

2023-08-20

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Avril Behan

Solas, avril.behan@solas.ie

Paul McCormack

Belfast Metropolitan College, paulmccormack@belfastmet.ac.uk

Barry McAuley

Technological University Dublin, barry.mcauley@tudublin.ie

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Recommended Citation

Behan, A., McCormack, P. and McAuley, B. (2023) Skills Matter – up-skilling across construction stakeholders for emerging roles, Proceedings of the 6th CitA BIM Gathering, Athlone, September 18th – 20th, pp 164-173. DOI: 10.21427/78JJ-Y507

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Funder: Horizon Europe

Skills Matter – up-skilling across construction stakeholders for emerging roles

Avril Behan¹, Paul McCormack² and Barry McAuley³

¹College of the Future, Solas, Castleforbes House, Castleforbes Road, Dublin 1

²Belfast Metropolitan College, e3 Building, 398 Springfield Road, Belfast,

³Northern School of Surveying and Construction Innovation, TU Dublin

E-mail: ¹avril.behan@solas.ie

²PaulMcCormack@belfastmet.ac.uk

³barry.mcauley@tudublin.ie

Abstract – The EU’s Climate Target Plan To 2030 (European Union 2020b) of achieving at least 55% reduction in Green House Gas emissions from 1990 levels, delivering towards a climate-neutral economy by 2050, requires systems-level change in the way we design, construct, and operate our built assets. Funding initiatives, such as co-ordinated by BUILD UP Skills, aim to deliver upskilling to the market but targets set by the European Skills Agenda may not be reached at current achievement levels. This paper presents the results of one completed and the progress of one ongoing Horizon 2020 funded project, BIMcert and ARISE, respectively. Learning from both projects demonstrate that bite-sized (micro-credential), just-in-time, recognised training that is supported by digital platforms, gamification, and quality face-to-face interventions have the potential to support better delivery toward delivery against climate targets. Additional focused initiatives targeted at attracting school-leavers, at increasing female and diverse participation in the sector, and at retraining the aging workforce are proposed as potential ways to broaden the impact of the projects described in the research.

Keywords – Construction, Education & training, UN SDG 4: Quality education

I INTRODUCTION

The EU’s Climate Target Plan To 2030 of achieving at least a 55% reduction in Green House Gas emissions from 1990 levels, delivering towards a climate-neutral economy by 2050, will require the deployment of new technologies [1][2] and the adoption of consistent information management standards for building performance, waste reduction, and continuous productivity improvement across all built environment stakeholders [3][4][5]. In turn, this will require widespread upskilling and reskilling of the construction workforce, systems-level thinking, and collaboration across the supply chain.

The European Academics Scientific Advisory Council has provided a suite of messages for policymakers in their Decarbonisation of buildings: for climate, health and jobs report, including a recommendation to “*expand, retrain and re-skill the building sector workforce to quickly deliver sustainable deep renovations*” [7]. The EU supports this decarbonisation agenda via a range of ‘*investment in skills funds*’ under the European Skills Agenda with a total value of €85 billion [8].

Additional funding will also be available between 2021 and 2027 via €55 billion investment in the Just Transition Mechanism: “*a key tool to ensure that the transition towards a climate-neutral economy happens in a fair way, leaving no one behind*” [9][10]. Pillar 1: The Just Transition Fund provides supports that include upskilling and reskilling of workers, which aligns with funding already and historically available through Horizon 2020 – Energy Calls and the LIFE programme. Last year’s Life 2021 call included a specific Clean Energy Transition (CET) sub-programme targeted at supporting achievement of the European Green Deal.

Significant progress has been made in improving the energy performance of buildings through digitalisation at planning and design stages of built assets, for example, through the MENs – Meeting the energy professional skills – Horizon 2020 project [11]. In parallel, BUILD UP Skills, an initiative to improve the qualification and skills of Europe’s construction workers, which acts as a springboard to stimulate the demand for energy efficiency skills [12], has coordinated the delivery of national skills roadmaps, with associated training deployment and sharing of best practice (more detail in Section 2). Specifically in respect of ERASMUS+,

two specific priorities align with Energy Transition: Digital Transformation and Environment and Fight Against Climate Change. Some of these funding initiatives receive supporting or matching funding from national Governments and local sources, such as through labour-market activation and retrofit schemes (e.g., Springboard+ in Ireland [13][14].

Despite this progress in some parts of the construction supply chain, and the widespread availability of funding at various levels, the uptake of training and reskilling opportunities at site level and among lower qualified workers, while improving, is lower than necessary to meet sectoral and societal requirements (Table 1).

Indicators	Objective for 2025	Current level (latest year available)	Percentage increase
Participation of adults aged 25-64 in learning during the last 12 months (in %)	50%	38% (2016)	+32%
Participation of low-qualified adults 25-64 in learning during the last 12 months (in %)	30%	18% (2016)	+67%
Share of unemployed adults aged 25-64 with a recent learning experience (in %)	20%	11% (2019)	+82%
Share of adults aged 16-74 having at least basic digital skills (in %)	70%	56% (2019)	+25%

Table 1 European Skills Agenda objectives to 2025 [7].

To achieve the 2025 European Skills Agenda targets and to enable European countries to meet their energy transition targets, it is essential that lessons are learned from training and education successes and that these inform future activity.

The research presented here reports on recent and ongoing exemplars of successful upskilling for energy transition achieved within the BIM Energy Performance Alliance (BIM-EPA), including implementations across twelve European countries using cohort-appropriate tools and methodologies.

Section 2 of the paper describes the focus and achievements of BIM-EPA. Section 3 details two successful up-skilling projects, BIMcert and ARISE, which were implemented across a number of European jurisdictions with funding from

Horizon2020 Coordination and Support Actions. Section 4 discusses the implications of the results of these projects in the context of the EU and global need for significant growth in the availability and quality of up-skilling towards emerging roles that support energy transition. The final section is a brief conclusion.

II BUILD UP SKILLS

Since 2011, the BUILD UP Skills initiative has supported the upskilling of building workers and professionals across Europe, with a view to delivering building renovations offering high-energy performance and resulting in nearly zero-energy buildings [11]. The initiative hosts annual European exchange meetings that aim to create a forum between relevant projects for discussion on common challenges and good practices in an effort to advance the skills agenda in the field of energy-efficient and sustainable buildings. Representatives from the Director-Generates of Energy, Employment, Environment, and Internal Market are typically in attendance at these forums to present on the latest policy developments and to encourage further collaboration.

The BUILD UP Skills initiative brings together several policy priorities, namely energy efficiency, economic growth, circularity, education, and digitalization in recognition that, without skilled construction workers and professionals at all levels, the decarbonisation of our building stock, which is one of the essential pillars of the Green Deal, will not be achieved. While previously funded under Horizon2020, future BUILD UP Skills activities will now be funded under the LIFE CET programme.

The 1st BUILD UP Skills programme focused on mapping current capability within EU member states, developing national qualifications platforms and roadmaps, and creating schemes and frameworks of training and qualifications. The 2nd BUILD UP Skills calls closed early 2022 and sought applications from consortia to develop national roadmaps beyond 2022, focusing on simulating demand.

The next section describes the BIM-EPA which evolved from the BUILD UP Skills activities.

III BIM-EPA

BIM Energy Performance Alliance (BIM-EPA) (Figure 1) is an association of aligned, former H2020 and Erasmus+ projects, including BIMcert, BIMEET, BIMplement, BIMzeED, and NET-UBIEP, with additional partners vital to the upskilling of the AEC sector in respect of digitalisation and energy transition. The alliance has over 100 partners across twelve European countries and was founded during a workshop hosted by the Climate, Infrastructure, and Environment Executive Agency with the objective of obtaining increased impact from CINEA-sponsored

funding programmes. CINEA has cultivated the relationship within the alliance through invitations to participate in EU Energy Week, the BUILD UP Skills Exchange, and VET Training Week.



Figure 1. BIM Energy Performance Alliance logo

Previous work by BIM-EPA partners has confirmed, through the achievement of measurable, positive results, the advantages of BIM as an improved enabler of higher levels of sustainable energy in buildings, when compared to traditional methods. They have also developed and showcased training programmes to upskill the construction sector workforce in digital construction (inc. BIM) using holistic approaches to reduce energy use and sustain lower emissions.

A number of BIM-EPA partners are also members of the New European Bauhaus initiative which “connects the European Green Deal to our daily lives and living spaces” [14]. This helps guide the alliance’s work to achieve positive impacts and cultural change toward enabling Europe to be “a leader in the circular economy” [15].

The alliance has a stated intention of delivering a pan-European, virtual Centre of Excellence (CoE) for Digital Construction, that will make existing and developing tools, teaching content, and blended materials widely available to stakeholders across the built environment. The Digital Repository will be the core of the Centre from which a range of services can be delivered to the industry in support of the energy transition. The alliance has 5 specific focus areas:

1. improved achievement of energy targets and savings resultant from ongoing utilisation of the outputs of previous projects, particularly in collaboration between projects and partners.
2. cross-project dissemination and communication to amplify messaging and improve impact across Europe.
3. connected recognition, accreditation, and certification of micromodules, modules, and awards.
4. exploitation of the outputs from previous projects through collaboration and cross-advancement.
5. Identification of, and action towards, future collaboration opportunities.

The alliance is closely connected with built environment actors across the full supply chain, including governments, local authorities, municipalities, public and private clients, contractors and sub-contractors, consultants, craft workers, and unskilled labours. These connections enable identification of skills gaps in respect of particular energy transition interventions (e.g. Expert Group on Future Skills Needs 2021)), including in respect of agreement on the EU’s Renovation Wave Strategy in 2020, which resulted in the revision of the Energy Performance of Buildings Directive in 2021 [17][18].

The skills required to enable this Renovation Wave are captured within relevant EU, national, and local policy and include the introduction of certification schemes to support the development of new competencies, which will, in most cases, be absorbed into existing profiles or roles within the sector. The adoption of new competencies at professional levels is strongly supported by relevant professional bodies and representative groups leveraging their Continuing Professional Development programmes and education programme accreditation requirements to deliver necessary changes in behaviour [19]. For example, since its 2021 signing of a Surveyors Declare – Sustainability Declaration, the Society of Chartered Surveyors Ireland requires recording of CPD against a tool called ‘*My Sustainability Journal*’.

However, achieving the same impact among non-professional construction workers is a greater challenge. The alliance’s purpose focuses on these hard-to-reach but essential and numerically greater groups. This stems from the alliance’s origins with the BUILD UP Skills initiative’s calls targeted at “*blue collar*” and “*no collar*” workers and the ERASMUS+ programme, which has a track-record supporting vocational education.

Additionally, the alliance’s training and upskilling target audiences include those with existing experience but limited formal recognition of those skillsets. This lack of recognition creates barriers to mobility and limits opportunities for individuals. At a systems level, the absence of formal arrangements for mutual and pan-European recognition reduces the ability of countries and regions with surplus work to avail of skills developed and available in other jurisdictions.

As the Renovation Wave moves across Europe, there will be an increasing reliance on worker mobility to meet demand. The alliance recognises that vocational and lower-skilled workers respond better to task-based, bite-sized, and micro-module learning where there is dynamic engagement that empowers the learner to both higher achievement within an individual learning opportunity and to be more encouraged to undertake additional upskilling as a

result of positive outcomes from each separate occasion.

Authors including Brown and McCracken and McAuley et al. identified a range of barriers to the uptake of available upskilling such as fear of failure, perceptions of the value of training, and previous experience. The projects described in the following focus on delivering a positive experience of high-value upskilling, where learners feel supported both in their training experiences and in their personal learning journeys [20][21].

Two specific projects undertaken by BIM-EPA partners are described in the following.

a) *arISE Digitalisation - a vital enabler of Net Zero Construction*

The ARISE consortium led by Belfast Met received a grant of € 1.12 million from the Horizon 2020 work program: Building a low-carbon and climate-resilient future: Safe, clean and efficient energy, as part of the Call: Increasing Market Demand for Sustainable Energy Skills in the Construction Sector. Alphabetically in English, the project's nine partners are: The Architects' Council of Europe, Belfast Met, Bouwt ann Verandering, Copenhagen School of Design Denmark, iBIMi Building Smart Italy, Institute of Research in Environment Civil Engineering and Energy North Macedonia, ISSO Netherlands, Technico Lisboa Portugal, and TU Dublin Ireland [21][22].

The ARISE project has the ambitious global goal of revolutionizing *"the learning process by changing both delivery and recognition of sustainable energy skills in the construction sector"*. The intention is to develop and implement a unifying method for the recognition of competencies on digital and energy construction skills in Europe via a digital skills passport (Figure 2). The project has the twin targets of creating stimulus and providing adequate, widespread upskilling actions to ensure that digital and energy construction skills are market *"currency"*. These outcomes are critical to programme two of BUILD UP Skills where the focus is on demand creation as well as meeting needs nationally and across the continent.

ARISE recognises this symbiotic, self-generating loop between Need, Offer, and Demand (Figure 3). Therefore, to stimulate the Demand, ARISE will emphasize the need, while also increasing the offer, by establishing a common-knowledge baseline and specific specialised skills to individual construction professionals. Increasing requirements, competencies, and applicable skills in digital construction, big data, and BIM to specifically support sustainability and energy transition trends in the construction sector will be a priority.

The project is developing, testing, and delivering a widely recognisable Framework for Europe for a continuous professional development (CPD) scheme. It will be assisted by the development of an online delivery platform to support a set of various direct actions. The combination of the framework/training scheme delivery and auxiliary direct support actions to construction sector target audiences, together with the platform, format, and accreditation type, will influence and raise demand for sustainable energy skills.

Specifically, the project will leverage Blockchain technology to remove the friction and blockages from individuals' learning journeys in developing an open, competency-based qualification scheme. It will create a "cryptocurrency" of skills and learning in the digital built environment, activated by blockchain technology to ensure trust in the awards gained by a learner. Called "CERTcoin", the currency will be a digital asset designed to stimulate engagement and quantify skills development and learning. CERTcoin is a model for providing professionals and workers with a mutually recognised, comparable, and accepted *"tender"* advantage for their skills, to enhance their employment while raising the standards and demand across the construction sector. This system will be based on a digital maturity ranking method to measure the level of skills and to account for and record CPD learning through micro and macro transactions.

Learners will engage with a mobile-friendly gamified platform which rewards the achievement of specific learning milestones. Bringing learning to the gemba. Japanese for "the real place" and used in Lean practices to represent "the workplace" has been shown to achieve high quality results in vocational learners) [23][24]. Initially, the platform will recognise successes with points and digital badges. These can then be sent as CERTcoin currency to the blockchain network, which will allow a large European repository for recognition and certification to be created.

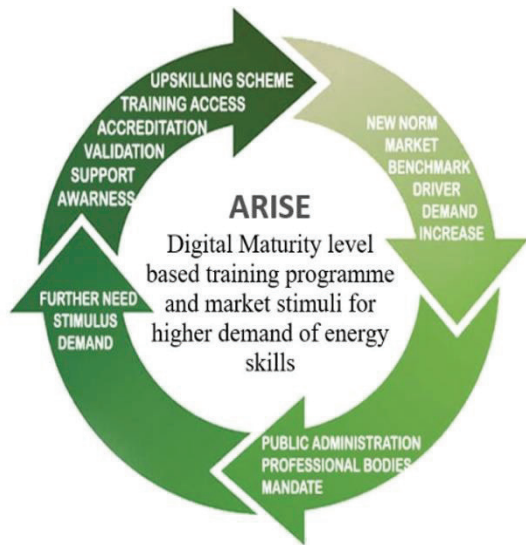


Figure 2. ARISE Push & Pull, Demand Driver Approach

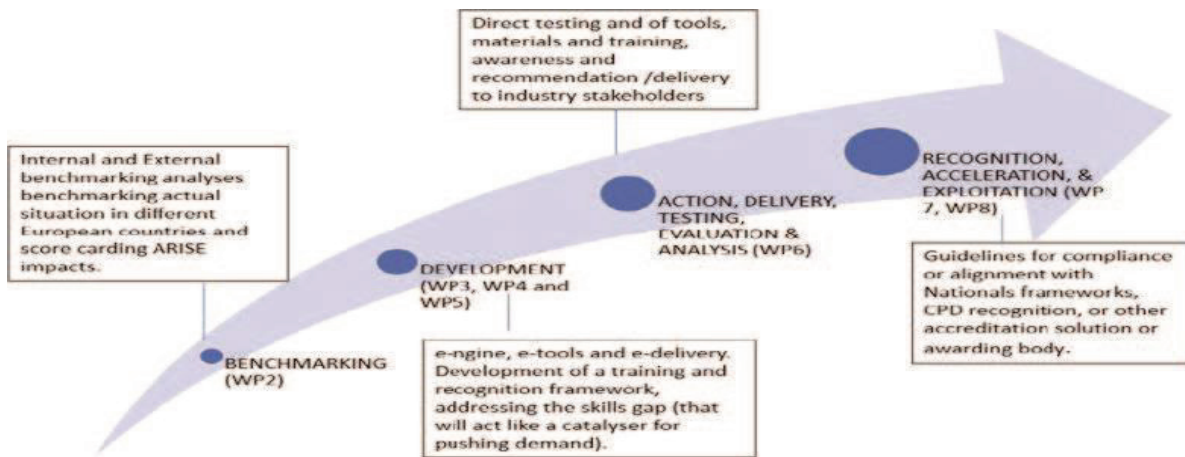


Figure 3. ARISE methodology

In alignment with the project schedule, pilot testing has not yet commenced with industry partners since international benchmarking and tool development are not sufficiently complete. The outcomes are expected to demonstrate how digitalisation can be harnessed to stimulate and empower all workers to reach their full potential; how micro modules, segmented accreditation, and digitalised individual learning accounts can provide accelerated access to further education; and how a dual pathway of reward through exchange of certification and/or recognition will increase vocational mobility and opportunity supporting sectoral energy transition.

Results will be published once available on the project’s website with dissemination through the BUILD UP Skills network and tools.

b) *BIMcert*

BIMcert was a Horizon2020 project funded to €1.16m under the Work Program for Clean, Secure and Efficient Energy, led by Belfast Met, with project partners Construction Industry Training Board Northern Ireland, Energy Institute Hrvoje Požar Croatia, Future Analytics Consulting Ireland, Institute of Research in Environment Civil Engineering and Energy North Macedonia, Technico Lisboa Portugal, and TU Dublin Ireland. The BIMcert project team was supported and guided by an active group of industry partners including O’Hare McGovern Architects, Belfast and Civil Engineering Institute Macedonia [25].

The BIMcert project developed a blended, fully supported suite of Building Information Modelling training curriculum and tools, which allows geographically dispersed construction project teams to use technology to enhance information exchange

and collaboration. The project focused on testing the BIM approaches to green and passive building design to contribute to improving energy efficiency.

The program content was developed in a accessible open format allowing middle managers, blue collar workers, and other work tied industry personnel to access the training and accreditation at times and locations of their choice in order to increase their BIM skills, utilise these in their work increasing energy efficient construction and improve their skills/employment mobility.

A state of the nation survey across partner countries revealed barriers to digital adoption in support of energy upskilling of: fear of breaking something (that was working sufficiently well); not understanding terminology, need, and potential; not having time to learn; an assumption that this method was for others; logistical issues including aspects of personal mobility; and a challenge of understanding the personal benefit of upskilling or reskilling.

The project examined a wide range of potential tools and methods through initial surveys. These

included Problem/Project Based Learning, Narrative Videos, Guided Self-Study, Mastery Learning, Scaffolding, Case Studies, Instructor-led Tutoring, Active Learning, Flipped Classrooms, and Role Playing. While a preference emerged among respondents to the survey for instructor-led tutoring, the same respondents typically also identified a challenge of being time-poor. To address this contradiction, BIMcert focussed on creating a pool of resources that supported flipped classrooms (i.e., self-guided learning by students with support from narrative videos and problem-based learning activities before engaging with tutors in a more traditional classroom-based setting). However, these materials could equally be used by tutors where time for training was less constrained.

The project undertook extensive testing in workshops in each partner jurisdiction with groups of students of differing qualification levels and at different stages on their learning journeys. The above assumptions in respect of pedagogical tools were validated in these industry works. This enabled the project to develop a “*beyond blended*” approach to learning which connected digital and face-to-face modes of delivery of bite-size learning units with flexibility in respect of just-in-time delivery combined with tutor-led sessions. To motivate learners and support bite-size integration into connected pathways, the project created a gamified, digitally badged system of support and assessment

Each module can be taken independently or can become part of a supported learning journey connected as a Training Plan where dependencies between learning in modules are managed through in-system assessments.

O’Hare McGovern (OHMG), a leading architectural practice in Northern Ireland and an associate partner to the project, trialled BIMcert’s modules and Training Plans as part of their BIM Plan to upskill 27 staff to UK Qualification Level 3 and six managerial and leadership staff to Level 4. Particular focus was placed on BIM for Cost Control and in respect of co-ordination and collaboration between office and field aspects of construction. Implementation of BIM on 6 projects, supported by training through BIMcert, resulted in improved collaboration and higher quality of finished buildings. OHMG reported “*improved whole life value to our clients*” and the ability to achieve a “*seamless flow of structured data between the project delivery team and stakeholders*”. Associate partners in each of BIMcert’s active jurisdictions, for instance Civil Engineering Institute Macedonia, achieved similar results, supporting workers at all levels in respect of skills development and demystification of BIM terminology and practices.

BIMcert’s survey and workshop activities enabled engagement with over 5000 industry supply

chain participants where learning tool selections were verified, and content improved in support of improved learning. More detail on the achievements of these engagements is available in (McAuley et al. 2020). Figure 4 consolidates the results of BIMcert in infographic form:

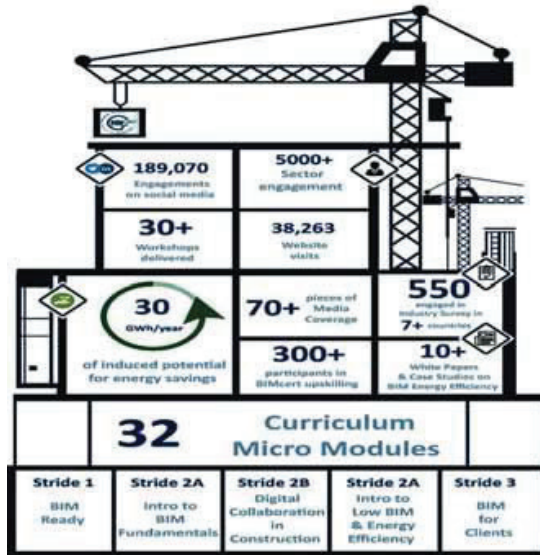


Figure 4. BIMcert results and achievements

IV DISCUSSION

The two projects presented above demonstrate the potential for practical, bite-sized, and authoritatively recognised training programmes to support the upskilling of the construction supply chain in respect of the global energy transition required over the next three decades toward a zero carbon Europe in 2050.

However, EASAC has identified a requirement for the creation of 3 million more jobs “*to deliver new and renovated buildings with nearly zero GHG emissions*” [7]. To enable this scale of recruitment and associated upskilling, reskilling, and initial training, a number of step-changes are required, particularly at systems level. Some potential target activities, which can build on the successes of projects such as previously described, are identified in the following.

a) *Increased construction supply chain engagement and participation*

For many construction supply chain participants, the challenges associated with energy transition are not yet sufficiently real or relevant to their day-to-day activities. For instance, the Irish Central Statistics office reports that 98.4% of construction companies employ fewer than 50 persons and 92.8% of enterprises comprise fewer than 6 persons. At these small scales, while organisations should have the agility to respond to new market requirements, this type of innovation is frequently not possible or

rewarded because of systems-level barriers. Even where opportunities are identified and small organisations wish to respond, difficulties are frequently experienced regarding upskilling related to available time and finance, both for direct training and for associated infrastructure investment.

Innovation Programmes

Supports available from various national initiatives and inter-regional agencies seek to address these requirements and enable better and more widespread responses. For example, the Irish Government has provided the Build Digital Project with a grant of €2.5 million over 5 years as one of 7 priority actions implemented by the Construction Sector Group's Innovation and Digital Adoption Sub-Group. The Build Digital Project is intended to transform the Irish construction and built environment sectors by enabling all stakeholders, particularly SMEs, suppliers, and clients, to develop, maintain, and continuously improve their capabilities through digital adoption to support delivery of Project Ireland 2040, which includes achievement of Ireland's energy transition targets under the Climate Action Plan and the National Development Plan.

A key tenet of the Build Digital Project is the adoption of a bottom-up approach where the “*Voice of the Customer*” is heard and acted upon. The project has embedded over 50 industry members from across the breadth and depth of the construction supply chain into its Industry Steering Group and directly within the activities of its five pillars, two of which are Sustainability and Circular Economy and Education and Training [26]. The project is building an Exchange Hub for the sharing of best practice and support materials, which will, in turn, be used to deliver appropriate Education and Training into the sector at all levels using a network of vocational, further, higher, and tertiary education providers from across the public and private sectors, supported by professional bodies and funding such as Skillnet, Springboard+, and direct Government funding.

Innovation actions such as Build Digital connect government policy to representative groups to training and education and have significant potential as change agents in support of more widespread and sector-impacting adoption.

Clustering

Additionally, the power of clustering as a mechanism to increase collaboration and co-petition between organisations, particularly SMEs, with shared challenges is being recognised and financially supported by governments and their agencies. Construction Cluster Ireland was established in 2021

through funding from Enterprise Ireland, the agency responsible for developing and growing Irish enterprises in world markets. One of its key activities focuses on supporting SMEs to understand and prepare for market changes created by policy change. The Cluster is connected to TU Dublin as its academic host to specifically support the upskilling necessary within cluster member companies in response to market changes. Greater participation by companies of all scales in clusters has the potential to be the mechanism through which the reskilling imperative is communicated and acted upon, with the potential for achieving better business outcomes and increased amounts of activity as the motivations.

b) Attracting workers

The issue of attracting workers has three particularly problematic aspects: school-leavers / new entrants; female participation; and aging existing workforce.

School-Leavers and New Entrants

Perceptions of the construction industry in respect of energy performance are low relative to other industries. This is one of a number of factors, alongside a perception of instability and low quality employment, that results in low recruitment into the sector from school-leavers, both into further and higher education, creating a skills shortage [17]. Increased schools outreach activities are capable of increasing the attractiveness of the sector as a career choice. The STEPS – Engineering outreach programme operated by Engineers Ireland and the 5*S - Space, Surveyors and Students – STEM and the Sustainable Development Goals (Cahalane et al. 2021) programme supported by Science Foundation Ireland's Discover Programme and ESERO [27], the European Space Education Resource Office, are successful examples of the impact of targeted initiatives that increase recruitment towards particular professions and sectors.

Attracting a female workforce

Depending on data being used, women comprise as low as 5.5% or as high as 20% of the construction workforce [28][29]. Attracting people from more diverse backgrounds, including more women, into the sector is critical to addressing skills shortages. The ability of projects such as BIMcert, ARISE, and Build Digital to highlight the increasing digitalisation and improved sustainability of the sector will be essential to achieving this goal. Additionally, specific projects aimed at increasing diversity such as the ERASMUS+ A-STEP 2030: Attracting Diverse Talent to the Engineering Professions of 2030 have also achieved success in highlighting the essential connection

between particular jobs and professions and the global need to achieve the UN Sustainable Development Goals [30].

Aging workforce

The US reports that workers aged 55 and over in 2018 represented 22% of the workforce, an increase from 17% in 2011 [31]. Similarly, in the European Union, the percentage of workers over 50 grew from 24.7% in 2011 to 31.5% in 2018 [32]. These statistics present challenges in maintaining existing knowledge, increasing on site risk and lost work days, and openness to change, upskilling, and reskilling. To counter the latter challenge, the BIMcert project's field trials with industry demonstrated success in delivering to mixed age cohorts by providing training that is just-in-time, on-site when possible (as per Health & Safety Toolbox Talks), with low technological barriers (similarities to everyday online usage was highlighted with learners), and with face-to-face supports at appropriate intervals during a learning journey.

Duplicating these learnings has the potential to enable workers over the age of 50 to maintain relevance and will support their employers in retention of corporate memory while also responding to current and future challenges. Further study is required to identify additional supports that can increase the effectiveness of reskilling for this older cohort. This is particularly necessary as worldwide governments seek to increase retirement ages and maintain current workers beyond traditional pensionable ages.

V CONCLUSIONS & LESSONS LEARNED

The activities reported in this paper highlight a number of successes in respect of upskilling for energy transition. However, the scale of impact currently being achieved through significant investment, particularly from the European Union, is insufficient to achieve the targets in the European Skills Agenda and required to address Climate Change requirements.

This paper has identified a number of opportunities that will leverage the learnings from existing projects to achieve greater impact, particularly regarding the numbers of upskilled and reskilled workers. Additional engagement is needed at systems level to ensure joined-up-thinking of the nature identified by the Horizon 2020 Call: Increasing Market Demand for Sustainable Energy Skills in the Construction Sector, through which ARISE has received funding. Only through mobilisation of a need – offer - demand loop will the construction sector rise to the challenge of reducing emissions and achieving an effective energy transition.

ACKNOWLEDGEMENTS

The authors would like to acknowledge Technological University Dublin and Belfast Metropolitan College, which collectively supported these projects, and Horizon2020 funding: ARISE - ARISE inspiring demand for sustainable energy skills, by providing clear learning interactions, transparency of upskilling transactions and recognition of qualifications achieved (101033864) BIMcert - the right path for BIM training (785155) EU Erasmus + A-STEP 2030 project funded under call number 2018-1-FR01-KA203-047854

The authors would also like to acknowledge the support of project partners within BIMcert, ARISE, BIM-EPA, Build Digital, 5*S, and Construction Cluster Ireland.

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