of smart technologies and digital project management tools requires a significant restructuring of traditional TVET systems to develop the necessary skills.

Cost is a major barrier to industry buy-in for digitalizing TVET delivery. The sector is largely composed of SMEs for whom the high cost of VR and XR training tools and equipment is often unaffordable. Low levels of digital competence by traditional trainers and a lack of facilities for providing them with training are further challenges. Industry experts consulted for this report also highlight challenges relating to the need to develop and adapt broader TVET curricula to include digital training.

Furthermore, the absence of standardized data practices and guidelines, as well as concerns around cybersecurity and privacy breaches, are hampering implementation of digital solutions for TVET delivery in the sector.

5. TVET for sustainable construction

The building and construction sector contributes significantly to global carbon dioxide emissions, accounting for approximately 34 per cent (UNEP, 2025). Regulatory changes, alongside growing client expectations, mean the industry is facing mounting pressure to adapt and embed sustainable practices. Despite this, the current rate of adaptation is unlikely to meet the Paris Agreement's environmental goals (UNEP, 2025). It is, therefore, imperative that sustainability becomes a cornerstone of the construction industry's future with TVET leading the way in equipping current and future trainees with the skills needed to drive this transition.

5.1 Drivers of sustainable construction

Policy measures are driving change. For example, in the EU, the Energy Performance of Buildings Directive (EPBD)⁷ requires zero-emission standards for new buildings and whole-life carbon reporting by 2030. Other regions and countries have implemented similar regulations, from low-emission material requirements to mandatory life cycle assessments.⁸ Nevertheless, UNEP (2024) reports that by 2030, 80 per cent of new buildings (by total floor area growth), will be in developing economies, many of which still lack stringent energy codes.

The World Green Building Council (WorldGBC) is coordinating over 70 national Green Building Councils to transform the building and construction industry towards net zero carbon emissions. Their Global Policy Principles cover carbon emissions, resilience, circularity, water use, biodiversity, health, equity and access, aligning with the Paris Agreement and UN Sustainable Development Goals (WorldGBC, 2023). In addition, client demand is also driving change with growing awareness pushing the industry towards greener practices. Companies are adopting eco-friendly materials, integrating energy-efficient technologies and applying circular economy principles to limit resource use and reduce carbon emissions.

Together, regulatory action, international climate commitments and market pressures are accelerating the adoption of sustainable construction methods and redefining the skillsets required across the sector.

In focus 5: Sustainable construction

SMARTER: Finance for families, global

In 2019, the UNEP's Copenhagen Centre on Energy Efficiency, with support from the EU Horizon Programme, launched the SMARTER initiative to provide guidance on green and affordable living to low-income families, non-government organization (NGO) workers and government representatives. By improving knowledge and skills for green building, the initiative promotes energy saving solutions and sustainable practices, helping to lower energy costs, improve quality of life and reduce the environmental impact of housing. Through a financial leverage initiative, the programme also supports low-income households to engage with green housing transitions. Partnerships for co-designing green mortgage products specifically for new property acquisition have also been established by national financial institutes in Brazil, Colombia, Czech Republic, Indonesia, Ireland, Italy, Morocco, Poland and Romania.

Source: SMARTER, <https://c2e2.unepccc.org/smarker>.

⁷ European Union Directive 2024/1275 of the European Parliament and of the Council of 24 April 2024 on the energy performance of buildings, https://ec.europa.eu/commission/presscorner/detail/en/ip_24_1965.

⁸ Recent legislation updates reported by NEP Report 2024 include France's RE2020, Denmark's 2023 regulations, California's 2022 standards, UK's 2021 Building Regulations, Singapore's 2021 Code for Environmental Sustainability, China's latest Energy Performance Code, Sri Lanka's Energy Efficiency Building Code 2020 (UNEP, 2024).

5.2 Skills and occupational impacts

Following guidance from CGDD (2015) and ONEMEV (2022), occupations are typically classified into two categories:

Green occupations: roles whose primary purpose is to measure, prevent, control or correct environmental damage. These can include waste management, pollution control, renewable energy, water treatment and conservation.

Greening occupations: roles where environmental considerations are integrated into existing job functions, requiring additional green skills alongside core technical competencies. These include many traditional construction

jobs such as structural works, equipment installation and maintenance.

Green occupations typically demand higher levels of specialized environmental skills, while greening occupations require targeted upskilling within the existing skillset. The specific blend of skills depends on qualification level and the autonomy expected in the role.

The green technical and transversal skills required for green and greening occupations differ in both intensity and scope. Building and construction occupations fall within both typologies as outlined in Table 2.

Table 2: Green and greening occupations

Examples of green occupations	Examples of greening occupations
Technician specializing in waste management and recovery of materials	Carpenter assembling bio-sourced materials
Renewable energy technician	Painter using ecological paints
Water treatment engineer	Electrician specializing in energy efficiency
Certified energy modelling professional ensuring new building code compliance	Plumber installing water-saving systems
Building retrofit designer and planner	Worker with specific retrofit skills to integrate in different construction trades

Source: author, 2025

Furthermore, the type of skills required varies according to workers competency levels:

- In **low-skilled jobs**, the focus is on environmental awareness, sustainable work practices and basic adaptations (e.g., ecological paints, low-carbon concrete, waste sorting).
- In **medium-skilled jobs**, significant technical skills are required e.g., solar panel or heat pump installer, and in emerging new professions such as alternative-energy technicians.
- In **high-skilled jobs**, advanced technical expertise in areas such as nearly zero energy building (nZEB) design, engineering or climate science is required, with greater demand for specialized green knowledge (ILO, 2022).

In order to meet the changing needs of the sector, new green skills must be embedded across core construction activities, including the use of bio-sourced and recycled materials, advanced insulation techniques for air/water tightness, installation of high-performance equipment and the development of emerging energy technologies. Shifts in work responsibilities also require changes in site management and enhanced collaboration between trades. For example, replacing concrete with bio-sourced structures alters both the mix of professionals needed and their working relationships. Construction site management must likewise adopt more sustainable practices – minimizing waste, reusing materials, conserving water and reducing noise pollution (CGDD, 2015). Examples of additional knowledge and skills needed for greening jobs are provided in Table 3.

Table 3: Greening building trades and their development

Examples of trade specialisms		Examples of additional green knowledge and skills
Design studies	<ul style="list-style-type: none"> • Building architecture • Architecture and design • Diagnostics • Engineering • Building inspection and technical diagnostics • Building and public works engineering and design 	<ul style="list-style-type: none"> • Understanding principles of sustainable building as a whole • Awareness of whole building and whole of life emissions and their calculations • Understanding of basic principles of building science such as building envelope,⁹ thermal inertia and air circulation • Ability to adopt an integrated approach at all stages of construction and design • Knowledge of sustainable, traditional and natural materials
Site management	<ul style="list-style-type: none"> • Construction site management • Project management 	<ul style="list-style-type: none"> • Awareness of environmental impact of buildings • Knowledge of the basic principles of reducing site emissions • Ability to identify and use sustainable, non-toxic and responsibly sourced products that are low in embodied carbon • Ability to assess the compliance and adequacy of work carried out in relation to environmental standards
Assembly of structures	<ul style="list-style-type: none"> • Production, assembly and installation of wood frames 	<ul style="list-style-type: none"> • Knowledge of choosing optimal raw materials taking into account environmental impact and energy efficiency • Ability to adapt designs to suit environmental factors (e.g., climate, vegetation, natural light, temperature, humidity)
Structural work	<ul style="list-style-type: none"> • Masonry • Carpentry 	<ul style="list-style-type: none"> • Knowledge of operational strategies and techniques for installing natural materials (e.g., straw, raw earth, hemp, cork, wood) • Knowledge of traditional and innovative techniques for building envelope construction
Finishing trades	<ul style="list-style-type: none"> • Electrical • Plumbing • Painting • Joinery • Roofing • Insulation 	<ul style="list-style-type: none"> • Understanding the roles of different trades in achieving required energy and carbon performance to minimize energy demand and associated costs over the life of the building • Ability to carry out renewable energy and water-saving installation projects, taking into account legislative, technical and site constraints • Ability to select the materials and installations certified as sustainable and with a low carbon footprint • Knowledge to assess the compliance and adequacy of the work carried out in relation to environmental standards
Equipment installation and maintenance	<ul style="list-style-type: none"> • Infrastructure and building maintenance management and engineering • Heating, ventilation and air conditioning (HVAC) • Refrigeration 	<ul style="list-style-type: none"> • Knowledge of how to check energy parameters of buildings on site • Understanding of the effect of repair and renovation work on the structure of the building • Knowledge of planning interventions that improve energy efficiency from a cost-benefit point of view
Low-skilled support	<ul style="list-style-type: none"> • Labourers • Assistants • Cleaners 	<ul style="list-style-type: none"> • Ability to collect construction waste and equipment packaging, follow given guidelines for on site cleanup and storage of materials for recycling or reuse purposes • Ability to support skilled tradespeople, performing basic tasks on installation of natural or ecological materials • Ability to operate basic machinery such as compactors or jackhammers under supervision, following instructions on noise control and idle reduction to reduce fuel use and emissions • Ability to use certified sustainable cleaning products (e.g. products with EU Ecolabel, Green Seal, US Environment Protection Agency Safer Choice), follow guidelines on water conservation, waste management, dust and energy reduction

Source: CGDD (2015), author's elaboration added.

⁹ The building envelope refers to the physical barrier between the interior and exterior of a building. It includes all the elements that separate the indoor environment from the outside.

5.3 Identifying and integrating new green skills

To reform TVET curricula, it is first necessary to identify the new green skills relevant to different professions. Analysing how jobs evolve makes it possible to determine the competencies and skills they require. As for any other skill, identifying new green skills requires breaking down occupations into their core components – roles, responsibilities and tasks (ILO, 2022). This process involves:

- 1 Defining the stand-alone duties of a role.
- 2 Mapping the specific actions required to perform each duty.
- 3 Determining the skills needed and the expected performance level.

Once the core skills and knowledge competencies have been identified, TVET learning outcomes should be aligned accordingly, incorporating both transversal and technical green skills. The degree of curricula adaption required will vary across occupations.

Green transversal skills and knowledge

Green transversal skills are underpinned by awareness of ecological challenges such as climate change, carbon emissions and the protection of natural resources and biodiversity. They also take into account broader social impacts, such as migration driven by extreme weather, sea-level rise, drought and desertification.

ILO (2019) identifies the fundamental transversal skills required for workers in the green transition as:

- open-mindedness to adopt innovative tools and processes;
- cooperative skills for collective environmental action;
- resilience to navigate change;
- communication and negotiation skills to influence teams and clients;
- entrepreneurial skills to leverage low-carbon technologies;
- occupational health and safety; and
- foundational digital skills to reduce environmental impact.

While often included in training standards, these skills are described with varying specificity, from broad guidance to explicit learning outcomes and assessments.

Technical skills

Technical skills are trade-specific and vary in complexity depending on the occupation. Expert group discussions

identified four key skill groups for the construction sector:

- **Bio-sourced construction materials and practices:** sourcing, assembling and disassembling.
- **Energy efficiency and water conservation:** design, performance assessment, equipment installation and de-installation.
- **Waste management and circular economy:** recycling, reusing, transformation and waste reduction.
- **Digital tools for green transitions:** BIM for energy-efficient design, carbon modelling software and 3-dimensional digital twins for predictive maintenance.

Additional competencies, such as environmental regulatory compliance and building labelling assessments, are more relevant to higher-educational contexts. These competencies draw on disciplines including building science, architectural planning, engineering and the retrofitting of existing structures.

The sector's technological evolution and shifting sustainability requirements will continue to create demand for new occupational profiles, including roles that combine digital skills with green construction expertise. TVET must, therefore, remain agile, adapting content and delivery to meet these hybrid skill demands.

5.4 Incorporating sustainability in TVET

Building a sustainability-ready workforce requires alignment between qualification standards and curricula. Updates to occupational descriptors and learning outcomes define the 'what' of green skills, while training providers determine the 'how' through curriculum design and delivery. Expert group discussions revealed two complementary trends:

- 1 **Mainstreaming sustainability into full qualifications:** embedding green skills, knowledge and practices into broad, standards-based TVET programmes (ISCED levels 3-5). These qualifications are developed with industry and public agencies to meet labour market needs, and often involve revising regulations and formal standards.
- 2 **Targeted green skills training:** delivering short, outcomes-based courses such as MCs or modular subject bundles. These can be developed by private actors with formal recognition provided through accreditation or endorsement.

A broad standards-based approach fosters a deeper understanding of why sustainable practices matter, linking green skills to the wider construction process and encouraging complex task execution, autonomy, teamwork and problem-solving (Clarke et al., 2020). Targeted training can quickly address specific skill gaps but may lack the contextual knowledge needed for systemic change.

Integrating sustainability into qualification standards

Approaches to embedding green learning outcomes into qualification standards vary widely, not only between countries but often between regulators within the same system. Even when ecological transition and sustainable development (ETSD) concepts are acknowledged, their inclusion can be inconsistent in depth, specificity and framing.

Research in France during the mid-2010s found that ETSD references were especially common in building and construction standards, but their treatment ranged from broad contextual statements to detailed technical requirements (Baupere et al., 2016). The vocational qualification for *Heating, ventilation and air conditioning design technician*, for example, has been updated to reflect new environmental regulations (RE2020), incorporating technical references to energy-efficient solutions and environmental data sheets alongside legacy regulatory knowledge. However, not all construction-related standards have embedded ETSD so explicitly, with some only making passing mention in introductory sections without translating them into measurable skills or performance criteria (Gosseume et al., 2024).

Similarly, in Spain, the creation of a new professional qualification in energy auditing followed the adoption of EU-driven regulatory changes. The resulting standard included clear competency blocks on coordinating audits, measuring energy use, analysing results and recommending efficiency measures. Yet this comprehensive integration was triggered by a legal requirement, illustrating how regulation, rather than a systemic commitment to sustainability, often determines whether ETSD principles are robustly embedded.¹⁰

These examples highlight a broader pattern – while awareness of ETSD may be present during the design phase, its consistent operationalization into training standards depends heavily on regulatory drivers. This can result in patchy coverage, where some occupations fully integrate sustainability principles whilst others only reference them superficially.

Investing in research and development

Research and development (R&D) is essential for driving innovation, increasing economic growth and creating more efficient processes. Across Africa, however, a lack of sufficient R&D investment is a significant barrier to industry capacity to engage in sustainable construction practices. With only a small number of companies involved in research, TVET centres have limited access to external data forcing them to rely primarily on campus-based figures. This constraint significantly hinders the development of innovative practices. There is a pressing need for enhanced collaboration between TVET schools and companies to support research as a basis for curriculum development. In Ghana, for example, some TVET schools have research facilities and are working to introduce bio-sourced materials into construction practices. A lack of company support, however, limits trainees' ability to fully develop these topics. The importance of R&D for both TVET institutions and industry suggests the need for market-driven opportunities to align TVET systems and skill offerings with industry need.

In focus 6: Implementing green TVET programmes

Various initiatives, various regions

Europe

The European Construction Blueprint initiative, funded by the European Commission through the 2018 Erasmus+ Sector Skills Alliances, brought together three European sectoral organizations, nine national sector representatives and 12 TVET and higher education providers from across 12 EU countries. The project aim was to develop a coordinated sectoral strategy for skills development in the construction industry, improving alignment between industry needs and training provision.

One of the key outcomes was the development of reference curricula for short TVET programmes in three priority areas: energy efficiency, circular economy in construction, and digitalization. These were targeted at trainees and workers with qualifications between levels three and five of the European Qualifications Framework (EQF).

¹⁰ This regulation is a major outcome of the Construye 2020+ project (an EU's Horizon Programme initiative), managed by the Fundacion Laboral de la Construcción and the Spanish National Institute of Qualifications (Incuat) who developed the new standard regulation.

The resulting curricula are designed as flexible, user-friendly models that can be adapted to diverse training environments and suitable for use by TVET institutions across the EU and beyond. The curricula are tailored to specific occupational profiles – such as general construction worker, bricklayer, carpenter, electrician, plasterer, plumber and site supervisor – and each curriculum includes programme objectives, required competences, delivery hours and other key elements to support implementation. A second project phase started in January 2025 (Construction Blueprint 2) and will also deal with greening and digitalization for the sector.

The Sustainability at Work – Future-Oriented Training (NIB) programme, funded by the German Federal Ministry of Education, Family Affairs, Senior Citizens, Women and Youth (BMBFSJ) and the European Social Fund Plus (ESF Plus), supports the integration of sustainability into vocational education and training (VET). It funds projects that equip trainers to design sustainability-focused curricula and develop related courses, and helps companies address the challenges of sustainable transformation – with particular emphasis on the construction sector.

Africa

Don Bosco Tech Africa, a network of around 118 TVET centres across 34 African nations, is working with approximately 45,000 youths annually to develop their skills through efficient resource mobilization and management. The network is updating and greening TVET curricula across multiple countries – a significant undertaking given many existing programmes are outdated and misaligned with current market needs, requiring a substantial effort to modernize and incorporate sustainable green principles.

Global

Another example is the Copenhagen Centre on Energy Efficiency (C2E2), part of the UNEP Copenhagen Climate Centre (UNEP CCC), which launched a programme to support developing countries in strengthening energy efficiency skills. Review processes have been conducted in Kenya and Argentina, in collaboration with local Ministries of Energy and Ministries of Education and Training. These reviews include monitoring activities aimed at identifying skills gaps within national education systems and recommending targeted improvements to prepare the workforce to meet the growing demand in energy-efficient industries.

Findings from these reviews, alongside practical workshops involving local stakeholders, have supported the collaborative integration of energy efficiency content into undergraduate curricula. Additional strategies include the development of specialized technical qualifications, postgraduate programmes and continuing professional education courses. Greater engagement from national education ministries is seen as a strategic next step in advancing these efforts.

Sources: European Construction Blueprint, www.fundacionlaboral.org/en/projects/training/training-tools/construction-blueprint-2-2025-2028-erasmus-programme; Sustainability at Work - Future-Oriented Training, www.bibb.de/de/161509.php; Don Bosco Tech Africa, <https://dbtechafrika.org>; Copenhagen Centre on Energy Efficiency, <https://c2e2.unepccc.org>.

6. TVET and migration in construction

Chapter 3 focused on the role of migrant workers in construction and its associated TVET challenges regionally, while this chapter explores the implications of migration flows for training systems, credential recognition and inclusive TVET practices.

6.1 Current migration trends in the construction sector

Construction is a major employer of migrant workers globally, with demand rapidly increasing. This trend is a result of several factors combining including persistent skills shortages in many countries, rapid urbanization requiring new infrastructure, increased state spending on infrastructure projects and aging construction workforces in developed nations (Buckley et al., 2016; Surono and Ariyanto, 2024). The increased complexity and technological sophistication of modern construction projects have also heightened the need for skilled migrant labour.

Migration pathways relevant to the construction sector include formal programmes, such as bilateral labour agreements and regulated mobility schemes, and informal routes driven by economic necessity or conflict. TVET systems must be responsive to both, ensuring skills recognition and training pathways are accessible regardless of the formality of a worker's migration journey.

Increasing use of temporary migration channels

A significant trend in global construction labour markets is the increasing reliance on temporary migration channels over permanent residency pathways. Buckley et al. (2016) note that many countries have structured immigration policies in favour of temporary migration schemes. These include:

- international student visas;
- circular migration programmes;
- working holiday visas;
- temporary work permits; and
- asylum claims (in limited cases).

Countries such as Canada, New Zealand and Australia have actively designed immigration pathways that specifically target skilled tradespeople on a temporary rather than permanent basis. These systems provide flexibility, enabling construction labour markets to expand during boom periods and contract during downturns (ILO, 2016a).

However, the temporary nature of these pathways creates vulnerabilities for migrant workers. The ILO (2016a) highlights that many migrant construction workers face limited access to social protection, healthcare, housing and avenues to dispute unfair working conditions, particularly when their visa status is tied to a single employer.

While many countries focus on temporary migration, some employers and programmes prioritize long-term relationships. For example, the German construction companies participating in the Pool Approach (see In focus 9) train non-EU apprentices with the intention of establishing permanent employment relationships, demonstrating an alternative to temporary migration schemes.

New migration routes and destinations

The International Organization for Migration reported 281 million international migrants globally in 2020 representing 3.6 per cent of the world's population – a significant increase from 2.8 per cent in 2000 (IOM, 2024). This figure does not include internal migration, which is estimated to be much larger (IOM, 2024). Of these, around 51.9 per cent are men and 48.1 per cent women. Disaggregated gender data specific to the construction sector remains limited however.

Construction remains one of the largest sectors employing migrant labour, with the geographical distribution of these workers shifting as economic growth patterns evolve (IOM, 2024). Currently, rapidly developing markets in the Middle East, Asia and Africa are attracting more migrant labour. Key trends in migration in the regions include:

- The **Gulf Cooperation Council (GCC) countries** (UAE, Saudi Arabia, Qatar) are prominent destinations for South and South-East Asian migrant construction workers who make up the majority of the regions workforce (IOM, 2024). Major events such as the 2022 FIFA World Cup in Qatar accelerated these trends, leading to largescale infrastructure projects requiring a substantial migrant workforce (Buckley et al., 2016; Millward, 2016).
- An **intra-Asian migration** shift since the early 2000s driven by rapid economic expansion occurred, with labour flowing from south-east Asian countries towards Thailand, Malaysia and China (Santoso, 2009, cited in Buckley et al., 2016).
- Growing **construction booms in African nations** since the mid-2010s have created new migration corridors within the continent, with skilled professionals also being attracted from other countries in Asia, the Middle East, and southern and eastern Europe (ILO, 2023b).

- **Disaster-induced migration** often occurs as natural disasters trigger large-scale movements of people, mobilizing skills needed for reconstruction and rebuilding efforts. For example, following the 2011 earthquake in Christchurch, New Zealand, the New Zealand government facilitated an influx of international construction workers – primarily from the Philippines – through targeted visa programmes to address urgent labour shortages. These events highlight the need for temporary migration schemes and the corresponding need for responsive TVET systems to support skills recognition, safety training and rapid workforce integration (Stats NZ, 2019; ILO, 2016a).

In addition, **climate change induced migration** is increasingly driving both internal and cross-border migration, particularly in regions vulnerable to sea-level rise, extreme weather events and environmental degradation. In the Pacific Islands, for example, planned relocation has become a necessary adaptation strategy, requiring comprehensive support systems to ensure the sustainability of displaced communities (IOM, 2024). In Asia and the Pacific, climate-related displacement is increasingly disrupting access to education. Sudden-onset disasters (for example floods and cyclones) and slow-onset environmental changes (including salinization and sea-level rise) have led to large-scale internal and cross-border displacement. In 2020 alone, 21.3 million people were displaced in the region due to natural disasters – the highest globally (UNESCO and UNU-IAS, 2023).

These shifts present significant challenges for TVET systems, which must adapt to provide relevant skills and training for both migrants and host communities in the face of evolving environmental realities. This trend is likely to have significant implications for the construction sector, both in terms of demand for infrastructure development and availability of workers.

Displacement scenarios range from temporary relocation during emergencies to permanent migration, government-planned resettlement and 'trapped populations' unable to move. Each scenario presents unique educational challenges – from loss of documentation and disrupted school attendance to reduced funding for relocated learners. In some contexts, schools double as emergency shelters, further destabilizing learning environments (Raj, 2022; IOM, 2021). Policy responses remain inconsistent, with Bangladesh standing out as the only country in the Asia-Pacific region with a national policy ensuring displaced learners' right to education (UNESCO and UNU-IAS, 2023). A rights-based framework is urgently needed to embed education guarantees in national and regional climate resilience strategies.

6.2 Challenges faced by migrant workers and TVET providers

Migrant workers are vital to the global construction workforce but frequently face structural and systemic challenges that affect their job security, working conditions and access to training. Both the ILO (2016a) and Surono and Ariyanto (2024) highlight ongoing issues such as labour market segmentation, precarious employment situations, language and cultural barriers, and exclusion from upskilling pathways, as discussed below.

Precarity, discrimination and labour market segmentation

Migrant workers are essential to the construction sector globally but are disproportionately affected by structural inequalities in employment. Labour market segmentation in the industry is well-documented, with a shrinking pool of high-paid, permanent professionals and a growing workforce of low-wage, insecure workers. Migrants are overwhelmingly concentrated in the latter group, often hired on short-term contracts or through labour-only subcontractors. This polarization contributes to deepening income disparities and persistent job insecurity (ILO, 2016a; Surono and Ariyanto, 2024).

Discrimination compounds this vulnerability, driving migrant workers into the most precarious and lowest-paid areas of the sector. In South Africa, for example, foreign workers often lack legal protections, making them more susceptible to arrest and exploitation (ILO, 2016a). In Malaysia, migrant workers – both documented and undocumented – make up a large share of the construction workforce and are frequently assigned hazardous, poorly regulated tasks with minimal oversight (ILO, 2016b). Across parts of southern and eastern Europe, informal employment of migrants is widespread, limiting access to labour rights, social protection and mechanisms to redress injustice (FRA, 2019).

Language barriers and cultural integration

Language barriers significantly impact migrant construction workers, affecting their workplace safety, productivity and ability to understand their rights and access services. Cultural differences further complicate integration as established societal norms and expectations may differ from those in migrants' countries of origin leading to misunderstandings and potential marginalization (Kim et al., 2024).

Difficulties with skills recognition and standardization

The lack of consistent, standardized systems for recognizing overseas qualifications remains a significant barrier for many migrant construction workers. Even highly skilled individuals often struggle to have their credentials and prior experience formally recognized in destination countries, which frequently relegates them to roles well below their training and capability level. This ‘deskilling’ effect results in a substantial waste of human capital – both for the individuals and the industries in which they work (Anger, 2024).

A joint investigation by Lighthouse Reports and the Financial Times (2024) found that nearly half of all migrant graduates in Europe are employed in roles below their qualification levels, compared to less than one-third of native graduates. This underutilization of personnel is not only a personal setback but also has broader economic implications, with estimated productivity losses of 33.8 billion Euros annually across the surveyed European countries and associated states¹¹ (Lighthouse Reports and the Financial Times, 2024). In Australia, skilled migrants earn approximately 10 per cent less than their Australian-born counterparts with equivalent qualifications, with total wage loss attributed to qualification non-recognition estimated at over \$4 billion Australian Dollars annually (CEDA, 2024).

Despite these systemic barriers, employer attitudes toward formal qualification recognition can vary. Some employers prioritize demonstrated competence over formal certification. For instance, a number of German construction firms assess incoming workers via practical tests at an intermediate level – equivalent to a second-year apprenticeship – regardless of whether formal documentation is available. While these practices offer more flexible pathways into employment, they are unevenly applied and often do not lead to full qualification recognition or long-term market mobility and career progression.

Vulnerability to exploitation

Migrant construction workers face heightened vulnerability to various forms of exploitation, including wage theft, excessive working hours, dangerous conditions and, in extreme cases, forced labour and trafficking. The intersection of migration debt, precarious legal status and informal employment conditions make migrants particularly

susceptible to exploitation (Wells, 2016). Many migrant workers incur significant debts to finance passage to their destination country, often paying exorbitant and sometimes illegal recruitment fees. This financial burden, coupled with immigration regulations that may tie workers to specific employers, creates conditions where migrants feel unable to refuse unsafe work, report abuse or leave exploitative situations (Wells, 2016).

Well-structured programmes with appropriate support systems can mitigate these risks. Germany’s Pool Approach (see In focus 9), for example, has an apprenticeship programme that actively encourages female participation, boasts a 100 per cent completion rate and consistently reports positive experiences from all participants.

Exclusion from social welfare and training programmes

Migrant construction workers frequently face exclusion from social welfare systems and state-funded training programmes in destination countries. Even legally resident migrants can face exclusion from unemployment benefits, healthcare coverage, pension schemes and publicly funded skills development initiatives (for example, exclusions allowed under EU Directives 2014/36/EU, 2011/98/EU).¹² This exclusion creates significant insecurity for migrant workers and increases their vulnerability in cases of injury, unemployment or economic downturns in the construction sector. The lack of access to training and skills development opportunities further entrenches migrants’ disadvantage in construction labour markets.

Occupational safety and health risks

Migrant workers frequently contend with unsafe conditions in the workplace and endure subpar working environments, engaging in strenuous and hazardous tasks without adequate safety measures. This heightened risk is exacerbated by language barriers, lack of proper safety training and fear of reporting unsafe conditions due to precarious legal status (Millward, 2016). In the United States, for example, immigrant construction workers experience a disproportionately high rate of work-related injuries compared to non-migrant workers due, in part, to language barriers that impede their comprehension of safety guidelines and proper equipment handling (Boukhris, 2024).

11 The study covered: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the UK.

12 Directive 2014/36/EU of the European Parliament and of the Council of 26 February 2014 on the conditions of entry and stay of third-country nationals for the purpose of employment as seasonal workers. Directive 2011/98/EU of the European Parliament and of the Council of 13 December 2011 on a single application procedure for a single permit for third-country nationals to reside and work in the territory of a Member State and on a common set of rights for third-country workers legally residing in a Member State.

Gender-specific challenges

Despite being a vital part of the construction sector, female migrant workers are often marginalized within this male-dominated industry. Many female workers labour in precarious conditions, facing discrimination, low wages and limited access to training and advancement opportunities (ILO, 2016c).

TVET availability, accessibility, acceptability and adaptability for refugees

Within the broader context of migration, refugees – people forced to flee their countries to escape conflict, violence or persecution (UNHCR, n.d.) – encounter distinct legal, social and structural barriers that require targeted attention. A 2018 British Council report adds further depth to the challenges listed above, particularly in relation to TVET for refugees. The report identifies several key themes (British Council, 2018):

Availability: TVET for refugees exists in all five countries studied – Ethiopia, Jordan, Pakistan, South Africa and the UK – but is never universally available. For example, in Ethiopia, while the government contributes 75 per cent of the cost of TVET for refugees and UNHCR contributes the remaining 25 per cent, it is unclear whether this funding is available to all refugees or limited to certain groups.

Accessibility: Refugee policy and bureaucratic practices often create barriers that deny access to TVET, for example, in South Africa refugees face challenges in obtaining the necessary documentation to prove their status and enrol in TVET programmes. The British Council report mentions cases where refugees with certain permits have been unable to enrol because their documentation did not clearly indicate their entitlement to public education. In some countries, however, progress has been made in relaxing the policies to enable greater access – notably in Jordan, where Syrian refugees have had access, and non-Syrian refugees have increasingly been allowed to enrol in public TVET, and in the UK where refugee learners are broadly entitled to access further education under the same conditions as nationals.

Acceptability: TVET often fails to provide refugees with learning opportunities that are personally acceptable, rarely taking into account prior learning, work experience, cultural practices and norms, or aspirations. The report highlights an example from Jordan, where Syrian women find it difficult to pursue employability programmes because their community traditionally expects them to be homemakers.

Adaptability: While efforts are being made to adapt existing policies, funding systems and programmes to refugees' needs, there is much room for improvement. The report cites the example of the EU-Jordan Compact, which aims to create job opportunities for both Jordanian nationals and Syrian refugees. This initiative demonstrates an attempt to adapt policies to include refugees in the labour market, but its implementation and effectiveness are still being evaluated.

These challenges are further compounded by the global context outlined in the World Migration Report (IOM, 2024). The COVID-19 pandemic, for example, exacerbated long-standing structural issues in economies and labour markets, further limiting access to decent work for vulnerable groups (IOM, 2024). This is particularly relevant for migrant workers in the construction sector, who often fall into these vulnerable categories.

6.3 Opportunities for inclusive TVET programmes

Various strategies can be adopted to ensure TVET programmes are inclusive and accessible for migrant workers, some of which are outlined below.

Develop certification programmes to formally recognize migrant workers' skills

RPL systems are essential for validating skills acquired through informal pathways, particularly for migrant workers in construction. In Ethiopia, the Ministry of Labour and Skills has implemented a robust RPL framework tailored to indigenous crafts in the construction sector. Since 2023, the initiative has certified over 650 professionals, promoting equity, social inclusion and labour market integration (see In focus 7).

The example by Ethiopia's Ministry of Labour and Skills demonstrates how RPL can provide a bridge between informal competencies and formal qualifications. The British Council (2018) recommends standardized certification schemes and quality assurance systems aligned with international frameworks such as the ASEAN Qualifications Reference Framework (AQRf) – a recommendation echoed by the ILO (2016a) and operationalized by countries seeking to harmonize skills recognition for migrants.

In addition, UNESCO's 2019 Global Education Monitoring Report highlights how forcibly displaced populations often face a 'double exclusion' from both education systems and formal employment (UNESCO, 2019a). The report

recommends TVET systems offer modular, flexible and portable pathways that accommodate interrupted learning histories and legal uncertainty – particularly relevant in humanitarian and post-conflict contexts (UNESCO, 2019a).

Transparent and accessible information systems are also essential. The British Council (2018) emphasizes the development of digital platforms to track recognized skills,

enabling migrant workers to navigate certification processes and employers to verify qualifications.

Capacity building for certification bodies and TVET providers is another critical step. Training assessors to recognize the value of prior experience and create culturally sensitive evaluation criteria ensures that RPL systems are fair, inclusive and internationally trusted.

In focus 7: RPL in Ethiopia's construction sector

Ministry of Labour and Skills, Ethiopia

In Ethiopia, many workers acquire skills informally through community learning, informal apprenticeships or on-the-job experience, but without formal certification these skills remain invisible to the labour market. To address this, the Ministry of Labour and Skills, with support from GIZ Ethiopia and the ILO, launched a Recognition of Prior Learning initiative in 2023, targeting the construction sector and related indigenous crafts.

The programme develops occupational standards, curricula and assessment tools for occupations previously excluded from formal TVET. It also provides guidelines, training materials and assessor capacity building to ensure quality and consistency. Initial pilots in Addis Ababa assessed 114 skilled workers, enabling them to gain nationally recognized qualifications regardless of their educational pathway.

RPL is also improving employability, equity and labour market integration for disadvantaged groups, including refugees and internally displaced persons. By shortening study times, reducing duplication of training and strengthening industry–TVET linkages, the initiative is enhancing Ethiopia's skills base and promoting social cohesion.

Source: Ethiopia Ministry of Labour and Skills, www.ilo.org/resource/news/ethiopia-takes-step-towards-inclusive-certification-through-recognition.

Harmonize TVET standards between origin and destination countries

Harmonization of TVET standards between countries of origin and destination is critical for promoting labour mobility and skills transferability. Evidence from ASEAN shows that workforce mismatches and inconsistent certification/recognition are major barriers to mobility (ASEAN, 2018). AQRf was created to address these issues by enabling cross-country comparability of qualifications, while recent analysis documents persistent recognition hurdles – especially in construction (ASEAN, 2018; ADBI et al., 2024).

Lessons from Africa, where regional qualifications frameworks are emerging – notably the African Continental Qualifications Framework (ACQF) – also demonstrate the need for regional collaboration to ensure returning or transnational workers are not trapped in informal work due to skills recognition gaps (Castel-Branco, 2020; ETF, 2020; ILO, 2021b). As cross-border construction labour flows increase – whether through regional migration corridors or humanitarian displacement – TVET systems must evolve to provide consistent, transparent recognition processes that do not disadvantage migrant workers.

Existing international conventions and frameworks offer a solid foundation for this work. The *1997 Convention on the Recognition of Qualifications concerning Higher Education in the European Region* establishes key principles – such as fairness, transparency and the right to recognition – that, while originally designed for higher education, are increasingly being extended to vocational qualifications. The principles of the Convention have influenced mutual recognition agreements and qualifications frameworks across Europe and beyond and offer a scalable model for TVET.

Complementing this, the *2019 Global Convention on the Recognition of Qualifications concerning Higher Education* aims to bridge regional systems and promote a common framework for recognizing competencies worldwide, including those of migrants'. The Convention explicitly encourages the development of cross-border recognition mechanisms that are inclusive, rights-based and applicable beyond traditional higher education.

The 2011, *Asia-Pacific Regional Convention on the Recognition of Qualifications in Higher Education* set a precedent for regional cooperation, while the AQRf continues to be a key tool for aligning national systems and supporting skills mobility.

Similarly, the 2014 African Continental Qualifications Framework (ACQF) and the revised *Convention on the Recognition of Studies, Certificates, Diplomas, Degrees and Other Academic Qualifications in Higher Education in African States* (Addis Convention) are laying the groundwork for harmonized qualifications across Africa, which can be adapted to TVET contexts through targeted policy and institutional reform.

Instead of building new systems from scratch, countries can draw on these frameworks to:

- establish bilateral or multilateral TVET recognition agreements;
- adapt existing recognition protocols to vocational education levels (e.g., ISCED 3–5);
- strengthen quality assurance systems that promote cross-border trust;
- create regional information-sharing platforms and qualification databases; and
- ensure refugees and displaced workers are not excluded from recognition mechanisms due to lack of documentation or disrupted education pathways (UNESCO and ILO, 2019; UNESCO, 2019b; African Union Commission, 2022; ASEAN, 2018).

These efforts must be backed by policy coordination between labour, education and migration authorities, and be supported by industry to ensure TVET systems reflect labour market needs. International conventions provide not just the legal scaffolding, but also a shared language for building inclusive, mobile and future-ready vocational education systems across borders.

Implement support services

Support services are a linchpin for enabling migrant workers to transition into formal employment in the construction sector. These include legal aid, vocational language training, psychosocial counselling and orientation to workplace norms and rights.

A UNESCO discussion paper on migration and TVET argues that a ‘learning ecosystem’ approach – integrating TVET with legal, social and employment services – is more effective than siloed interventions (Wedekind et al., 2019). It recommends embedding support services directly into vocational training pathways, particularly in fragile and displacement-prone regions (Wedekind et al., 2019).

Digital platforms offering guidance on migration law, employment rights, qualification recognition and job matching are also vital. Not only do they support migrants, but they also reduce administrative bottlenecks in the skills recognition process.

Create inclusive TVET programmes addressing the specific needs of migrants

Inclusive TVET systems must reflect the lived realities of migrant workers by offering culturally responsive training, trauma-informed pedagogy and accessible, flexible learning options. OECD (2023) and UNESCO (2022) advocate for modular, stackable qualifications that enable trainees to enter and exit training as needed while progressively building credentials.

In Europe, pre-apprenticeship programmes tailored to migrants have shown strong results. These initiatives typically combine language training, vocation induction and job-matching services, and are supported by wraparound assistance such as housing and administrative support. Such models have enabled greater migrant participation in vocational pathways and apprenticeships. For example, Germany has introduced reforms allowing asylum seekers to access pre-vocational training and apprenticeships, with residence permit extensions linked to TVET enrolment.

Key enablers of inclusive TVET include early language acquisition, RPL, employer incentives and embedded guidance and support systems. These enablers are highly relevant for countries in Asia and the Pacific and Africa, where integrating migrants often coincides with the broader task of modernizing TVET systems.

In addition to inclusivity, adaptability is also crucial. The British Council (2018) and the World Migration Report (IOM, 2024) stress the importance of building responsive TVET systems that can adjust to shifting migration patterns and policy changes. They recommend embedding periodic evaluations and feedback loops to keep training aligned with labour market and policy developments (British Council, 2018; IOM, 2024).

Promote and support skills-based migration pathways

As climate-linked displacement accelerates, TVET must respond to the needs of climate-displaced populations. Countries such as Argentina have introduced humanitarian pathways in response to such migration, creating an opportunity to develop TVET programmes focused on climate-resilient construction techniques and targeting communities most affected by environmental shocks (Raj, 2022; UNHCR, 2024).

In focus 8: International mobility pathways

Talent Beyond Boundaries and TalentLift Canada, Global

Talent Beyond Boundaries (TBB) and TalentLift Canada are pioneering initiatives that connect skilled refugees with international employment opportunities, offering alternatives to traditional resettlement. Both address labour shortages in destination countries while enabling displaced individuals to achieve self-reliance and integration.

TBB works with governments and employers in Australia, Canada, the USA and the UK to create employment-based visa pathways for refugees. In Australia, the co-designed Skilled Refugee Labour Agreement Pilot has enabled over 500 refugees between July 2023 and June 2025 to secure jobs and rebuild their lives, with concessions such as waivers for certain visa requirements and options for permanent residency.

TalentLift Canada operates under the Economic Mobility Pathways Pilot (EMPP), supporting employers in hiring and relocating skilled refugees into sectors such as healthcare, technology and skilled trades. By embedding displaced talent into the workforce, these programmes demonstrate that with the right frameworks, refugee workers can contribute meaningfully to host economies while gaining stability and security.

Source: Talent Beyond Boundaries, www.talentbeyondboundaries.org; TalentLift Canada, www.talentlift.ca.

Leverage 'brain gain' and skills circulation from migration

The concept of 'brain gain' reframes the narrative around migration, viewing it as an opportunity for skills accumulation and knowledge transfer. Construction workers who acquire advanced skills abroad can return with valuable capabilities including modern techniques, sustainable construction methods and project management frameworks.

Policies supporting temporary and circular migration are particularly effective in the construction sector, where workers often move seasonally or project-by-project. These arrangements, when paired with well-functioning RPL systems, allow for continuous skills circulation between countries therefore benefitting both destination and origin country economies.

The German Skilled Workers Immigration Act offers a compelling example of how immigration policy can align with workforce planning (BMWK, 2024). It facilitates the migration of skilled workers through streamlined visa processes, recognition of foreign qualifications and pre-departure support. Its structured approach provides a reference point for countries seeking to integrate migration into long-term labour market strategies.

The World Migration Report (IOM, 2024) also calls attention to the need for regional cooperation, particularly in regions undergoing significant migration policy reform, such as South America. Coordinated approaches to TVET and migration governance are crucial to avoid fragmented systems and to support migrants in contributing productively to multiple economies throughout their working lives (IOM, 2024).

Engage the private sector

The private sector perspective is often underrepresented in discussions about labour migration, which typically focus on a 'triple win' for countries of origin and destination, and for migrants themselves. However, engagement with private employers is crucial for creating sustainable migration programmes. Private sector willingness to participate depends on multiple factors including economic considerations, regulatory frameworks, available support systems and alignment with business needs.

Implement a joined-up approach

By implementing the integrated strategies outlined above, countries can create TVET ecosystems that empower migrant workers while strengthening the construction sector more broadly. This requires deliberate policy coordination across education, labour, migration and social protection sectors – and the active engagement of employers, civil society and international agencies. As previously discussed, the frameworks and insights provided by UNESCO, ILO, British Council, ASEAN bodies and national examples from Germany offer a strong foundation for action in the Asia-Pacific, European and African contexts.

In focus 9: Skills circulation**BAUVERBÄNDE NRW e. V.: Pool Approach, Germany**

The Pool Approach initiative by BAUVERBÄNDE NRW e. V. in Germany aims to match German construction companies with suitable candidates from non-EU countries for apprenticeships. This approach helps address skills shortages in the German construction sector while providing opportunities for young adults from countries with limited job prospects. The initiative includes language and cultural preparation before arrival in Germany, ongoing support during the apprenticeship and assistance with bureaucratic matters for participating companies.

Since 2023, the programme has successfully placed several cohorts of apprentices from Ethiopia and Mozambique with German construction companies. In 2023, 17 young people were matched with German construction companies increasing to 30 in 2024. All apprentices have continued their training and both the apprentices and the companies report high levels of satisfaction with the programme.

This innovative practice demonstrates a structured approach to integrating migrant workers into the construction sector through TVET, addressing challenges such as language barriers, skills recognition and cultural integration. It also showcases the potential for international cooperation in addressing skills shortages and provides opportunities for workforce development across borders.

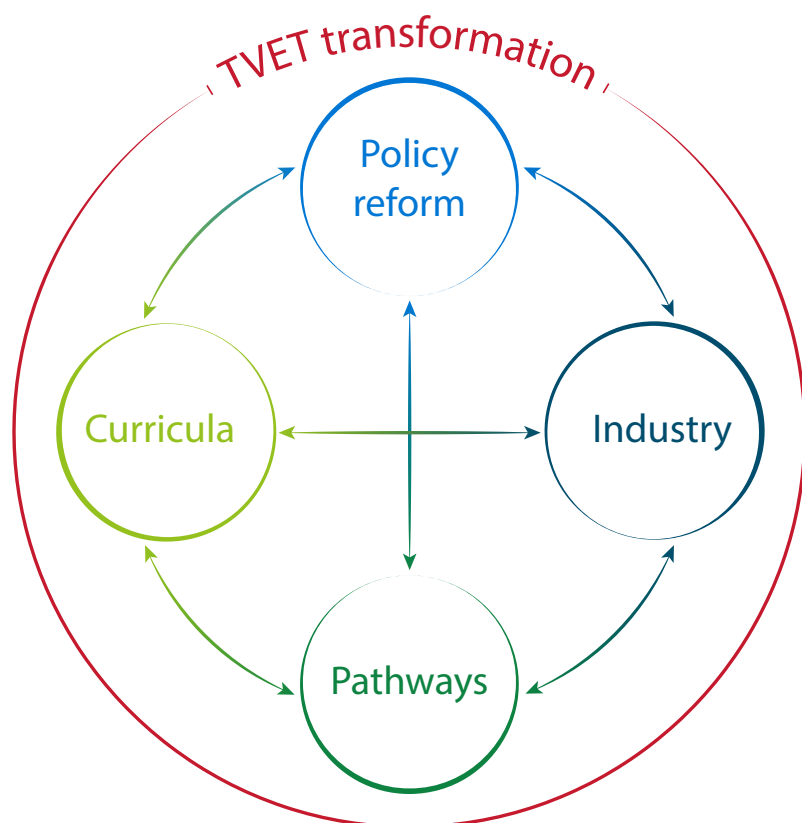
Source: BAUVERBÄNDE NRW e. V., www.bauverbaende.nrw/internationale-projekte/partnerafrika-projekt-1-1.

7. Cross-cutting themes and synergies

The transformation of TVET in the building and construction sector involves complex interactions between policy development, industry collaboration and curricula modernization. These elements create synergies that enhance the overall effectiveness of TVET programmes.

Figure 1 shows the interconnection of TVET transformation as a quadrant-based framework with bidirectional influences highlighted across the system. The concept is expanded in further detail in the following section.

Figure 1: Bidirectional influences across TVET transformation



Source: author, 2025

7.1 Policy → Curricula

Policy establishes the enabling (or constraining) environment for curriculum reform. Regulatory mandates on sustainability, energy efficiency or digital readiness drive updates to qualification standards and curricula. For instance, the European Construction Blueprint (see In focus 6) initiative developed EU-aligned curricula in areas such as circular economy and energy efficiency in response to regulatory and labour market needs. Similarly, France's *Heating, ventilation and air conditioning design technician* qualification was revised to reflect updated national environmental regulations.

National frameworks for MCs, such as Singapore's SkillsFuture (see In focus 3), exemplify how governments are enabling modular curriculum structures. Without this scaffolding,

training providers lack the legitimacy or clarity needed to design qualifications that are both flexible and stackable.

7.2 Industry → Curricula

While industry's role in curricula design is both desirable and already active in some contexts, it is not yet widespread across all regions or sectors. Collaboration is essential to ensure trainees receive the training required to prepare for emerging roles, technologies and processes. In Moldova, for example, energy-efficient building training is co-delivered by companies promoting sustainable construction techniques. This results in curricula aligned with real-life environmental goals and technical standards.

In Malaysia, the integration of BIM, digital workshops and online platforms has reshaped TVET curricula in response to

technological shifts. Likewise, the Italian Higher Technological Institutes (Istituti Tecnologici Superiori – ITS Academy) and Australia’s Institute of Applied Technology and Construction, co-designed training programmes that simulate real-life site conditions to build job readiness and digital proficiency.

7.3 Policy/industry → Pathways

Inclusive TVET pathways emerge when policy and industry collaborate. The Ara Education Charitable Trust in New Zealand (see In focus 2), for example, is a partnership between government, industry and schools. It supports trainees in South Auckland with wraparound services that help them transition into work or other training opportunities across the construction sector. Similarly, the Pool Approach (see In focus 9) between Germany, Ethiopia and Mozambique supports construction labour migration via skills-alignment, pre-departure training and regulated employment pathways. This is enabled by bilateral policy agreements and direct employer involvement, linking skills supply with ethical labour demand.

Corporate social responsibility initiatives also shape pathways, such as BRANZ’s Climate Exchange Tool in New Zealand, which helps influence industry to embrace sustainability, not through mandates but by fostering peer-driven knowledge exchange and showcasing benefits for businesses.

7.4 Pathways → Curricula/policy/industry

Incorporating trainees’ experiences and needs back into training systems helps drive change in training content, delivery modes and credentialing policy. As trainees’ demands for pathways that are modular, multilingual and inclusive increases, this exerts pressure on both training providers and employers to innovate. In doing so, they shape a more agile and equitable TVET ecosystem. This can be seen in Canada’s Quick Train initiative (see in Focus 3), for example, where a rise in demand for short, flexible qualifications has led to a coalition of colleges offering industry-relevant MCs in construction technology.

Another example is ODFeL in Nigeria, which has responded to women’s increased interest in construction skills by offering culturally appropriate, digital learning options. This shift is not only about access; it redefines what kind of content is taught and how. Digital assessment pilots, for example in New Zealand’s Epic Learning initiative (see In focus 4), also respond to trainee demand for accessible, personalized tools that support diverse learning preferences and languages – especially relevant for migrants.

The implications of these cross-cutting trends, summarized in Table 4 below, highlights potential opportunities and system-level responses for TVET across key domains.

Table 4: Digital, green and combined skills

Digital skills demands	Green skills demands		Emerging combined skills
<ul style="list-style-type: none"> • BIM competencies • VR and AR applications • IoT integration skills • Digital project management capabilities • Data analysis and interpretation • Digital collaboration tools proficiency • Cybersecurity awareness • Basic digital literacy and STEM competencies 	Technical skills <ul style="list-style-type: none"> • Bio-sourced materials knowledge and handling • Energy efficiency assessment and implementation • Waste management and circular economy practices • Material recycling and recovery expertise • Net-zero emission building techniques • Sustainable construction methods • Environmental regulation compliance • Building environmental performance assessment 	Transversal skills <ul style="list-style-type: none"> • Environmental awareness • Ecological transition understanding • Resource efficiency mindset • Adaptability to new sustainable practices • Cross-trade knowledge for material reuse • Problem-solving for sustainable solutions • Team collaboration for integrated sustainable approaches 	<ul style="list-style-type: none"> • Digital tools for environmental assessment • Smart building systems integration • Digital waste management tracking • Sustainable material sourcing through digital marketplaces • Energy efficiency monitoring through digital platforms • Digital platforms for supply-demand matching in material reuse

Source: author, 2025.

8. Recommendations

This chapter makes recommendations based on insights from the BILT Expert Group. The recommendations follow a three-tier classification with each level addressing a particular type of stakeholder. The macro-level addresses policymakers and system governance authorities such as national TVET agencies, ministries and statutory bodies. The meso-level relates to organizations advocating for modernization of TVET systems and represents private interests such as businesses, chambers of industry and crafts, and trade unions. Finally, the micro-level provides operational recommendations to be implemented by TVET providers, institutions and other private organizations such as corporate training centres or companies that provide training pathways for youth and adults.

8.1 Macro-level: Policies

Digital transformation of TVET delivery

Assessment of skills qualification frameworks:

a comprehensive review of existing skills qualification frameworks is needed across learning, assessments and workplace training ecosystems to identify where outcomes could be strengthened through partial or full digital transformation. Such a review would help align policies on digitalizing TVET delivery with existing frameworks, minimizing conflicts and duplication. It could also highlight pinch points and processes where digitalization would generate greater efficiency.

Feedback mechanism for agile response: a robust monitoring and evaluation system is essential for continuous review of accreditation standards, processes and professional qualifications in TVET for the construction sector. Such a system would support timely responses to opportunities and challenges arising from digitalization across all aspect of TVET delivery. It should actively involve stakeholders from across the TVET ecosystem and provide regular feedback through structured meetings or flexible engagements tailored to the sector. Given the dynamic impact of digitalization, the system must also promote flexibility and agile training models that can readily incorporate feedback and deliver relevant inputs for operators at different levels.

Incorporating sustainability into TVET

Green qualifications and industry professions: emerging fields, such as energy consumption reduction, nZEB design and assessment, building life cycle assessments and circular economy principles, demand the development of new, specialized qualification profiles. This requires the creation of new training provisions – almost from scratch in many

countries – that target a new generation of technicians, building designers, assessors and surveyors. Recognition of these green occupations also depends on their integration into national job taxonomies and classifications, as well as learning pathways within qualification frameworks. At the same time, it is essential to engage industry on the importance of incorporating these professionals into the construction value chain to ensure both regulatory compliance and environmental sustainability.

Traditional qualifications and green transversal and technical skills:

many traditional trades are being reshaped by the green transition, including specialists in heating/cooling installations, renewable energy equipment, bio-sourced materials, second-life material recovery and waste management. A new generation of professional is also needed across diverse trades, such as site managers, masons, carpenters, secondary works technicians, equipment installers and maintenance technicians. Learning pathways must include more than just technical expertise, instead incorporating transversal competencies such as environmental awareness, ecological responsibility and deeper understanding of environmental impacts, while also engaging with ethical questions and values in the professional context.

Modernizing qualifications is essential. Therefore, TVET system must accelerate updating qualifications, reducing the current time lag from years to months. For particularly strategic policy objectives linked to national economic development, derogations from standard formal procedures should be considered. Prioritization could be labour market-driven based on industry needs, or policy-driven based on national green policy goals, with the active involvement of private sector companies. Updates could range from revision of full qualifications to more targeted changes in subsystems, modules or units describing specific evolving skills.

TVET supporting just and safe migration

Recognition and portability of skills: adopting and implementing skills recognition frameworks, such as regional qualifications reference frameworks and skills passports, ensures construction qualifications are portable between origin and destination countries. This can be strengthened through bilateral and multilateral training agreements that align curricula, assessment methods and standards across sending and receiving countries, enabling mutual recognition and maintaining industry relevance.

Integrating migration into national TVET strategies:

the needs of migrant workers should be incorporated into national TVET strategies and should include clear regulatory provisions for pre-departure and post-arrival training. This training must cover technical skills, occupational safety, workers' rights and language proficiency, ensuring migrant workers are prepared for their roles and can adapt quickly to workplace expectations and legal requirements.

8.2 Meso-level: Advocacy**Industry cooperation for digital TVET delivery**

Onboarding industry leaders: as key industry gatekeepers, companies play a vital role in supporting digital TVET delivery through internship opportunities and work-based learning. Their backing is essential as decisions on technological investment, upgrades and the extent of their engagement with digital TVET, are typically made at top management level. Focused advocacy is therefore needed to persuade these leaders with a strong business case that highlights cost-benefit for their organizations. Securing industry leaders' commitment not only drives participation but also creates opportunities for potential investment in TVET institutions, strengthening their capacity to deliver digital training.

Industry placement and internships: to maintain relevance and keep training up-to-date, both trainers and trainees require structured industry placements or internships. Such opportunities provide trainers with practical exposure to real-world practices and technologies thereby enhancing the quality of their teaching, and trainees with the chance to refine their skills in real work settings. Such placements also benefit industry by allowing trainers and trainees to contribute their developing expertise to ongoing operations. In addition, direct engagement with industry equips trainers with a greater understanding of evolving skills demands, helping them better align training programmes with market demand.

Private sector support for a greener TVET

Industry–TVET collaboration on greening: in many national settings, collaboration with industry on environmental topics is weak. While some companies are leading on sustainability, most – especially SMEs – remain hesitant. TVET providers must, therefore, actively engage with industry to encourage forward-looking practices and help businesses adopt greener operations. Conversely, when market demand for green skills moves faster than training systems, leading-edge companies can play a vital role in moving TVET forward through partnership and innovation.

TVET-industry synergies can take multiple forms including:

- Staff exchange and cross-fertilization initiatives (in collaboration with research centres) focused on innovative green products and processes.
- Knowledge sharing on environmental regulations, labels and quality standards.
- Work-based reskilling workshops for teachers.
- Collaborative design of short, stackable units on green skills – both general and technical – delivered as MCs ensuring transparency, quality and skills recognition by companies and practitioners across specific territories, regions or communities.

In-company sustainable learning environments: green and sustainable learning environments within companies provide a rich context for vocational training and continued education. Such environments promote ecological, economic and social sustainability – not only through the content of training but also through the ways in which learning is organized, delivered and supported. The focus is not just on what is learned, but also how, where and under what conditions. When training content and company frameworks reinforce one another, sustainable learning can firmly take root.

Industry–TVET partnerships for migrant skills development

Industry–TVET partnerships for targeted upskilling: strong collaboration between industry and TVET providers is needed to deliver targeted upskilling for migrant workers. This should include workplace-based language support, cultural orientation and training tailored to specific roles within the construction sector. Embedding these support systems in the workplace can accelerate skills acquisition, improve safety and strengthen retention.

Advocacy and ethical recruitment: engaging industry bodies and unions to advocate for policy reforms that improve migrant access to training, credential recognition and career progression – whilst aligning industry hiring standards with TVET certification – can promote ethical recruitment practices. This approach helps ensure migrants secure decent work, fair pay and safe working conditions while also enabling them to contribute their skills more effectively to the sector.

8.3 Micro-level: TVET provision

Support for digital TVET delivery

Digital infrastructure investment: investment in digital infrastructure at TVET centres is vital for equipping trainers with the skills and knowledge they need to effectively teach on new technology. This includes access to learning resources and essential equipment and technology to support practical instruction, as well as access to digital learning platforms and online resources for blended and remote learning. Investment in digital infrastructure for reliable internet connectivity is also fundamental. In addition, acquisition of the latest tools and equipment helps ensure trainees are equipped with both technical construction skills and digital skills for working in a sustainable construction environment.

Trainer competency: the need for educator training and development that equips trainers with the skills and knowledge they need to teach new technologies and sustainable practices cannot be overstated. Training can be provided in the form of short courses addressing key knowledge gaps in digital skills, industry trends and digital delivery. Establishing channels for exchange of knowledge and best practice between trainers from different TVET institutions and/or regions is also a low-cost way to improve digital TVET delivery for the sector. Enhancing trainer competency also relies on TVET institutions having the infrastructure required to access and apply the latest technologies for delivering high-quality education.

Provide green knowledge and skills

Trainee knowledge and educator capacity for sustainability: the importance of green construction can sometimes be overlooked as trainees – hoping for quick employment – focus on conventional materials and skills. TVET providers, therefore, must champion the importance of sustainable construction and future planning through their educational programmes. At the foundational level, teachers' and educators' knowledge of – and capacity to teach about – green technology for construction must be prioritized. Industry can support this by offering teacher secondments that provide access to advanced equipment, and by sharing practical expertise particularly in areas such as renewable energy, smart-grid systems and sustainable materials. Providing training – across all knowledge and competency levels – on both ecological and socio-economic dimensions, can also lead to a more responsible, ethical future workforce.

Partnerships with other TVET institutions on

sustainability: construction sector environmental goals cannot be achieved by TVET institutions working in silo. TVET institutions must create partnerships with other TVET providers, companies, public authorities, funders, research centres and associations – both national and international – in order to maximize their impact. Whilst it is essential to receive support from local authorities and businesses to promote synergy with local economic development policies, it is also recommended that TVET institutions establish international networks with experienced providers who can supply knowledge and best practice on green excellence.

Expanding access to flexible and inclusive learning

Flexible, accessible learning for migrant workers: to improve accessibility and engagement of migrant workers in remote or temporary worksites, TVET providers should offer modular, flexible and blended learning options. These programmes must support both upskilling and the formal recognition of prior learning and training design should include multilingual and culturally responsive delivery.

Worker rights and safety: to ensure migrant workers understand workplace standards, can operate machinery safely and know how to access grievance mechanisms, rights-based and safety training must be included in all induction programmes. Equipping migrants with this knowledge from the outset helps protect their wellbeing and supports safe, fair and productive participation in the workforce.

Conclusion

The findings of this report make it clear that the future of the construction industry will depend on training systems that are agile, inclusive and sustainable. Digitalization, greening and migration are not isolated trends but interconnected influences reshaping labour demand and redefining the skills required for a rapidly evolving and expanding global construction market.

The BILT Expert Group recommendations, together with the best practice examples presented throughout this report, demonstrate how TVET providers and industry are collaborating to close skills gaps and advance ecological, economic and social sustainability. By working together, TVET stakeholders and companies can better align training provision with industry need, strengthen access for migrant workers and adopt innovative practices that combine digital delivery with sustainable construction approaches. The use of emerging technologies including AI, BIM and XR is already helping the sector reduce its environmental impact. Integrating and expanding these innovations through TVET provision is therefore imperative. Furthermore, the Expert Group recognizes digitalization as a key driver for enhancing migrant workers' access to training, particularly through remote learning and short, flexible modular programmes.

Looking ahead, TVET systems that integrate digital technology, prioritize green skills and support skills-related migration will be essential for meeting the projected workforce needs driven by the global infrastructure boom over the next decade. By embracing greening and digitalization, the sector can also contribute meaningfully to achieving the UN Sustainable Development Goals on quality education (Goal 4), industry innovation and infrastructure (Goal 9), climate action (Goal 13), as well as many others.

Ultimately, to achieve a sustainable and green future for construction and improve access for migrant workers, TVET stakeholders must embrace the opportunities offered by digitalization and commit to delivering high-quality, accessible training that supports sustainable infrastructure development worldwide.

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Transformative TVET for the building and construction sector

Embracing digitalization, greening and migration trends

As the building and construction sector rapidly evolves in response to digitalization, climate imperatives and workforce mobility, technical and vocational education and training (TVET) systems must adapt to remain relevant. This report explores how emerging technologies such as building information modelling, artificial intelligence and extended reality are transforming TVET delivery, and why embedding sustainability into curricula is critical for reducing the sector's environmental footprint.

Drawing on insights from the BILT Expert Group and case studies across Africa, Asia and the Pacific, and Europe, this report highlights the central role of migrant workers in addressing global labour shortages and the need to improve integration and access to TVET for these workers. This report also outlines how ethical recruitment, skills recognition and inclusive training can enhance mobility and equality.

With practical recommendations for policymakers, educators and industry leaders, this publication offers a roadmap to align skills development and recognition with the needs of a construction sector that is greener, more digital and increasingly global.

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