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Barry McAuley
Technological University Dublin, barry.mcauley@tudublin.ie

Avril Behan
Technological University Dublin, avril.behan@tudublin.ie

Paul McCormack
Belfast Metropolitan College, psulmvvotmsvk@belfastmet.ac.uk

Andrew Hamilton
Belfast Metropolitan Collete, andrew.hamilton@belfastmet.ac.uk

Eduardo Rebelo
Belfast Metropolitan College, erebelo@belfastmet.ac.uk

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Improving the Sustainability of the Built Environment by Upskilling SMEs in Building Information Modelling Through the Horizon 2020 BIMcert Project

Authors

Barry McAuley, Avril Behan, Paul McCormack, Andrew Hamilton, Eduardo Rebelo, and Sheryl Lynch

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Dr Barry McAuley
School of Multidisciplinary Technologies, TU Dublin
barry.mcauley@tudublin.ie

Dr Avril Behan
School of Multidisciplinary Technologies, TU Dublin
avril.behan@tudublin.ie

Paul McCormack
Belfast Metropolitan College
PaulMcCormack@belfastmet.ac.uk

Andrew Hamilton
Belfast Metropolitan College
AndrewHamilton@belfastmet.ac.uk

Eduardo Rebelo
Belfast Metropolitan College
ERebelo@belfastmet.ac.uk

Dr Sheryl Lynch
Future Analytics Consulting Ltd
sheryl.lynch@futureanalytics.ie

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Abstract

The construction industry consumes up to 50% of mineral resources excavated from nature, generates about 33% of CO2 present in the atmosphere, and is responsible for 40% of total global energy through construction and operation of buildings. There is a realisation that SME's perceived lack of innovation is causing a genuine concern in the AEC industry as they do not have the skills or tools required to help address these concerns. To assist in overcoming these barriers, a number of funding initiatives have been put in place through Horizon 2020 with a focus on BIM, due to it having the potential to rapidly produce energy outputs that enable design teams to analyse and compare the most cost-effective energy-efficient options.

One of these initiatives, the BIMcert project, aims to educate all areas of the supply chain in the use of BIM, to achieve better energy efficiency during the design, construction and ongoing maintenance of an asset. The goal is to develop more efficient and suitable training programme materials that integrate sustainability and renewable concepts with practical application by integration with technology. This paper explores the final phase of testing and the launch of the platform. It discusses how the developed training material assists in improving sustainability in the built environment by training its practitioners in an efficient and greener manner of design and construct through the BIM process. The paper also defines recommendations to target the broader skills gap agenda.

Keywords
Building information modelling, sustainability, education, Horizon 2020.

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1. Introduction

The construction industry is dominated by SMEs, with estimates considering that these organisations account for around 97% of all construction businesses throughout the EU (Gledson and Phonix, 2017). Given that the construction sector is responsible for one-third of global carbon emissions, one-third of global resource consumption, and 40% of global waste generated, it is imperative that SMEs play a pivotal role in decreasing these alarming figures (Balasubramanian and Shukla. 2017). Sustainability in practice is becoming increasingly more important for SMEs as they contribute to the green agenda and demonstrate positive engagement in order to win construction-related contracts or meet customers' criteria.

Whereas larger organisations have time, staff and financial resources readily available, SMEs don't have such resources and therefore sustainability measures are perceived as costly and time-consuming (Goddard et al., 2016). Moreover, SMEs are perceived to lack innovation, which is causing a genuine concern for the industry despite the potential to improve existing processes and technologies, thus leading to significant practical and commercial benefits (Gledson and Phonix, 2017). Innovations in relation to the digital transformation of construction are now seen as critical change agents for the industry that can offer effective environmental solutions in targeting the rapidly-changing climate and global energy crisis (Farmer, 2016 and Chen, 2018).

SMEs have the potential to benefit from digital construction more than large firms because of their stature. Smaller-sized projects with a short duration can result in higher implementation rates. Their speed in decision-making permits SMEs to develop and deliver practical technical innovations (Saka and Chan, 2020 and Hardie and Newell, 2011). Such innovations include Building Information Modelling (BIM), which can be described as a collaborative process in which all parties involved in a project use three-dimensional design applications where information is shared between stakeholders and managed throughout an asset's lifecycle.

BIM is now seen as the centre of the AEC industry's digital transformation agenda (World Economic Forum, 2018). More importantly, in the context of sustainability, BIM can be used to model buildings and sequentially perform multiple analyses, enabling energy performance predictions that compare design alternatives, thus allowing for an improved final decision (Sanhudoa et al. 2018). While energy simulations are used to evaluate the energy performance of building operations, emerging BIM technology is expected to facilitate building lifecycle performance simulation with predefined and enriched building information (Li et al., 2020).

For BIM to be successfully adapted within an SME, they will need to address several barriers to entry, such as access to finance, cultural change, inadequate levels of communication and information exchange, adopting technology, resources, construction project coordination, and bureaucracy (Carroll and McAuley, 2017). This is difficult, as construction projects frequently suffer from many problems such as low product quality and working efficiency, budget overruns, and substantial construction waste (Avelar et al., 2019). Vidalakis et al. (2020) warn that SMEs' knowledge in existing BIM support systems is particularly low, with monetary-related issues identified as the main barrier. Further to these, non-financial factors such as peer education, industry initiatives and effective leadership were highlighted as the most useful in facilitating further adoption.

Consequently, and to reach EU energy-related targets, a number of funding initiatives have been initiated through EU interventions, including FP7 framework programmes and Horizon 2020, with a focus on BIM to contribute to energy savings to enable design teams to determine cost-effective and energy-efficient options. One such initiative is the BIMcert project. This allocates resources on a platform, with a methodology to educate the supply chain in BIM adoption.

2. Energy BIMcert background

Horizon 2020 is an initiative by the EU Research and Innovation programme where €80 billion of funding was made available from 2014 to 2020. As part of this programme, the initial funding focused on supporting innovation through research by demonstrating energy-driven technologies and solutions. The BIMcert consortium, which comprises of industry and academia, is deemed expert in providing BIM solutions, skills, training and education to the AEC sector. This consortium is supported by a Technical Advisory Board comprising of stakeholders and external experts. The consortium put forward a proposal to develop a method, materials and micro accreditation for upskilling the AEC industry supply chain to adopt BIM techniques and technologies to address energy efficiency demands.

The aim of BIMcert is to develop efficient and pertinent training programme materials that integrate concepts of sustainability with practical application and technology, based on real-life industry needs and limitations. The BIMcert consortium consists of members from Northern Ireland (Belfast Metropolitan College and Construction Industry Training Board (CITB NI)); Republic of Ireland (Technological University (TU) Dublin and Future Analytics Consulting); Portugal (CERIS/Instituto Superior Técnico); Macedonia (Institute for Research in Environment, Civil Engineering, and Energy (IECE)); and Croatia (Energy Institute Hrvoje Pozar (EIHP)). The primary objectives of the consortium were:

1. Improve the sustainability of the built environment by training its workforce in more efficient and greener ways of designing and constructing through to use of BIM processes, better materials, products and energy sources;
2. Engage with the entire construction sector supply chain via BIM to develop more extensive European links and to encourage a system of peer support across states of varying maturity concerning to delivery of more energy-efficient new-builds and renovated buildings;
3. Encourage greater workforce mobility, continuous upskilling and to better employability for all levels of employee in the construction sector;
4. Create clear pathways of the development for individuals and SMEs to upskill from any starting point of knowledge to any required level of individual to collaborative expertise in support of sustainable energy-efficient construction;
5. Develop a pan-European framework for recognition and accreditation of BIMcert's micro-accredited learning modules that will

combine to build towards fully standardised skills recognition linking within existing national and European initiatives and frameworks of accredited courses and awards.

The consortium established a series of work packages which were conducted in five stages:

- **Stage 1 – State-of-the-Art:** An open approach to gather state-of-the-art information through direct engagement with project stakeholders across Europe to ensure that the skills gaps identified by SMEs about the implementation of BIM technologies and methods in support of improved energy efficiency in the construction sector are correct;
- **Stage 2 – Development:** Development of the BIMcert platform which enables users to access the BIMcert curriculum, support stake-holders' communication and collaboration, provide information about the project, and share BIMcert outputs in the longer-term;
- **Stage 3 – Testing:** The rigorous evaluation of the curriculum, the learning materials and the proposed platform. A total of three phases of testing were conducted;
- **Stage 4 – Accreditation:** Accreditation of the proposed BIMcert training units and courses;
- **Stage 5 – Exploitation and dissemination:** The exploitation and dissemination of the project through a broad-ranging outreach campaign.

These work stages ran in parallel and were critical to each other's success. Research papers by McAuley et al. (2019a&b) focused on testing at Phases 1 and 2, and will be discussed in the next section to provide context on how and what pilot materials were created. The remaining part of the paper focuses on the final test phase and the launch of the platform.

3. Consortium jurisdictional overview

The maturity of BIM adoption across partners' jurisdictions varied significantly. CITB NI conducted a survey in the five countries which yielded 548 responses. To validate the findings, five workshops with stakeholders took place between 2nd - 6th June 2018. These were applied to gather supplemental data to cross-reference with the survey results. The workshops were open to the industry, and representatives of the advisory partners were encouraged to attend. The results found that all respondents recognised that BIM training is required at all levels within their respective practice. The survey findings indicate that 57% of respondents have received no formal BIM training, although 61% use an element of BIM. The main challenges identified from the survey and reiterated at the workshops were identified as (a) the lack of BIM skills (46%), and (b) the lack of client awareness of the value of BIM (43%).

Based on the workshop consultations, BIMcert coordinators noticed a discrepancy between industry knowledge and enthusiasm for adopting BIM. The results indicated that Government encouragement for BIM adoption, particularly within the UK and the Republic of Ireland, was a strong motivating factor. A lack of Government endorsement within Macedonia, and to a lesser extent Croatia, resulted in their AEC industry facing similar concerns to the aforementioned.

The lack of BIM maturity across Europe, and especially some of the partners' jurisdictions, informed the consortium that for potential users to understand how BIM is used for energy-related purposes they would need a fundamental understanding of the core principles, as well as knowledge of how to access information for review purposes. Furthermore, these findings influenced the consortium in its selection of training courses for practice development.

3.1 Development and testing of material phase 1 and 2

A state-of-the-art literature review of the current global status of BIM regarding education and applicable pedagogical methodologies to deliver these courses was performed in parallel. The survey and workshop findings were aligned with the results from the state-of-the-art literature review, where it was found that the most suitable pedagogical approach would involve a scaffolded learning environment guided by a series of instructor-led live lectures. This could be complemented through problem-based learning, design for disassembly, and guided self-learning, which would create an active learning environment. Different teaching approaches included narrative videos and live lectures, with a focus on engaging students in self-guided study through problem-based learning before they advance.

The initial findings for the proposed training courses and methodologies were tested through a series of reality check workshops as part of Phase 2. The inherent outcomes from the workshops resulted in the established final training descriptors, including learning outcomes, syllabi, methodologies and delivery details.

The consortium members decided that the optimum path was to divide the development of the curriculum into three strides. Figure 1 identifies the initial units and courses that best reflect the needs of the industry. The learner initially accesses the BIMcert portal and will be presented with one of two options. If the learner selects Option A, they must take the BIM Ready training unit plus online assessment. If the learner has prior knowledge of BIM, they can choose Option B, which will enable them to take the online assessment without enrolling in the training unit. Successful completion of the assessment, in either case, grants access to Stride 2.

It was agreed to divide Stride 2 into three sections. Within Stride 2A, learners can select many stand-alone units that will introduce them to BIM principles, digital skills and modelling techniques. Stride 2B represents units aimed at those more experienced BIM users who wish to advance their knowledge in BIM, e.g., interoperability, collaboration processes, etc. While learning outcomes have been developed for these training units, it was not feasible for the BIMcert consortium to develop these any further during the Horizon 2020 project.

Stride 2C offers learners the choice of one or more courses, each consisting of a series of units. Each unit within a course represents a specific learning outcome (LO). This LO/unit will be offered as an individual micro-size training option to ensure the BIMcert can attract learners who require specific areas of knowledge but do not have the time to complete a standard unit (Stride 2A and 2B) containing a series of LOs. After completion of all units associated with the course, the learner will receive a higher award. Learners can take advanced units once they complete the relevant Stride 2C course units, i.e.,

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Advanced BIM & Energy Efficiency. As with Stride 2B, it is not the intention of the consortium to develop all courses in this stride.

Stride 3 is a more discipline-focused stride representing current specialisations of BIM usage, tools and concepts. The range of units can be expanded or adjusted in the next stage of the BIMcert project in response to market needs.

Phase 2 testing comprised a total of five trial workshops, which were held across the partner jurisdictions (Republic of Ireland, United Kingdom, Croatia, Macedonia and Portugal). These workshops were hosted on partner city bases and online. A variety of material from a selection of LOs from the BIM Ready (Stride 1), BIM Fundamentals (Stride 2A), BIM Principles (Stride 2A), Digital Skills (Stride 2A) and Introduction to Low Energy Building Construction Course (Stride 2C) was developed for testing. The BIMcert consortium selected these learning units as they have the potential to promptly impact a significant number of practitioners across Europe.

In addition, the material could be delivered by instructor-led live lectures, which would allow the lecturer/trainer to engage with the participants. The intention was to develop learning material that could be used for guided self-learning and gain insight into how potential users would interact with this material. The workshops targeted both novice and groups of practitioners *au-fait* with BIM, including designers, architects, engineers, contractors, policymakers and professional institutes. The over-arching purpose of the workshops was to establish if the pilot material was adequate to meet the AEC industry's needs.

A total of 140 attendees across the five cities participated in testing the pilot material. It was agreed to host this pilot material on the BIMcert webpage (https://energyBIMcert.eu), where attendees completed an evaluation form to provide feedback on the training material. The workshops took place from January to April 2019 in the five key stakeholder jurisdictions and were led by Future Analytics Consulting (FAC). While the delivered material was generally well-received, some pertinent comments were recorded from each workshop.

The key findings from the workshop in Macedonia indicated that there should be a correlation with relevant national standards for construction and energy efficiency which could be a basis for BIM adoption. The training materials presented were found appropriate and legible. However, dividing the material into smaller learning units was suggested. A number of attendees recommended enriching the learning content with more information on BIM in the context of energy efficiency by presenting a prototype case study.

In Croatia, the attendees requested more information on real case studies, BIM objects, libraries, a focus on how to extract data from BIM models, and more interaction and time with the lecturers.

In Ireland, where BIM is more mature, key comments included the need for more practical application on materials. Other suggestions included reducing the learning scope and content to attract blue-collar workers and skilled tradespeople.

In Portugal, there was a request for material that focused on standards related to the organisation and digitisation of information for buildings and civil engineering works, including ISO 19650, case studies, and with more information on certification pathways, as well as the use of interactive tools such as Kahoot or other interactive mediums via the BIMcert platform.

Furthermore, the UK workshop found that material should be more practical in terms of how BIM will improve the workflow, reduce text on slides, and explore how BIMcert could be used for continuous professional development (CPD) points.

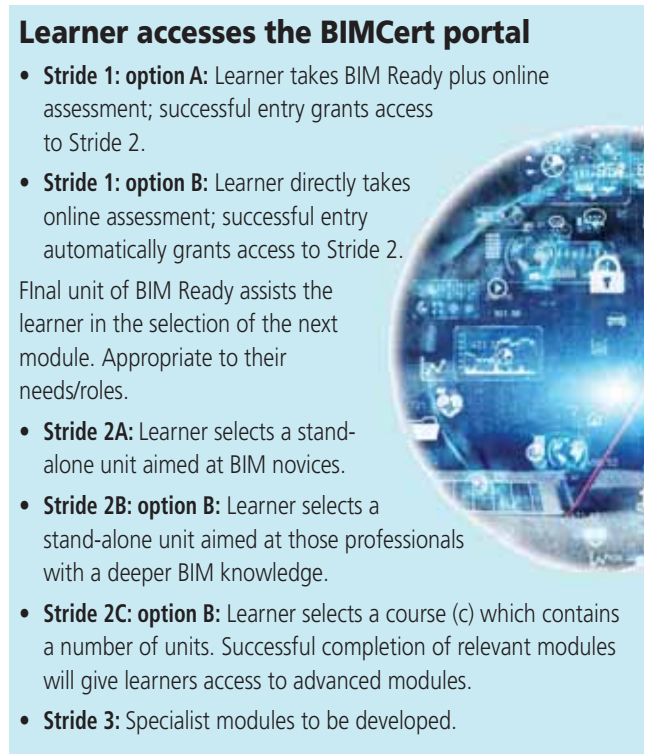

Figure 1 – BIMcert Learning Pathway.

4. Development and testing of material – Phase 3

Based on the workshop findings, each partner refined their material. An agreement was reached that the LOs would be established as individual training modules which would be linked to an overall training plan, i.e., a Complete Unit. In addition, applying shared LOs across a number of training units provides further incentives for the users whereby they can select a single LO instead of being constrained to complete a whole training unit. This methodology was agreed based on the functionality of the platform.

4.1 Training material developmentT

One of the key requests from the pilot workshops was for material to be "bite-size and shorter learning sections". To achieve this, an agreement was reached to break the LOs into the bite-size offerings, as outlined in Table 1. To deliver the bite-size training while satisfying the workshop findings, narrative videos with guided self-learning elements were created for all submodules.

Other learning methodologies included creating sub-pages on the platform which contained educational information. Each sub-page included blended multi-media resources such as researched materials, videos and links to education sources. The "book function" on the platform also enabled the creation of multi-page resources in a book-

like format which generated an automatic table of contents for ease of navigation. Other modules contained structured coursebooks, complementary tutorial videos to create a building energy model, and presentations to demonstrate how BIM is applied for calculation and optimisation of energy consumption.

4.2 BIMCert platform

The BIMcert platform was designed to be user friendly, with a clean and modern interface that can be used on mobile devices to engage with the entire supply chain. while enabling participants to achieve the appropriate qualification level. In addition, the platform is based on a well-known and tested framework (Moodle) which allows consistency, flexibility, and adaptability to different user needs.

Prior to uploading the material onto the training platform, the BIMcert team agreed on a standard template for each module, which is linked to a training plan whereby the user can see the relevant modules. All modules were presented by an image and a brief description with a "learn more" link, as illustrated in Figure 2. If the user selects the "learn more" option, this opens a more detailed understanding of the module and contains a rationale for this module's importance and what the learner will gain. It also provides information on what training plan the module is linked to and what modules should be taken before this one.

The time to complete the modules is also detailed in this section, i.e., a combination of the length of the lesson as well as the expected guided self-learning hours required. The user will then have the option to enrol in this module, as illustrated in Figure 3 for the BIM Dimensions module. Once the user is validated to the module, they

Module	Description	Training Plan
What are BIM (Maturity) Levels?	This module provides an understanding of BIM maturity levels and how they impact professional workflows.	BIM Principles
BIM Terms and Definitions	This module explains and provides an understanding of the essential BIM terms and definitions, allowing learners to start navigating the BIM jargon.	BIM Principles
BIM and Digitalisation Benefits-Overview	This module provides an overview of the benefits of BIM and digitisation to the AEC industry.	BIM Principles
BIM Dimension	On completion of this module, learners will be able to explain key terms and definitions within BIM, specifically BIM Dimensions.	BIM Principles
Intro to BIM tools for Low Energy Building Construction	This module enables the learner to develop a fundamental understanding of how BIM can be used as a digital enabling tool/ to help the AEC industry and professionals to reduce energy losses.	BIM to achieve Low Energy Buildings – Introduction
Energy system thinking key principles	The module provides an understanding of sustainable and energy-efficient design, construction, and operation principles of buildings and how they are applied in construction practices.	BIM to achieve Low Energy Buildings – Introduction
What is BIM and digital construction?	This module provides the learner with an understanding of the context and essentials of BIM and its role as an enabler for energy efficiency and a tool to address climate change.	BIM Principles
Intro to BIM Implementation – Impacts in project delivery	On completion of this module, learners will be able to explain the impact of BIM Maturity Level 2 requirements for project delivery.	BIM Principles
Digital Skills – Accessing information through the cloud	This module explains how to use cloud-based platforms to access and exchange information.	Digital Skills
Digital Skills – Accessing information through Portable devices	This module explains how to use portable devices to access and exchange information.	Digital Skills
Digital Skills & Collaboration I – and File Structure	This module provides a focus on ICT file management. As well as an understanding of the technological requirements for BIM implementation, especially in relation to Common Data Environments.	BIM Principles and Digital Skills
Digital Skills and Collaboration II – CDE Access BIM Models	This module explains how to use cloud-based storage and portable devices to access and exchange information. This module combines the Digital Skills – Accessing information through the cloud and Digital Skills – Accessing information Portable devices modules into one large module.	BIM Principles and Digital Skills
Digital Skills and Collaboration III – review BIM models	This module provides an understanding of how to use digital design review tools to access and evaluate a BIM model.	Digital Skills

Table 1 – Module details and associated training plan.

Figure 2 – BIMcert Interface: All modules were represented by an image and a brief description with a "learn more" link.

are presented with a number of sections to complete the module with an explanation of the key LOs, access to material, external links, and self-assessment review.

Each of the modules concludes with an assessment to ascertain if the user meets the intended LOs. The assessments are selected on the recommendations from the pilot workshops, including international best practice. It is essential to have a different range of assessments to meet the needs of different user types. The assessments include multiple-choice quizzes, tests built into the tutorial videos, guided self-learning assessments, and interactive illustrated puzzle games (Figure 4). The variety of assessments available ensures that the end-user is tested and engaged throughout the use of the BIMcert platform.

4.3 Phase 3 testing and results

To increase accessibility and participation for practitioners and academia, it was agreed among the partners that the subsequent workshops at Phase 3 would be hosted online, where trainees could also access the BIMcert platform easily. The flexibility of the delivery approach enables trial participants to engage with the platform by registering to enrol for modules via laptops or mobile devices anytime, anywhere. The webinars permit participants a first-hand experience to use the training platform whereby they can access the BIMcert training materials in the form of modules and training plans.

The rationale for choosing a webinar is to reach out to a diversified audience and encourage greater engagement from different jurisdictions through virtual connectivity. Users were provided with the opportunity to seek clarifications on content, assessments and learning materials with BIMcert experts over a "virtual face-to-face". Furthermore, it was decided to have "Practitioner Pop-Ups" for skilled tradespeople interested in understanding the BIM process. This resulted in a three-point approach where engagements were conducted separately for "trainers", "trainees" and "skilled tradespeople".

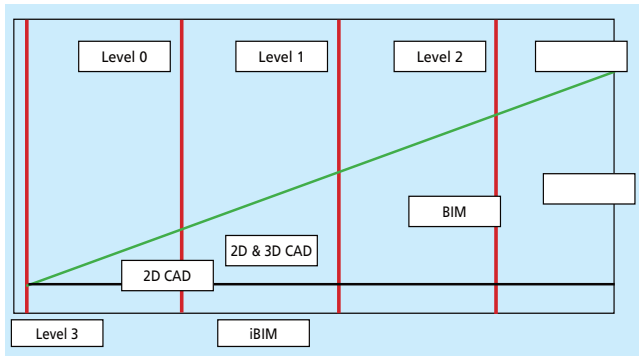

Figure 4 – Illustrated game puzzle, self-assessment.

Figure 3 – Module Breakdown: BIM dimensions image.

The goal of the BIMCert project was to improve the sustainability of the built environment by training its workforce in more efficient and greener means of designing and constructing through the use of BIM processes. The final test proved that this had been achieved, whereas practitioners were provided with tools to support their learning paths through a micro-modules approach. The material assisted in upskilling the AEC industry supply chain by offering just-in-time training through a wide selection of training options to suit their needs. These micro-modules afford SMEs an opportunity to demonstrate to clients that they have fundamental capabilities to work in a digitally-focused environment with sustainability in mind.

The outcome of Phase 3 indicates that the developed material permits users to advance through learnings at their own pace, thus satisfying their individual ambitions and learning curves. This creates a clear path for practitioners and SME professionals. Figure 5 illustrates the key outcomes from the BIMCert project, capped by the achievement of engaging with over 5000 practitioners throughout the supply chain.

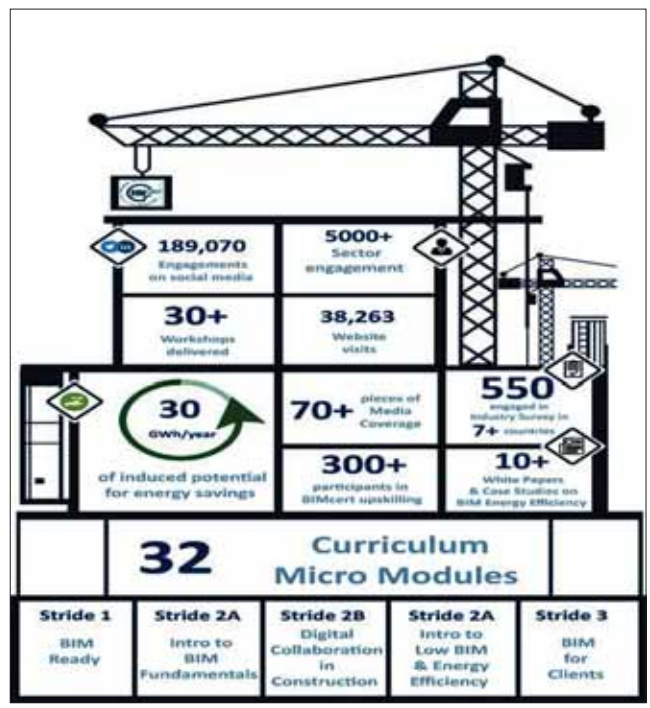

Figure 5 – BIMCert results and outcomes.

5. Potential impact for the UK and Ireland

While the consortium members of Croatia and Macedonia have a much-needed resource for their respective AEC sectors due to low BIM maturity, the other three members (Portugal, Ireland and UK) have an upskilling tool that further helps drive digital construction uptake within SMEs and education providers.

With regard to Ireland, the current COVID-19 crisis has seen organisations accelerate their digital agendas, thus enabling them to realise the relevant benefits that digital tools offer. Ireland already has a wide range of training solutions from HEIs and software providers, as well as industry roadmaps (National BIM Council Roadmap to Digital Transition 2017 – 2021), CPD events, an internationally-recognised conference (CitA BIM Gathering), certification routes, e.g., NSAI ISO 19650 accreditation, as well as templates and guidance documents i.e., the Royal Institute of the Architects of Ireland BIM Pack and Construction Industry Federation Guides. These are all complemented by a broad selection of government reports that endorse BIM (McAuley et al., 2020).

However, there is still no mandate in place, which leaves a critical lack of funding to provide guidance and training resources for SMEs. The BIMcert platform offers a potential vehicle to meet the training needs of underfunded SMEs.

The UK has invested heavily in digital construction with the Centre for Digital Built Britain, which is funded as part of the HM Government's recommendations in the 2017 Autumn Budget by up to £5.4 million. This enabled it to launch initiatives such as "Delivering a Digital Built Britain", a request for feasibility studies, research projects, or experimental development projects ranging in value from £50,000 to £250,000. Other initiatives included an £18 million funding released by the UK Research and Innovation Department in 2019 to transform the construction industry through digital technology.

Regarding BIMcert, it holds the greatest potential within Northern Ireland, as BIM resources, especially for SMEs, are still a key gap. The BIMcert platform has been aligned to the Open College Network (OCN) Northern Ireland, a recognised UK awarding organisation based in Northern Ireland. This has enabled the successful upskilling of a selection of SMEs in Northern Ireland who have gained awards from both BIMcert and OCN NI.

As part of the findings from the final round of testing, the BIMcert team released a set of recommendations to assist with targeting the broader skills gap agenda. These recommendations included:

- Incentivise energy efficiency, e.g., including energy criteria as part of pre-qualification in tenders;
- Standardise BIM curriculum, i.e., introduce a Pan-European BIM Passport and guidelines for CPD vocational mobility;
- Mandate BIM locally, i.e., localise via National Action plans and legislate for State buy-in / public procurement accordingly;
- Utilise platforms such as BIMcert, which offer bite-size micro accreditations.

A key enabler to facilitate BIM upskilling is to promote training curriculums. National skills agendas set locally should also include comparable skills which are recognised across boundaries. As outlined by Sutherland (2019), the Head of Sector, EASME European Commission: *"We don't all need to know absolutely everything, but we need to pick up the elements of knowledge that are relevant and can be used to facilitate BIM upskilling"*. The key ideology is to facilitate BIM upskilling within the broader agenda of digital skills to enable the imminent transition, which is essential to the industry's decarbonisation and to achieve positive climate action.

6. Conclusion

Facilitating BIM upskilling is recognised as an instrument to contribute to the European Green Deal by ensuring that the project life-cycle and costing analysis have a sustainable growth agenda for the future by using digital technologies. By association, promoting transferable skills via BIMcert is imperative in the AEC industry to instil digital transformation and for safeguarding a sustainable future for Europe. BIMcert has delivered flexible, iterative digital upskilling training to the entire construction supply chain by focusing on SMEs. This platform has offered an entry point for SMEs to begin their BIM journey, which can ultimately lead to increased productivity and guarantee better compliance with deadlines and energy targets, thus reducing cost and waste.

Further to this, this platform is accessible to participants globally for vocational education and remote blended learning access, which is critical during the current COVID-19 pandemic. The initiative has instigated change in standards and regulations in partner countries across Europe, especially those with low digitalisation maturity levels. The consortium's pan-European approach has provided international recognition to the BIMcert brand, which has helped its adoption within international jurisdictions. It also has the potential to influence and support policies and mandates and, by utilising real-world prototypes, to achieve better employability for all levels of employees in a greener, more sustainable construction sector.

The next iteration of BIMcert will be as part of the BIM Energy Performance Alliance (BIM–EPA) which will gather and link BIM modules, tools and materials from previous Horizon 2020 projects. This will enable the further development of a resource and skills recognition pathway that all stakeholders can utilise, deliver and stimulate.

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