BIMplement

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Introduction to the H2020 BIMplement project

Towards a learning building sector for enhanced quality control by setting up a qualification methodology integrating technical, cross-trade and BIM related skills and competences

ANA TISOV
Huygen Engineers and
Consultants,
Maastricht, The Netherlands
a.tisov@huygen.net

PETER OP 'T VELD
Huygen Engineers and
Consultants,
Maastricht, The Netherlands
p.optveld@huygen.net

JAN CROMWIJK
Stichting ISSO,
Rotterdam, The Netherlands
j.cromwijk@isso.nl

HENRI LE MAROIS
Alliance Villes Emploi,
Paris, France.
henri@lemarois.org

To improve the current situation and accelerate the rate and quality of nZEB construction and renovation, the European Commission took the challenge supporting several initiatives including H2020 Construction Skills funding schemes. This paper introduces the H2020 Construction Skills project BIMplement, explains its vision and how utilizing BIM to improve skills of different professions can lead to an improved quality and enhanced quality control over entire value chain. The overarching project goal is to achieve an improved quality for nearly Zero Energy Building (nZEB) construction and renovation by using BIM as a universal information carrier and enabler of the learning process within projects and between projects.

Keywords: Quality control, BIM, skills, competences and upskilling, qualification schemes.

Motivation

Given that about 75% of the EU building stock is considered energy inefficient and the energy use in buildings (residential and commercial) is responsible for about 40% of final energy consumption in the European Union [1], energy efficiency renovation represents a promising long-term growth possibility for the EU construction sector. Nevertheless, construction industry is seen as being relatively inefficient in both process and service delivery. There is evident gap between the designed level of energy efficiency and the level of energy efficiency realized [2] also due to a lack of built quality and skills gap. The construction sector suffers from a lack of skilled workers in general, while

energy efficiency renovations even requires additional competences and qualifications. According to the World Economic Forum, construction labor productivity has stagnated over the past 50 years [3].

This shows that nearly Zero Energy Building (nZEB) construction and renovation need an enhanced systematic approach for the quality control of the entire process. An enhanced quality control approach can only be achieved by a fully qualified and equipped workforce, capable to implement, execute and perform all the necessary actions with a full understanding of the responsibility of their own profession and actions, as well as the relation with the other involved professions and actions within the value chain.

Why to implement BIMplement?

With objectives to improve knowledge, skills and competences of all the relevant disciplines involved in nZEB construction and renovation, and create more collaboration between them, the BIMplement project was funded. The BIMplement is a 30 month-long EU funded project involving 10 partners from 5 different countries: France, the Netherlands, Lithuania, Spain and Poland which started in September 2017.

BIMplement origins - PROF/TRAC project

One of the first projects contracted under H2020 Construction Skills was PROF/TRAC: 'Professional multi-disciplinary Training and Continuing development in skills for nZEB principles' (2015–2018), www.proftrac.eu which is also the foundation for BIMplement. REHVA was one of the core partners in this project; moreover, four national REHVA members were involved in PROF/TRAC as national training providers (ATECYR, DANVAK, HKIS, TVVL).

The overall objective of PROF/TRAC was to develop a European training and qualification scheme as part of a life-long learning process for continuous development and up-skilling of professionals, aiming at middle and senior professionals with a higher education degree (white-collars). The collaboration in PROF/TRAC with European organizations like REHVA, Architect Council of Europe and Housing Europe turned out to be an important prerequisite for the implementation of the results as it appeared to be very effective both for endorsement and for a further European roll out as their national members can act as training providers.

BIMplement builds upon the PROF-TRAC project as also several BuildUp Skills projects (FR, NL, LT) where

these project's results and successes offer the necessary building blocks in training, CPD, methodologies for skills mapping (http://proftrac.eu/training-materials.html;) for all professions and for levels involved in nZEB skills.

BIMplement - the road towards an improved quality for nZEB in Europe

BIMplement engages further and tackles remaining challenge on how to make a major step forward in the implementation of these qualifications where BIM can offer the competitive advantage as an efficient management strategic tool and as such, gives an opportunity to implement results in a BIM-enabled workplace learning environment. This is done in a cross-cutting process that is:

- Cross-trade: with a multidisciplinary approach throughout the entire value chain of the buildings sector.
- Cross-European Qualification Framework (EQF) -level: addressing both blue-collar workers, middle and senior level professionals.
- Cross-time: by setting up a flexible qualification methodology so that new innovations and uses of technologies can be addressed.
- Cross-country: by setting up a mutual recognition scheme of qualifications among different Member States, but by leaving room for Member States specific roles and uses of technology
- Cross-value: by improved appreciation of the end user's needs including the quality of indoor environment (thermal and visual comfort, acoustics, air quality, etc.), in an improved operation and maintenance by closing the learning loop using BIM as information carrier.
- Cross-size: from SME to Enterprise, based on regional of local experience centres or BIM-Hubs.
- Cross-project: by using BIM as a learning environment, to facilitate and enable the learning flow.

In this way BIMplement paves a road towards an improved quality for nZEB construction and renovation by the following objectives:

- addressing the entire value chain of the building sector and the total construction process (from pre-design to in use phase);
- improving skills of professionals as blue-collar workers for nZEB quality (cross-trade & cross-level) via large scale trainings and continuous professional development (CPD);
- developing a flexible qualification methodology that is able to anticipate new products and processes (cross-time) in different countries (cross-country);
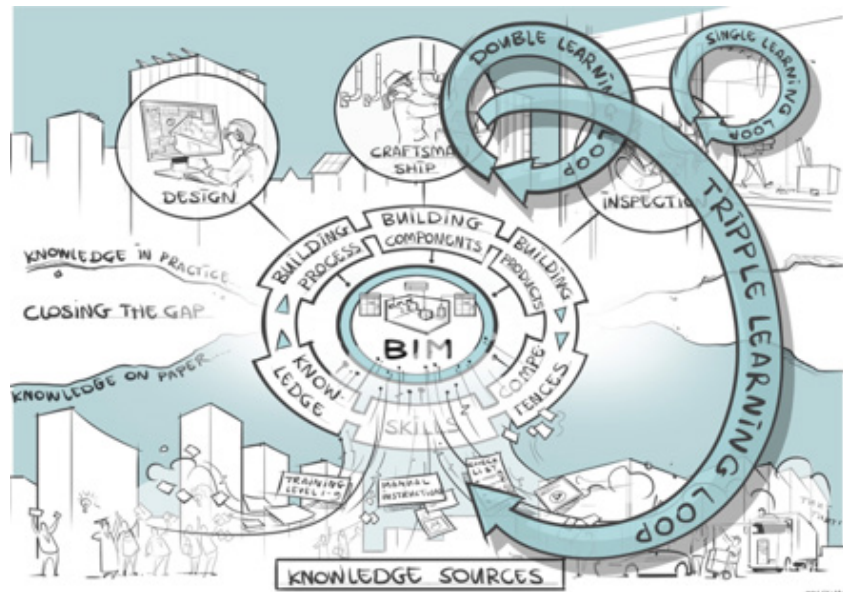- empowered by BIM and BIM enhanced workplace learning tools.

Figure 1. The BIMplement methodology aims to close the gap between the knowledge in practice and knowledge in paper by creating various learning and knowledge exchange loops, supported by adequate quality control.

Towards enhanced quality control over entire value chain by using BIM

The four BIMplement steps present a journey towards the upgrade of the quality of the work needed to meet nZEB targets.

Step 1: BIMplement methodology development with tools and learning content, using BIM as an information carrier

The project started with the development of a flexible qualification methodology to standardize the needed qualifications and a range of learning tools, to unlock and implement these qualifications. By using a systematic standardized approach, the mapped qualifications are to be transparent and comparable between EU member states, thus facilitating and providing EU mobility; robust and flexible (dynamic) approach for national adaptation. Also, as the evolution of technologies and materials is rapid, the methodology requires continuously reconsidering and updating our knowledge and skills.

BIMplement develops a general BIM-enhanced qualification framework (QF) structure and method to identify the different professions and professional levels for the specific crucial topics for nZEB technologies, concepts, products, as a function of the phases in the construction process. It is adaptable for blue and white collar-workers and professionals, with an implementation within existing learning tools and methodologies. This is based on PROF/TRAC Qualification scheme framework while utilizing BIM to connect the knowledge sources with the building process, building components and building products. The methodology building upon existing BIM process structures (CEN/TC 442 Building Information Modelling (BIM)) and existing classifications (e.g. IEC 81346 and ISO TC 59/SC 13/WG 11: ISO 16757 Data structures for building services product catalogues) where the BIMplement didactical task descriptions for the addressed technologies and components are then linked with suitable education material and trainings on a national level.

Step 2: Testing the methodology by implementing it for two specific areas: air-tightness and ventilation

To keep focus within the project itself, the testing of the methodology is dedicated to the implementation of ventilation systems and ensuring the air-tightness of buildings. As for the ventilation, there can be a didactical task connected with the BIM object or technology. Nevertheless, air-tightness is a more complex building application area as it is related to almost all the different building envelope components (transparent as opaque) as to joints application in-between. Therefore, air tightness should be assessed more holistically with objective to control air leakage and heat losses through the building fabric and at interfaces, joints & junctions.

Step 3: Pilots demonstration and validation

The objective of the BIMplement is to apply the methodology in 50 experimental sites (in NL, PL, LT, SP, FR) leading to upskilling 200 white collars and 1000 blue collars in 30–35 construction and renovation projects in France, and others each executing about 5 projects. The learning methods and the qualification schemes are connected to the projects defined in the pilot field labs and the experimental sites, this in order to improve the quality of the involved white- and blue-collar workers and thus, improving the overall quality of the construction process.

The methodology is implemented in collaboration with BIM-learning centres or national BIM experts where several objectives are to be achieved as presented in **Figure 2**.
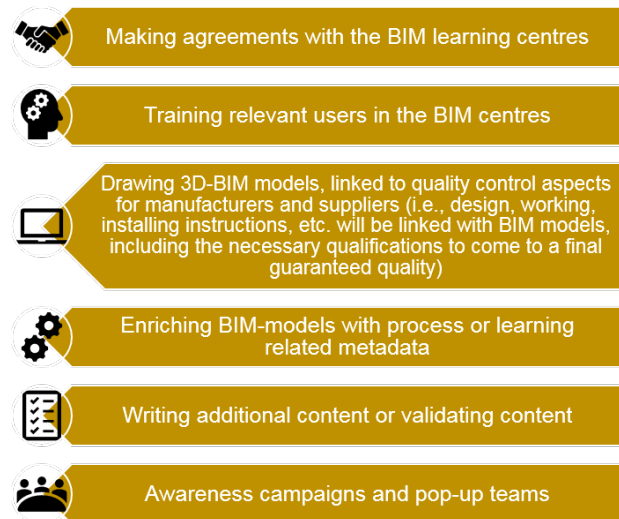

- Making agreements with the BIM learning centres
- Training relevant users in the BIM centres
- Drawing 3D-BIM models, linked to quality control aspects for manufacturers and suppliers (i.e., design, working, installing instructions, etc. will be linked with BIM models, including the necessary qualifications to come to a final guaranteed quality)
- Enriching BIM-models with process or learning related metadata
- Writing additional content or validating content
- Awareness campaigns and pop-up teams

Figure 2. Implementation strategy of the BIMplement methodology in 'real' construction projects.

First BIMplement trainings already took place in France

Read about the feedbacks from the BIMplement implementation sites:

In France, the one-day BIMplement training took place on the construction site of an office building at Saint-Nicolas-lez-Arras attended by 16 managers and white-collar workers from 14 companies involved in the works; 3 representatives from the client (KIC, a private office builder) and from the third party responsible for building control inspections; 1 BIMplement coach and 1 future 'BIMplement master trainer'. The comments of the participants confirm the interest of this training, as show these witnesses:

- Client's employees, KIC, had to convince the enterprises to come to the training where they expressed at first several concerns: '*I was quite afraid before, because I was not sure that the companies would come to this training session. Most of them were reluctant, saying that they did not understand the interest of a training on BIM and related issues (airtightness and ventilation). But all of them came, and all of them were very satisfied with the training. We (KIC) plan not only to continue the BIMplement training at our Saint-Nicolas-lez-Arras site, but also to use BIMplement at the construction site of a 4.500 m² office building in Valenciennes (nearby Lille) next year'.*

- From managers and white-collar workers following feedbacks were received:

  '*A very interesting training. I know now why and how the BIM model makes possible the positive interactions between the crafts…'*

  '*I discover that BIM is a beautiful tool to do a high-quality work…* '

  '*When you have high energy efficiency goals, BIM is of great help…'*

  '*I now see that BIM is the medium to solve the conflicts between the crafts at the workplace…'*

Figure 3. First BIMplement training taking place in France, 2018.

Step 4: Exploitation and replication

In the end project's aims to ensure that more Member States and nZEB areas will benefit, while fostering further cross-border cross-sector developments on a lasting basis. The lessons learned from the 'pilot field labs' and the 'experimental sites' will be capitalized, together with the tools and learning methods developed. To this effect, last phase of the project covers further exploitation and replication of the project results to increase the number of skilled building professionals and craftsmen across the building value chain through spillover effect. The projects replication and exploitation strategy aims at deliberate efforts to increase the impact of successfully tested innovative qualification and training schemes.

Figure 4. From BIMplement methodology to BIMplement in practice.

Conclusions so far and recommendations for future

After the mapping of existing knowledge sources was done on a national level, it seems there is sufficient knowledge to deliver quality. However, the problem is that the availability just on time and fit for purpose is very poor. As tested in BIMplement, utilizing BIM allows storing relevant learning and process metadata in an efficient way. Secondly, BIM can be enriched with quality levels, needed skills and linked trainings. In this way, BIM can serve as a multidisciplinary data repository. Enhancing or connecting BIM models with didactical information can enable and facilitate the learning process over the whole value chain. Thirdly, BIM can improve a collaboration between different disciplines and management of works allowing synchronization of design and construction phase. In the end, in BIMplement BIM on its own is not the goal but improved quality for nZEB construction and renovation and a more efficient systematic process are the goals. At the moment the best approach to reach these goals seems to be using BIM.

To conclude, the construction sector is one of the main pillars of the EU economy where the construction industry is one of the largest European industries with 9% of the GDP of the EU [4] and 18 million jobs and 3.1 million enterprises [5]. Innovative solutions within digitalization of the construction industry such as BIM, can respond to the sector's challenges as are lack of skilled workforce, energy efficiency and lagging productivity. On this matter, energy efficiency cannot be reached without sufficient quality and no quality without qualified workforce. As the practice shows, to obtain sufficient qualified workforce upskilling and trainings are required and this is where BIMplement comes in play. ∎

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