BIMplement

Towards an improved building sector through the setup of a flexible large-scale qualification methodology integrating technical, cross-craft, and BIM-related skills and competences.
www.bimplement-project.eu

A quickstart guide to the BIMplement method

Report: **D5.5: Methodology guide on qualification methodology, methodology for raising awareness, and methods and support for contractors**

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Partners involved RIMC, IVE, ACE HIA, ISSO, ASTUS, MOW, LBA

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Tables

Figures

HISTORY OF CHANGES		
VERSION	PUBLICATION DATE	CHANGE
1.0	31-08-2020	Initial version
1.1	29-01-2021	Revision due to the review meeting, extension of different parts with more details

1 Purpose of the guide

The ‘Methodology guide on qualification methodology, methodology for raising awareness, and methods and support for contractors’ (‘BIMplement Guide’) is a set of tools and recommendations developed to achieve improved replication and exploitation of BIMplement project results.

The guide’s main purpose is to facilitate the transfer of nZEB skills through a building modelling information (BIM)-enabled workplace learning approach, addressing all phases throughout the entire process in a cross-craft multidisciplinary approach.

It also summarises documents and templates developed during the BIMplement project along with deployment experience from five countries and provides links to other specific guides.

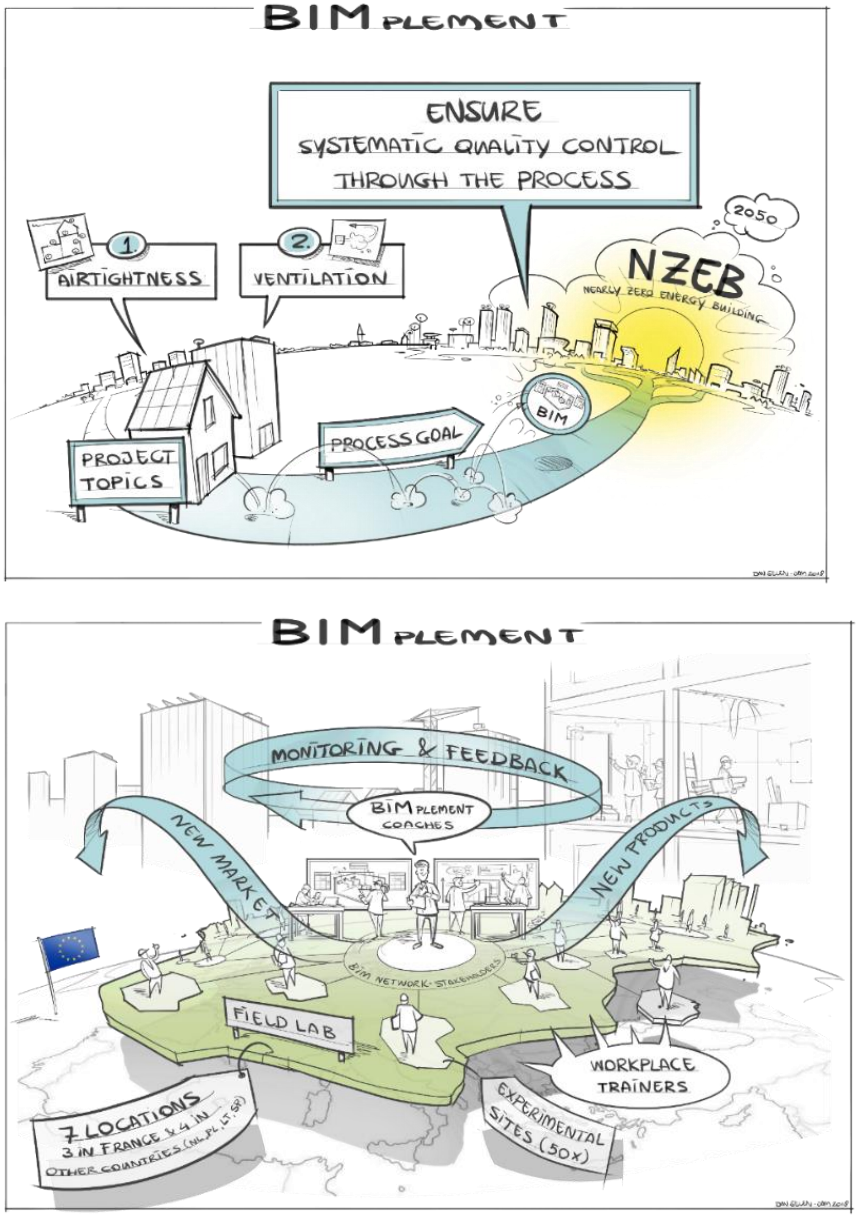
The guide is split into three main sections – an introduction, a presentation of methodologies, and an outline of a number of examples.

2 BIMplement storyline

2.1 Getting knowledge in use

The BIMplement project aims to train and equip the workforce so that workers are capable of implementing, executing, and performing all the necessary labour actions with a full understanding of these actions and the responsibility of their profession, thus ensuring building quality. BIMplement has worked on the insurance of total quality through the development of a BIMplement methodology based on airtightness and ventilation. This method uses BIM as an information carrier with the goal being to take a large step towards bringing the nearly zero-emissions buildings (nZEB) built environment of 2050 within reach (Figure 1).

Figure 1. BIMplement rationale

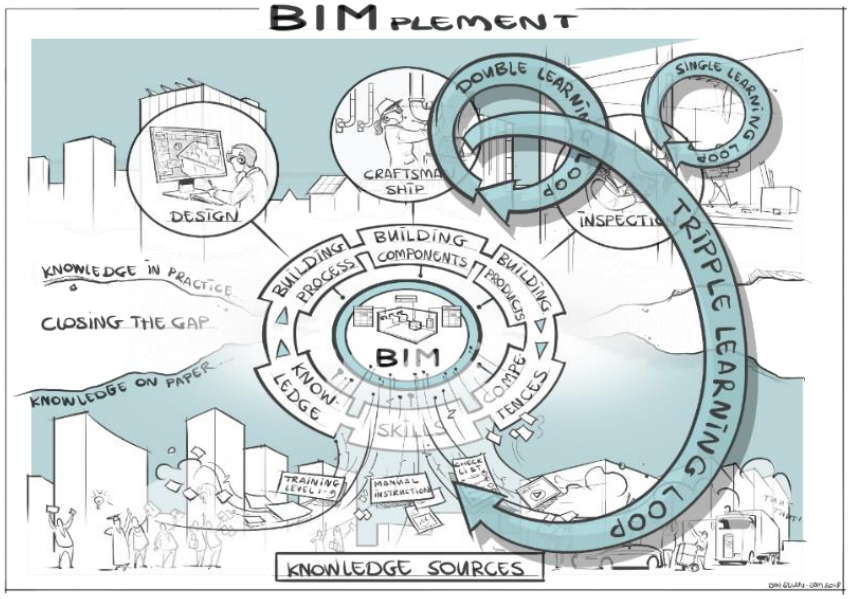


This visual outline the background of BIMplement. It covers the transition from an old built environment to a nZEB built environment in 2050.

BIMplement focuses on two of these topics, building ventilation and airtightness, to demonstrate how BIM can be used to implement them in continuous professional development and qualification schemes.

By using BIMplement and BIM-enabled qualifications, the circular use of knowledge can become a reality. BIMplement is applied for sustaining the built environment, with the process leading to the assurance of systematic quality control.

BIMplement methods have been tested at seven field labs and 50 experimental sites with the involvement of BIMplement coaches and workplace trainers. BIMplement coaches at the national and/or regional level are responsible for the seeding of a network (awareness campaign) and for finding suitable experimental and real instruction sites where elements of BIMplement can be applied. Workplace coaches are our partners for implementation within the experimental sites.



BIMplement is built around the central theme of BIM as an information carrier. Besides BIM, several other knowledge sources (training, inspections, manufacturer information, guides, etc.) are used. We organise these knowledge sources by outlining the difference between knowledge, skills, and competences. This makes it possible to make use of available knowledge and to feed this to the BIM environment. In BIMplement, we use BIM to connect knowledge sources with the building process, building components, and building products. The purpose of this is to prepare and implement what we call a BIMplement workflow.

2.2 Presentation of the BIMplement workflow (action steps)

Environmental challenges and those related to energy efficiency are more prevalent now than ever before. These are shifting the demand for specific workforce skills while at the same time raising expectations for construction sector employers, employees, and intermediary institutions, requiring more on-demand, personalised experience.

To this effect, the BIMplement method is defined as a method of applying BIM to qualification development and training with the aim of achieving energy efficiency targets in buildings.

Beneficiaries of the BIMplement method can tailor the BIMplement workflow to their needs using the set of guides, tools, and templates suggested by this general BIMplement guide. The BIMplement method provides solutions for turning BIM and nZEB knowledge into action through developing and improving the capacities of the construction sector workforce.

The BIMplement workflow follows four major steps accompanied by specific guides, tools, and templates supported by several digital platforms (Figure 2).

Figure 2. BIMplement service steps, tools, and templates

BIMPLEMENT SERVICE		1. AWARNESS RAISING CAMPAIGN						2. QUALIFICATIONS' NEEDS ANALYSIS				3. TRAINING		4. CONSULTANCY
BIMplement methodology elements/tools	Language	*Definition of aims, process, results*	*Couchers' training*	*Organisation of seminars and conferences*	*Individual workshops with clients*	*General trainings*	*Training territory and site selection*	*BIM project maturity assessment*	*Scope definition*	*Project team BIM and NZEB skills assessment*	*Training programme development*	*White-collar workers' training*	*Blue-collar workers' training*	*Consultancy services*
AWARENESS-RAISING TOOLS														
Methodology guide and tools for awareness campaign on BIM and NZEB quality	EN													
List of criteria for the selected territories	EN													
Criteria for selection of sites for training	EN													
Training content and list of tools for BIMplement coach	EN													
BIM MATURITY ASSESSMENT, QUALIFICATION ANALYSIS TOOLS														
BIM capability assessment	EN/FR													
Self-instruction guide (allows definition of professional activities, related skills, required competencies)	EN													
Model NZEB cross-trade quality and BIM Skills Matrix	EN													
Catalogue of constructive elements	EN													
Elaborated quality control and qualification matrix for ventilation and air tightness as an example	EN													
BIMPLEMENT TRAINING PACKAGE	EN													
Tools and learning methods and qualification schemes for BIM workplace trainers	EN													

BIMplement coach training package	EN													
BIMplement kit	EN													
BIMplement field labs and experimental sites	EN													
DIGITAL TOUCHPOINTS	EN													
PROF/TRAC, http://proftrac.eu/	EN													
Qualifications register www.statreg.lt (LT) and BUILD UP Skills Advisor-app (NL)	LT, NL													
youtube.com (IVE channel)	ES													
CLIENT ORGANISATIONS														
Construction companies														
Installation companies														
Design offices														
Training and education providers														
Technology suppliers (producers)														
Engineers, installers branches, architects' chambers														
Government agencies														

Source: D5.6 Implementation service concept

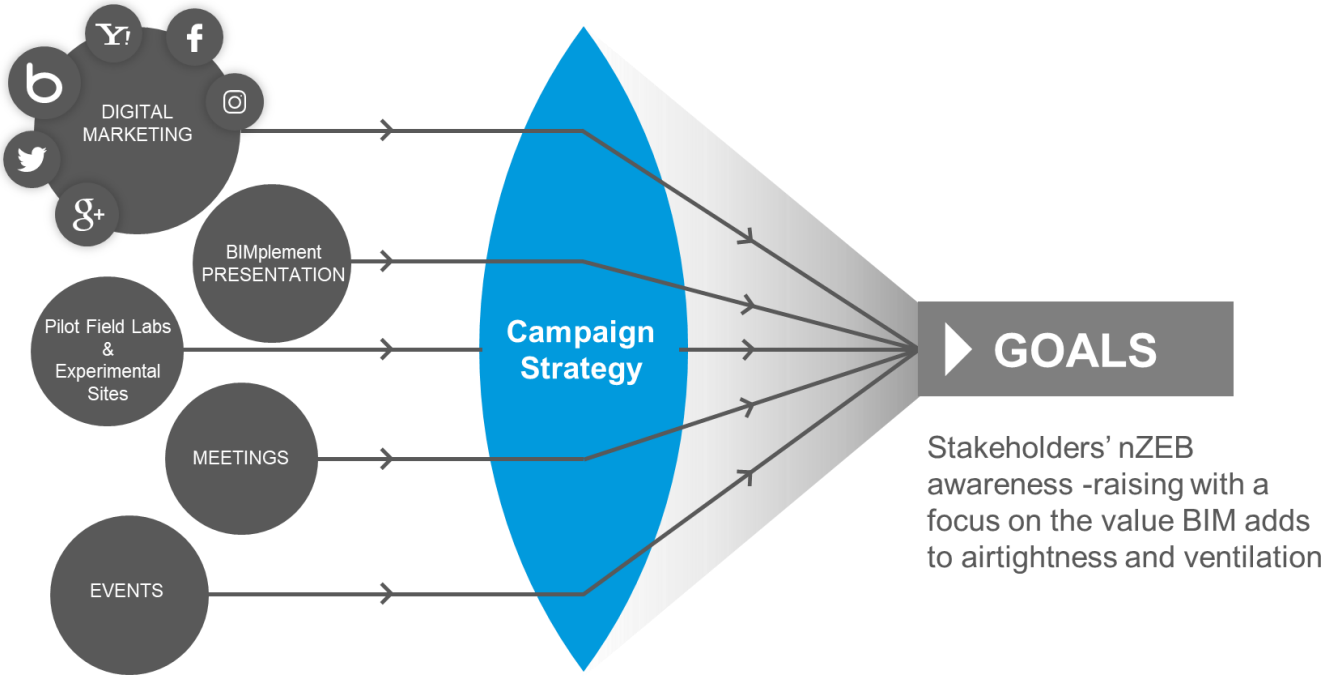
3 A roadmap for full implementation working from awareness to the measurement of effectiveness

3.1 Raising awareness

3.1.1 Methodology guide and tools for awareness campaign

The Methodology guide and tools for awareness campaign (D4.3) specifies the objectives, target groups, main message, methodology, and available tools for BIMplement coaches to assist in reporting activities.[1]

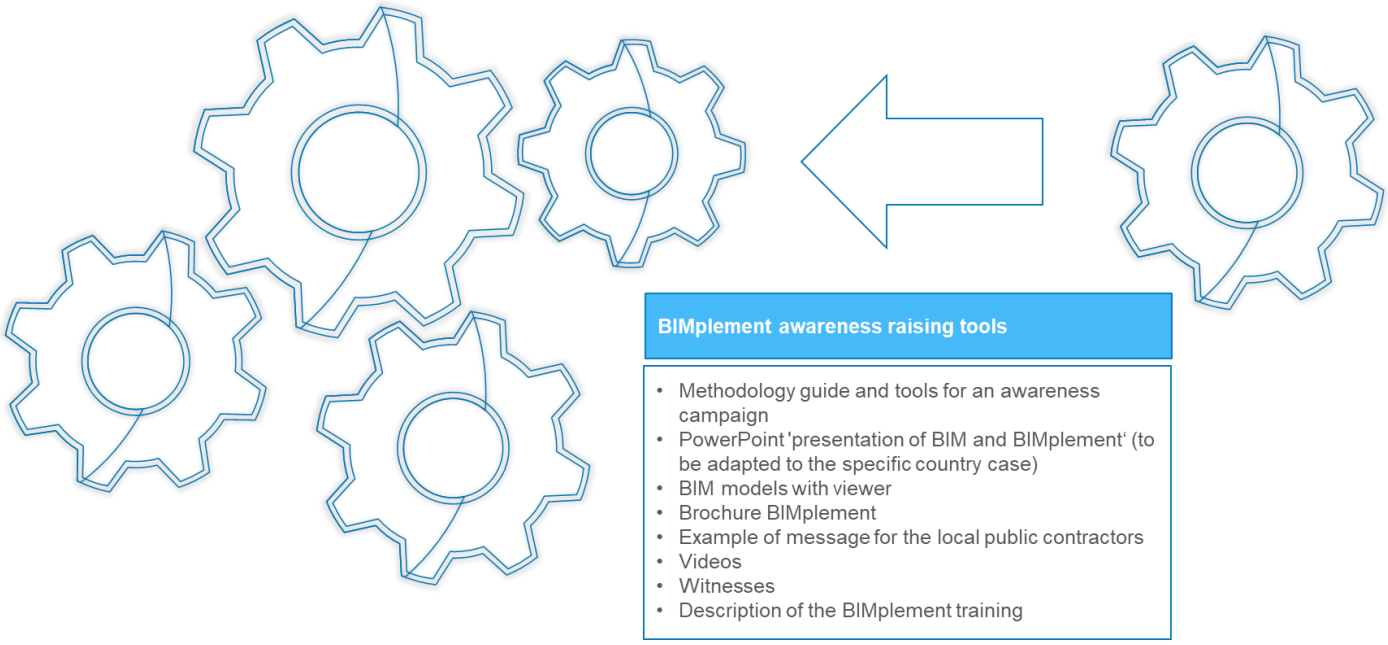
Figure 3 Awareness campaign strategy



The awareness campaign implemented by BIMplement coaches will create awareness in all the stakeholders in the building value chain (public and private contractors, architects, companies, etc.) regarding the value of BIM to the development of nZEBs and the required qualifications and training for white- and blue-collar workers. The awareness campaign should also lead to the inclusion of nZEB, BIM, and qualification requirements in the tenders. It should further motivate building and installation companies to build up the skills of their workforce.

Figure 4 BIMplement awareness raising tools

[1] Source: D4.3 Methodology guide and tools for awareness campaign



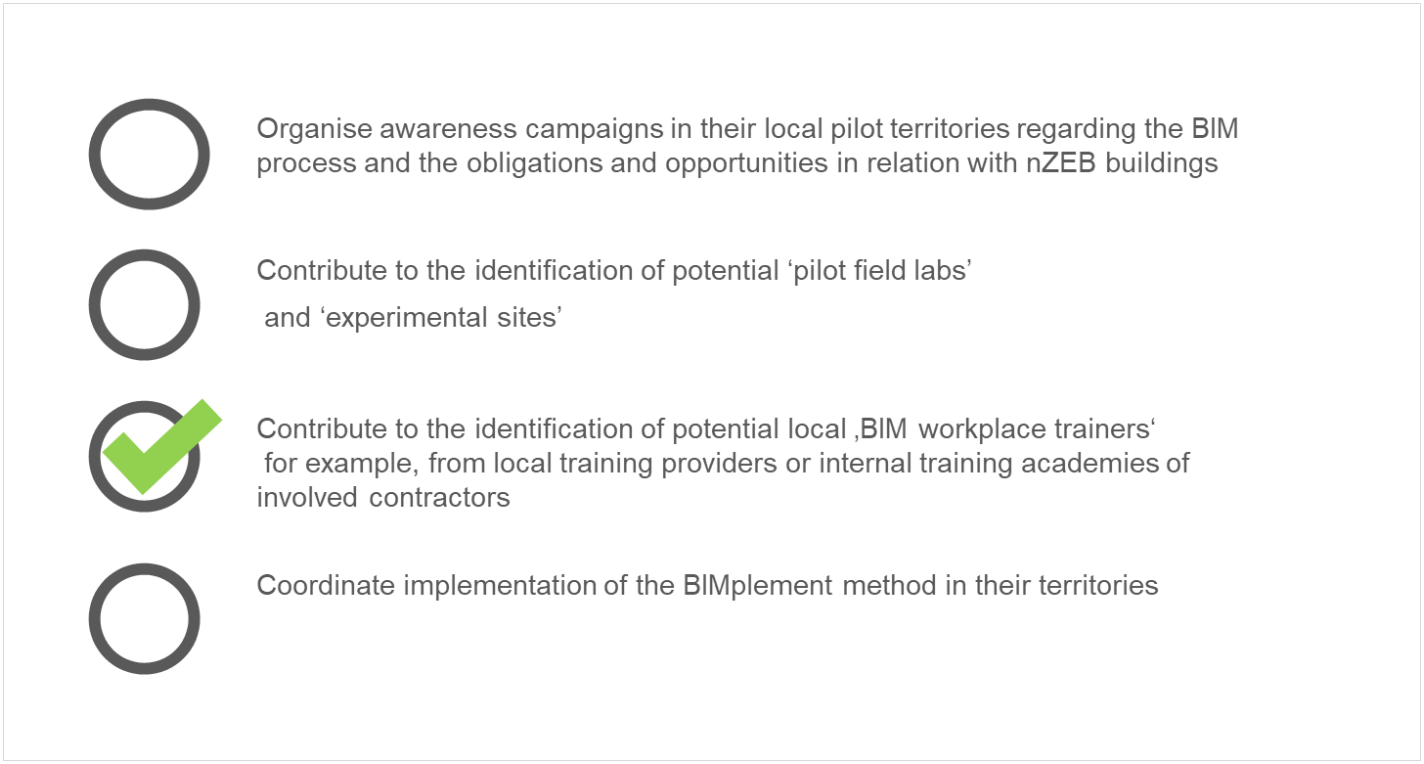
Source: D4.3 Methodology guide and tools for awareness campaign

Monitoring awareness campaigns is a key part of understanding their effectiveness and success in communicating messages, allowing us to determine their impact. Monitoring tools and methods can vary according to the type of action. Several examples of reporting tools for this purpose have been developed.

3.1.2 BIMplement coaches

The BIMplement coach oversees the implementation of the BIMplement project in his or her territory by mobilising stakeholders, finding, and documenting potential field labs and experimental sites, and coordinating the implementation of the project. In addition to conducting awareness campaigns, his or her role is to coordinate the BIMplement implementation, including the on-site training, and to ensure collaboration between the client, project manager, selected building companies, and trainers. The BIMplement coaches need to receive appropriate training and tools to be able to fulfil their assigned tasks.

Figure 5 Responsibilities of the BIMplement coach



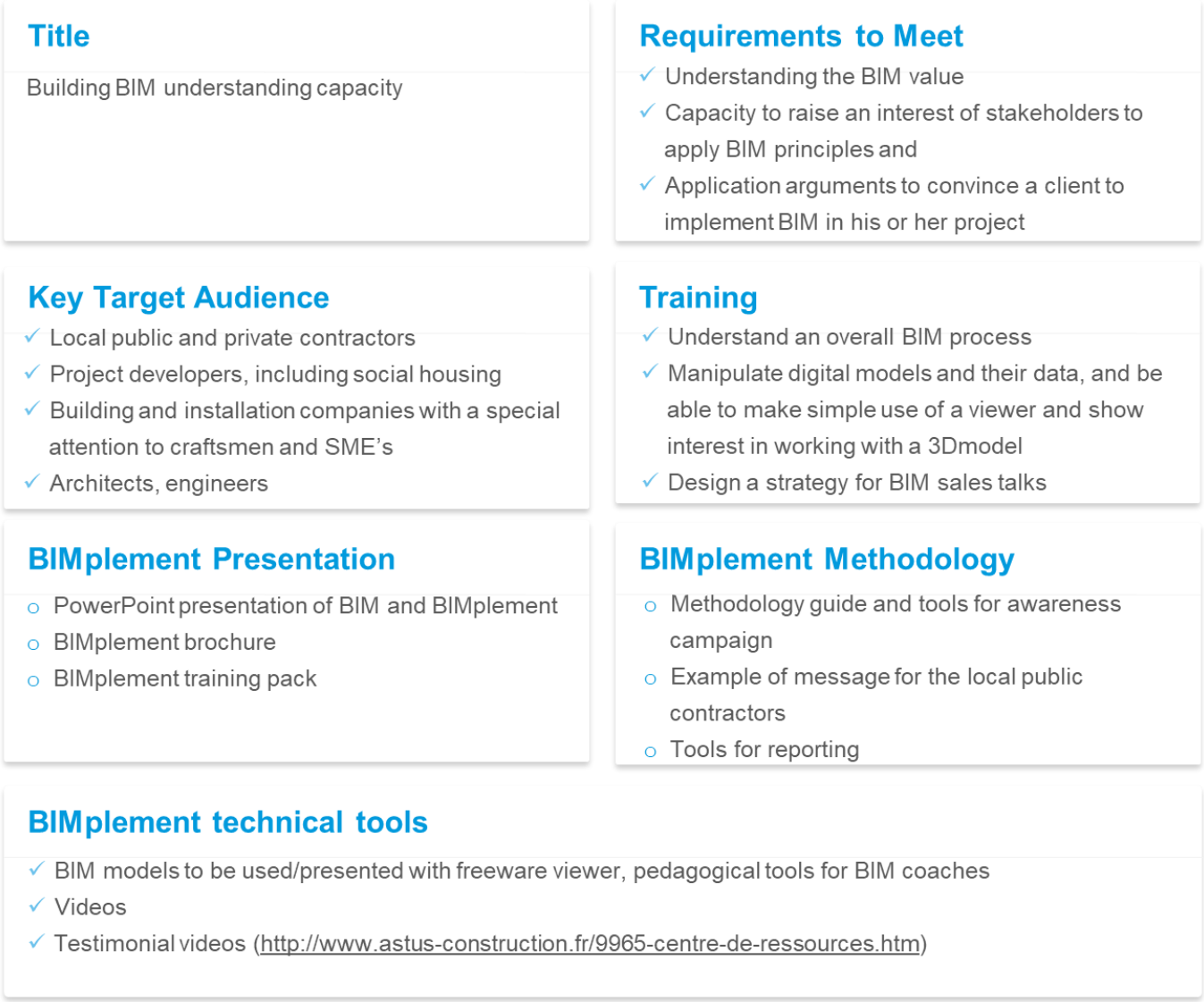
In France, BIMplement coaches are aligned with the regional 'Maison de l'Emploi' (Employment Houses), who have specific knowledge of the training capacities of their territories as well as of the building sector. In France, the BIMplement coach is not a construction technician but has basic building knowledge along with a limited knowledge of BIM.

A complete methodology has been developed as a toolbox for BIMplement coaches and has been put forward as an effective practice tool. Methodology guide and tools for awareness campaign (D 4.3) provides additional training sets and presentations that can serve as examples to be adapted to each territory. The goal is to give BIMplement coaches the appropriate training and tools. The BIMplement coaches can then organise local campaigns based on this know-how as well as on their individual experience and requirements. [2]

In addition to the specific BIM elements, the BIMplement coaches should be provided with basic building knowledge, an understanding of basic environmental requirements, and a basic understanding of the BIM process. BIMplement coaches will have different skills and initial knowledge depending on the country and his or her individual experience, and the tools need to be adapted to the requirements of each situation. This training session includes immersion in a BIM model to raise the interest of the participants in this tool (Figure 6).

[2]Source: D4.2 Training content and list of tools for BIMplement coach

Figure 6 Training content and list of tools for BIMplement coach



Each country can apply the BIMplement approach in its own way while assigning specific objectives and tasks to its coaches. Coaches need to be trained and to obtain the tools to implement these campaigns. Several tools have been created or collected for use during previous awareness campaigns. BIMplement coaches can find these tools in D4.2 - Training content and list of tools for BIMplement coach. New tools can be provided with different messages adapted to the target groups (local public contractors, craftsmen, and small and medium-sized enterprises (SMEs)).

3.1.3 Criteria for the choice of the local pilot territories, pilot field labs, and experimental sites[3]

[3] Source: D4.1 List of criteria and of the selected territories

There are two possible types of pilots: pilot field labs and pilot experimental sites.

Pilot field labs can be national or regional BIM-learning centres for the training of BIM workplace trainers along with the first tests of the BIMplement tools and learning methods can take place.

Experimental sites can be construction or renovation building sites where the tools and learning methods tested in the pilot field labs can be implemented. At these experimental sites, the trainers are the BIM workplace trainers, and the trainees are the white- and blue-collar workers working on the site.

It can happen that a pilot field lab and experimental site are situated in the same area. This may be caused by the fact that construction workers do not always leave the construction site, while it could also be more convenient to carry out training at the workplace.

D4.2 - Training content and list of tools for BIMplement coach addresses the subject of "how to choose pilot and experimental projects to implement BIMplement training". The following criteria are usable in any contexts and are simple and low challenging:

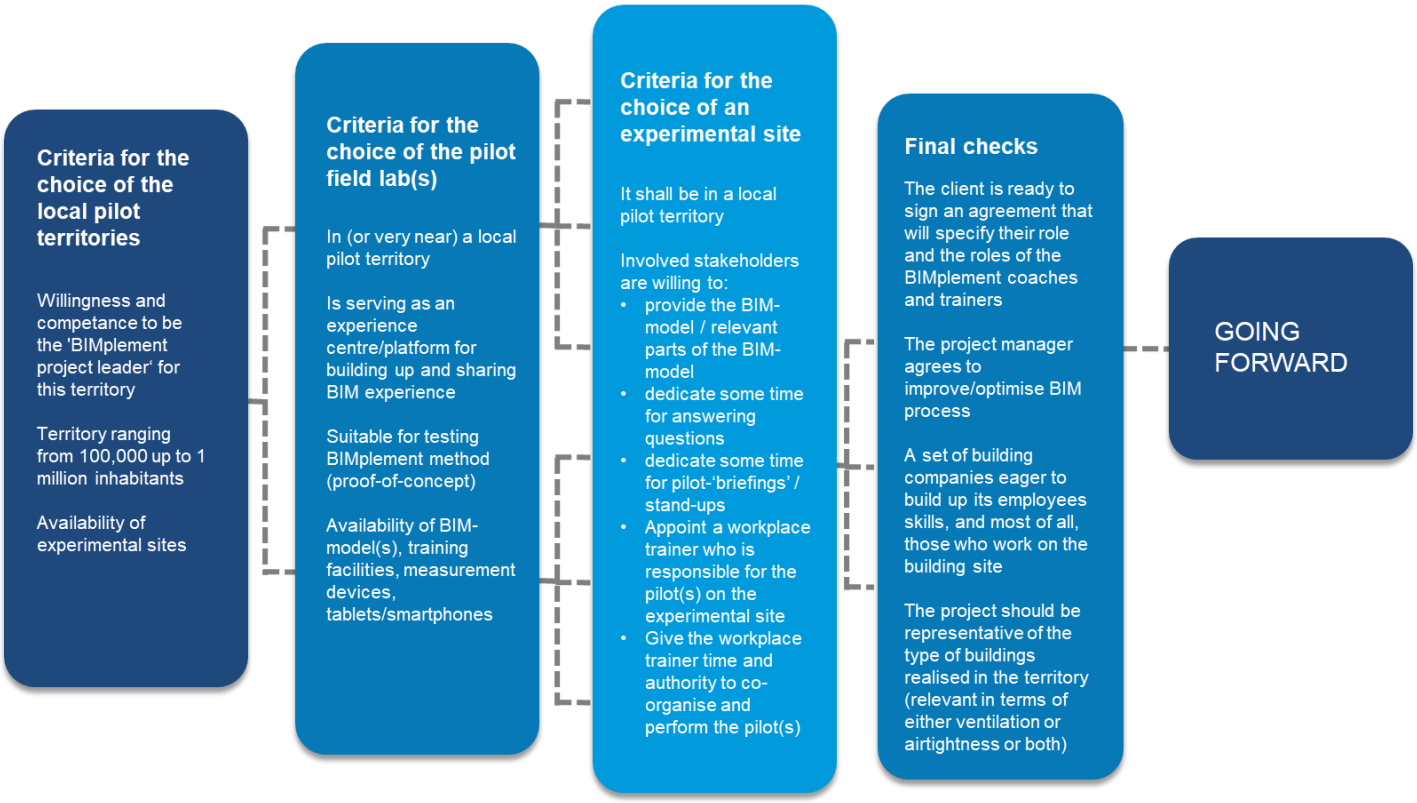
1. **The client** is involved in the BIMplement project, and ready to sign an agreement that will specify why and how the BIMplement training sessions will be implemented in his construction project. It will, for instance:
    - present the partners of the project: the client team, the BIM coach, the BIM trainer
    - specify that the client:
        - wishes to enhance BIM use on his project and legitimate the involvement of the BIM coach and trainers in his project, and so to the project manager and to the building companies'
        - agrees for his project to be the support of on-site training
        - give access to the actual BIM model(s) that will be used on site, and for the training courses, as well as to the BIM platform
        - give the BIM coach and trainers access to the building site, and to a place where the training will be implemented, and the BIM model will be accessible to the site workers.
        - allow the BIMplement partners to participate in the worksite meetings
    - specifies the roles of the BIMplement coaches and trainers, namely in terms of responsibilities, time, number, and duration of training, BIMplement project management on site and the realization of an assessment of the training sessions

    It is important to sign an agreement with the client to implement a BIMplement project. It eases the relations with all stakeholders and facilitates the implementation of training sessions for on-site workers.
2. **The project manager** has requested a BIM model and agrees to improve/optimize his participation in a BIM process. As a minimum, an architecture BIM model, or a 3D model exported with an ifc format is required. An architecture BIM model is compulsory for the building project to be accepted as a pilot or experimental project. The BIMplement trainer will have a full access to it; however, the client may limit its use. An additional MEP model is strongly recommended for a better implementation of the BIM process, and for its use to improve ventilation. A structural model, linked to joinery, will be the base for the implementation of a better building airtightness.

A set of building companies shall be eager to build up its employees' skills, and most of all, those who work on the building site.

BIMplement deliverable D4.1 provides the list of criteria of the selected territories. Figure 7 presents criteria for the choice of local pilot territories, pilot field labs and experimental sites.

Figure 7 Criteria for the choice of local pilot territories, pilot field labs and experimental sites



3.1.4 Audit of the pilot and experimental projects

Each BIMplement trainer needs to analyse each pilot and experimental project to check/confirm the compulsory levels imposed by the client and/or the national requirements for the building in terms of:

- energy consumption (nZEB requirements may be different from one country to another.)
- ventilation quality (countries do not always have requirements on ventilation.)
- airtightness (airtightness requirements may be different from one country to another.)

With the help of the project manager team, the BIMplement trainer will analyse the project to check that these points have been taken into consideration, specify the technical requirements, and propose which subject (ventilation or airtightness, or both) will be addressed by the BIMplement pilot or experimental project.

This audit applies also to the project BIM model(s), on the one hand to verify its quality and content along with its compatibility with the BIMplement project and on the other hand to implement the training session.

The BIMplement trainer, who will audit the projects, needs to:

1. Check with the project manager and design office(s) ensuring that the previous requests have been considered
2. Check the BIM model(s) quality
3. Decide what criteria will be especially worked out, on behalf of BIMplement
4. Prepare the training sessions (see the document on 'BIMplement training pack'
5. Check available BIM software on site, as well as BIM tools (access to the BIM model(s) with on-site computers or tablets)

The BIM model quality is an important point to check because a "good" BIM model is the base for building companies to have confidence in it and use it in addition to their usual 2D plans. The definition of a "good" BIM model is given in the maturity scan table. In Figure 8, 'level 01' corresponds to the minimum quality of a model in which geometry, objects and spaces have been identified along with the IFC specifications, which allow an export of the model into any freeware viewers. In these conditions, building companies will be able to visualize the project through the available BIM model(s).

The Figure 8 'level 2' corresponds to a model that has been made compatible with on-site workers needs by the project manager. It means that during the design phase, the technical offices have identified the difficulties that may appear during implementation, and included in the BIM model, as linked information's, all technical implementation guides, technical drawings, instructional videos. Any data that is needed on a construction site that is often difficult to find, should be linked to the BIM model. Also, the BIM model is a place to draw attention to difficulties that may occur during implementation, and clearly bring and display the technical solutions that have been designed.

Figure 8 BIM model quality assessment

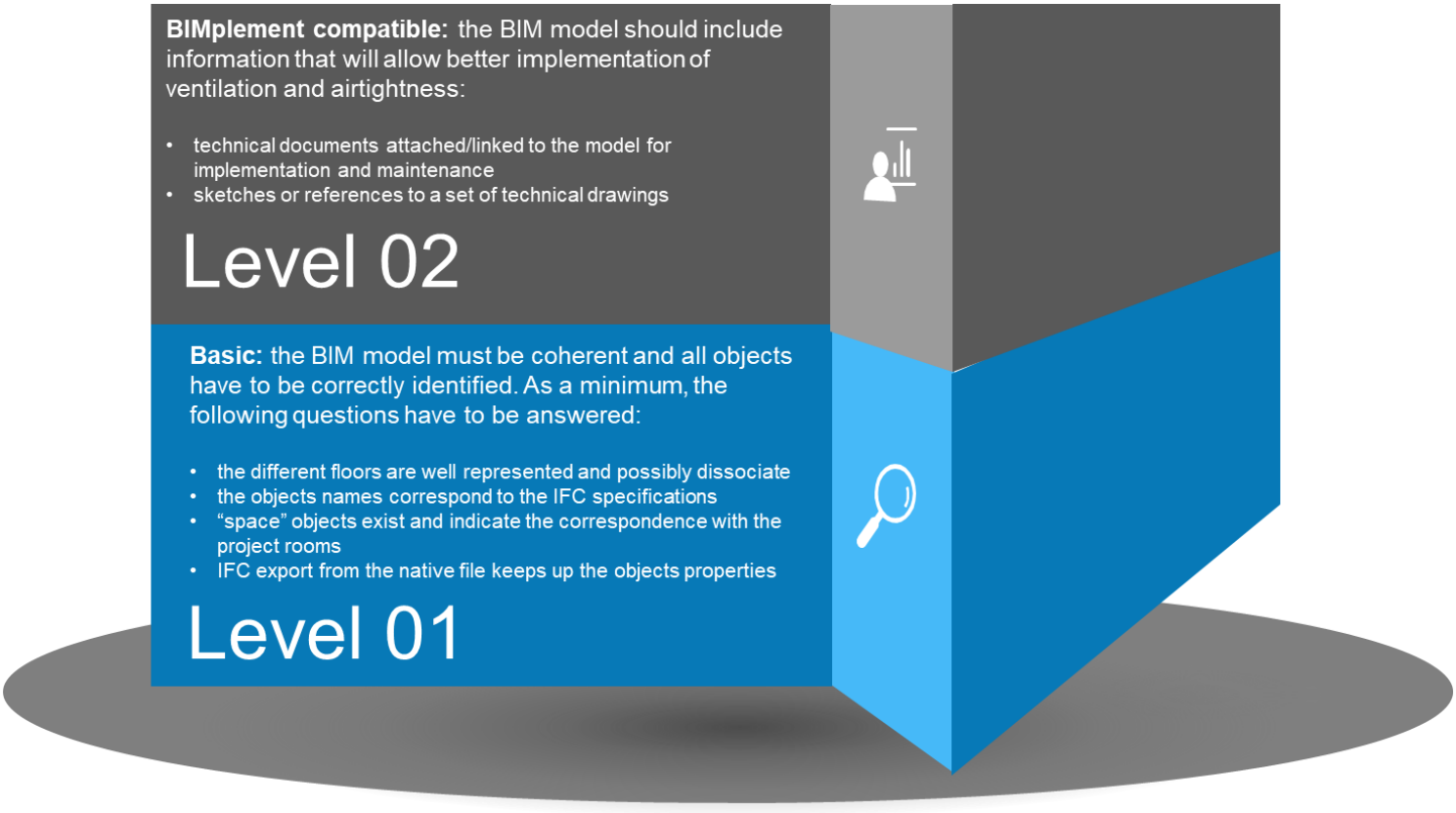
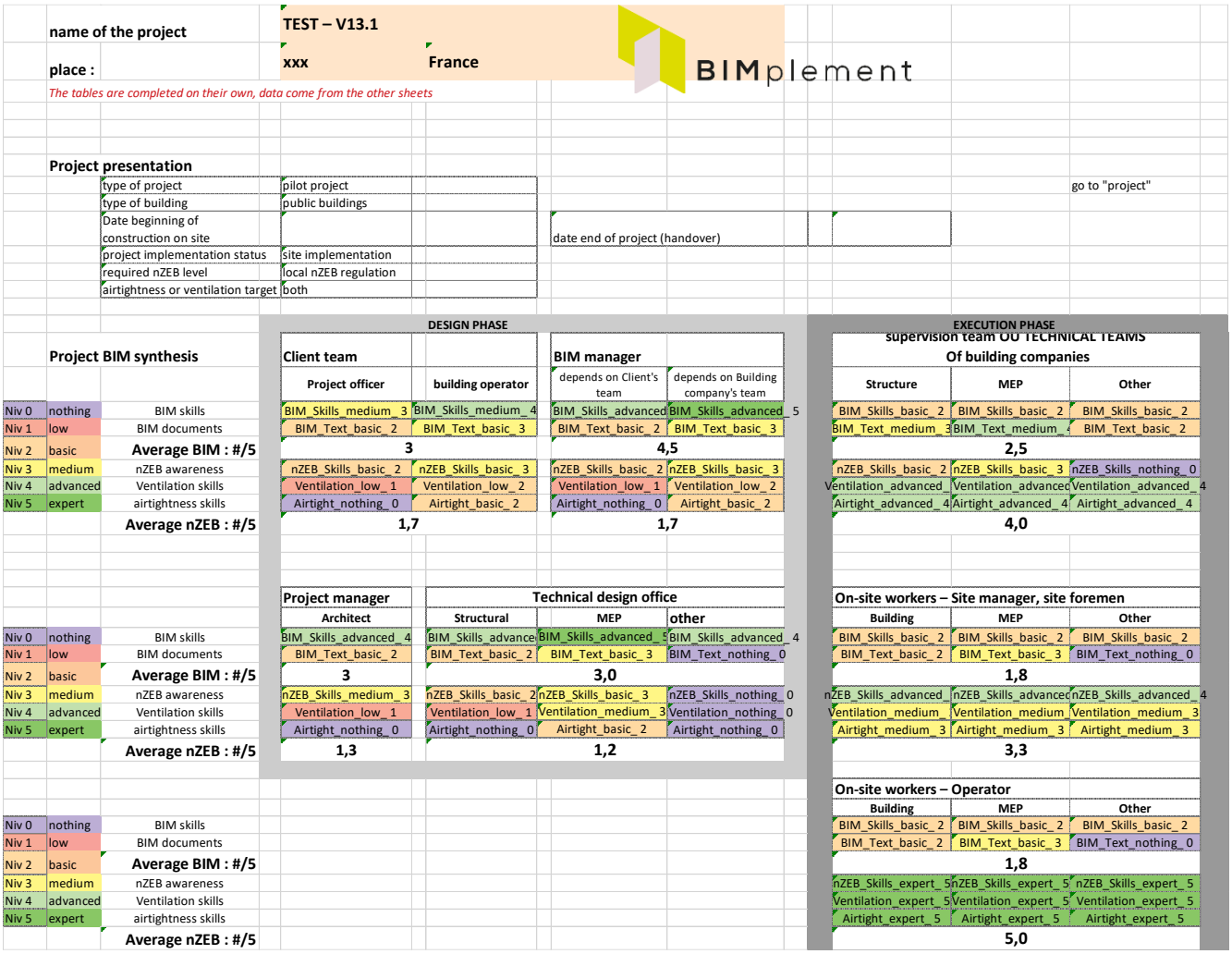


Figure 9 provides a template based on a synthesis of BIM and nZEB maturity assessments, accompanied by several tables containing a set of criteria. The full guide on how to use maturity scan can be found here. The "maturity scan" is a tool that provides a general overview of the level of skills of all stakeholders involved in a project, in terms of BIM, but also nZEB, airtightness and ventilation. This tool will be used by the training centres and site trainers:

- to assess the initial level of skills of all stakeholders,
- to identify the group(s) of stakeholders that needs to be upskilled,
- and possibly, to display the final level of skills acquired after the training sessions.

Figure 9. BIM and nZEB maturity assessment



	name of the project		TEST – V13.1											
	place :		xxx	France										
	The tables are completed on their own, data come from the other sheets													
	Project presentation													
		type of project	pilot project											go to "project"
		type of building	public buildings											
		Date beginning of construction on site			date end of project (handover)									
		project implementation status	site implementation											
		required nZEB level	local nZEB regulation											
		airtightness or ventilation target	both											
			DESIGN PHASE								EXECUTION PHASE			
	Project BIM synthesis		**Client team**		**BIM manager**						supervision team OU TECHNICAL TEAMS Of building companies			
			Project officer	building operator	depends on Client's team	depends on Building company's team					Structure	MEP	Other	
Niv 0	nothing	BIM skills	BIM_Skills_medium_ 3	BIM_Skills_medium_ 4	BIM_Skills_advanced	BIM_Skills_advanced_ 5					BIM_Skills_basic_ 2	BIM_Skills_basic_ 2	BIM_Skills_basic_ 2	
Niv 1	low	BIM documents	BIM_Text_basic_ 2	BIM_Text_basic_ 3	BIM_Text_basic_ 2	BIM_Text_basic_ 3					BIM_Text_medium_ 3	BIM_Text_medium_ 4	BIM_Text_basic_ 2	
Niv 2	basic	**Average BIM : #/5**	**3**		**4,5**						**2,5**			
Niv 3	medium	nZEB awareness	nZEB_Skills_basic_ 2	nZEB_Skills_basic_ 3	nZEB_Skills_basic_ 2	nZEB_Skills_basic_ 3					nZEB_Skills_basic_ 2	nZEB_Skills_basic_ 3	nZEB_Skills_nothing_ 0	
Niv 4	advanced	Ventilation skills	Ventilation_low_ 1	Ventilation_low_ 2	Ventilation_low_ 1	Ventilation_low_ 2					Ventilation_advanced_	Ventilation_advanced	Ventilation_advanced_ 4	
Niv 5	expert	airtightness skills	Airtight_nothing_ 0	Airtight_basic_ 2	Airtight_nothing_ 0	Airtight_basic_ 2					Airtight_advanced_ 4	Airtight_advanced_ 4	Airtight_advanced_ 4	
		Average nZEB : #/5	**1,7**		**1,7**						**4,0**			
			Project manager		**Technical design office**						**On-site workers – Site manager, site foremen**			
			Architect		Structural	MEP	other				Building	MEP	Other	
Niv 0	nothing	BIM skills	BIM_Skills_advanced_ 4		BIM_Skills_advance	BIM_Skills_advanced_ 5	BIM_Skills_advanced_ 4				BIM_Skills_basic_ 2	BIM_Skills_basic_ 2	BIM_Skills_basic_ 2	
Niv 1	low	BIM documents	BIM_Text_basic_ 2		BIM_Text_basic_ 2	BIM_Text_basic_ 3	BIM_Text_nothing_ 0				BIM_Text_basic_ 2	BIM_Text_basic_ 3	BIM_Text_nothing_ 0	
Niv 2	basic	**Average BIM : #/5**	**3**		**3,0**						**1,8**			
Niv 3	medium	nZEB awareness	nZEB_Skills_medium_ 3		nZEB_Skills_basic_ 2	nZEB_Skills_basic_ 3	nZEB_Skills_nothing_ 0				nZEB_Skills_advanced_	nZEB_Skills_advanced	nZEB_Skills_advanced_ 4	
Niv 4	advanced	Ventilation skills	Ventilation_low_ 1		Ventilation_low_ 1	Ventilation_medium_ 3	Ventilation_nothing_ 0				Ventilation_medium_	Ventilation_medium	Ventilation_medium_ 3	
Niv 5	expert	airtightness skills	Airtight_nothing_ 0		Airtight_nothing_ 0	Airtight_basic_ 2	Airtight_nothing_ 0				Airtight_medium_ 3	Airtight_medium_ 3	Airtight_medium_ 3	
		Average nZEB : #/5	**1,3**		**1,2**						**3,3**			
											On-site workers – Operator			
											Building	MEP	Other	
Niv 0	nothing	BIM skills									BIM_Skills_basic_ 2	BIM_Skills_basic_ 2	BIM_Skills_basic_ 2	
Niv 1	low	BIM documents									BIM_Text_basic_ 2	BIM_Text_basic_ 3	BIM_Text_nothing_ 0	
Niv 2	basic	**Average BIM : #/5**									**1,8**			
Niv 3	medium	nZEB awareness									nZEB_Skills_expert_ 5	nZEB_Skills_expert_ 5	nZEB_Skills_expert_ 5	
Niv 4	advanced	Ventilation skills									Ventilation_expert_ 5	Ventilation_expert_ 5	Ventilation_expert_ 5	
Niv 5	expert	airtightness skills									Airtight_expert_ 5	Airtight_expert_ 5	Airtight_expert_ 5	
		Average nZEB : #/5									**5,0**			

Source: link to the template at https://www.bimplement-project.eu/

Airtightness and ventilation

Most European countries have adopted specific regulations on airtightness and ventilation. Since 2000, it has been realised that because building insulation have been greatly improved, airtightness and ventilation have become the most important issues in the building process.

There are several questions that should be checked in this regard:

- In your country, is there a specific regulation regarding building airtightness?
- What types of buildings are covered by this regulation?
- What is the required level of airtightness? The unit of measurement should be specified. It may be:
  1) n50 (no unit)
  2) air renewal volume per m²/hour

- Are there specific documents edited in your country to help design offices and companies that realise high airtightness?
- Is a control of the building airtightness and ventilation performance required at the end of the construction project? Who does it? What is the procedure?

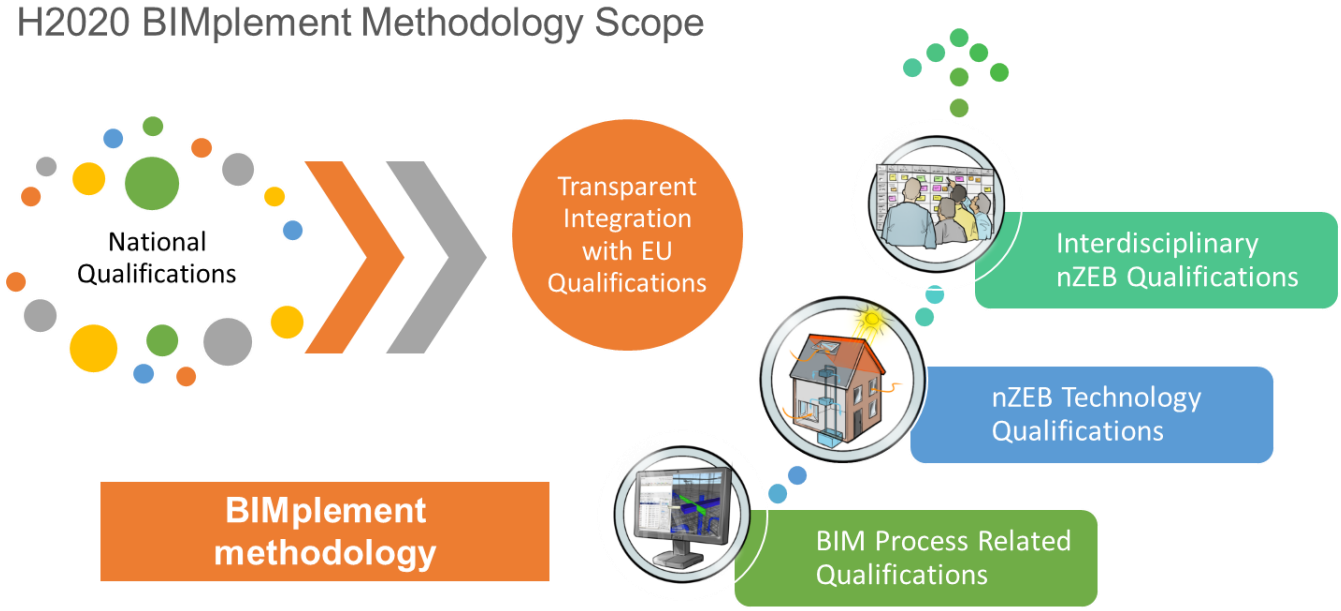
3.2 Project intake

3.2.1 The link between BIM and nZEB qualifications

The BIMplement scope includes a definition of BIM process-related qualifications, a definition of nZEB technology-related qualifications, as well as a definition of interdisciplinary nZEB qualifications with a special focus on airtightness and ventilation. BIMplement paves the way from qualifications at national level to transparent and comparable qualifications at EU level.

To enable linking between a BIM model and the different types of learning goals, the BIMplement methodology works on task based and layered qualification (Figure 10).
This enables proper upskilling from 'a holistic perspective' addressing BIM process, nZEB Technology and Interdisciplinary collaboration in conjunction.

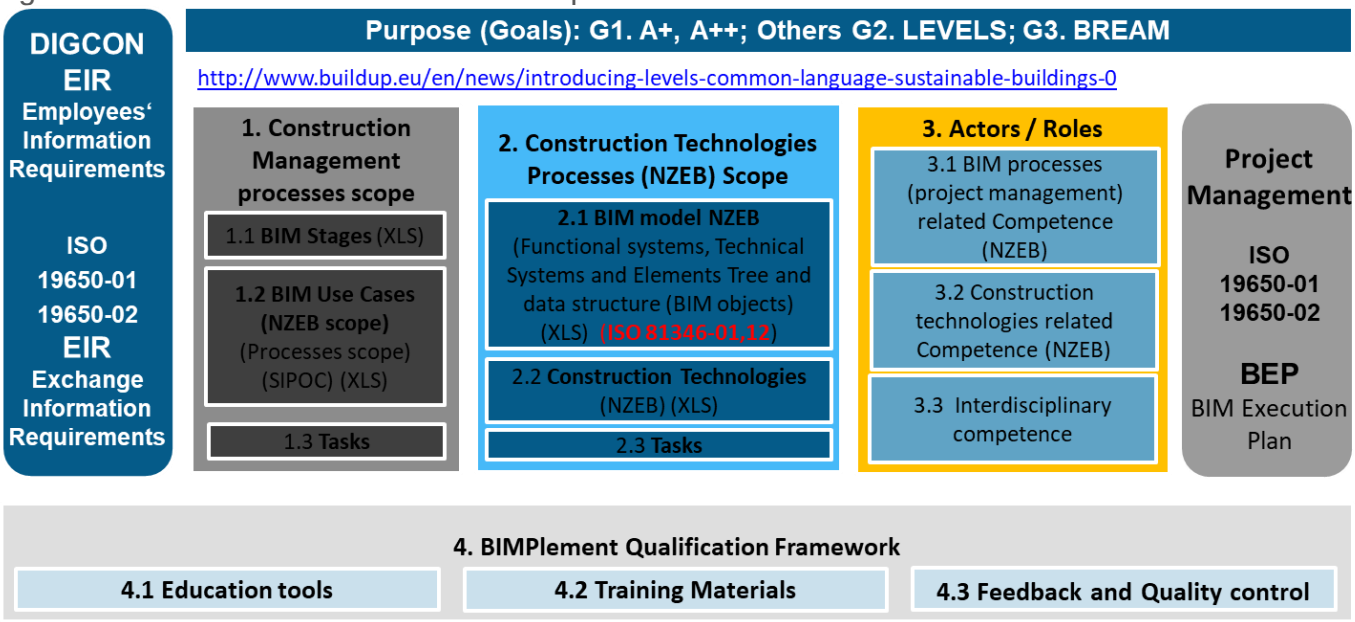
Figure 10. BIMplement scope



Overall BIMplement training methodology structure and main training content domains' scope including links between BIM and nZEB qualifications' content is presented in Figure 11. The basis for BIMplement competences development starts from understanding of importance and definition of clear and rational Customers' (Clients') requirements (EIR) and continues to identification and selection of goals for the whole project life cycle, including sustainability topics and effective BIM project planning activities, including development and running BIM execution plan (BEP).

Two main project management processes' groups were defined for the training scope. The first group includes Construction management processes related with definition of project stages and BIM Use Cases related with BIM for nZEB projects' planning and implementation. The second group includes the selection of rational construction technologies (related to airtightness and ventilation) and their implementation processes at all stages of the project life cycle (planning, design, construction and FM).
The overall scope was tested and used within different BIMplement partners' countries and projects within different projects scope, with different training content, components and technologies' use, within different real projects environments and with different initial BIM for nZEB projects' team maturity levels.

Figure 11. Link between BIM and nZEB qualifications



Prepared 06.20 by Vaidotas Šarka, Dalius Gedvilas, Donatas Aksomitas (in cooperation with VsI Skaitmenine statyba (www.digitalconstruction.lt), Lithuania

In the initial stage, the energy efficiency goals are set for the new project (Table 1). BIM connects different process elements, beginning with definition of the requirements for the exchange of information, the scope (e.g., nZEB), the construction life cycle stage, the tasks and construction technologies related to BIM, and the actors and their roles. This leads to a definition of the tasks and the according required competences.

Table 1. Setting BIM goals.

Code	BIM GOAL	Short description	Measurement criteria and possible deviations	Responsible for implementation
T1	Example: energy efficiency assessment in the BIM environment	We are preparing the model in such a way that it is easy to obtain information from the model for energy simulations.		
T2	Example: artificial lightning assessment in the BIM environment	The location of the lightning fixture in the architectural model is required.		
T3	Example: integrated project management environment	Remote exchange of information, version control, check-in, check-out, etc.		
T4	Example: analysis of BREEAM criteria in the BIM environment			

The BIM execution plan (BEP) assists public sponsors, design offices, and builders in developing a joint plan for the implementation of the project team's work and customer information requirements when implementing specific BIM projects. The BEP is formed by the sponsor (customer representatives) and the members of the project execution team. The plan is a set of priorities, strategies, procedures, and methods for the dissemination of information, rules for the procedures, and responsibilities to ensure the smooth running of the BIM project according to the required nZEB qualifications.

The BEP is prepared for each project individually, and it is recommended that it be set up and implemented at the earliest stage of project development. During the execution of the project, the plan must be updated in each phase with additional relevant information, and in all cases, it must be re-agreed upon and approved by both the project team and the developer.

The scope of the BEP may vary depending on the scope of the project, the importance of the project to the developer and the public, the depth of cooperation (communication), the type of customer (private or public), and the use of project results during the life cycle of the building.

The amount of information in the model is not limited, but it must be taken as a principle that the inclusion of excess information in the model leads to time costs for the model developer and users. The information model should be intended to provide only to the information necessary to achieve the objectives of the project and BIM.

BIMplement provides several tools, templates, and guidelines to facilitate BIM project implementation. These can be found at https://www.bimplement-project.eu/.

Use cases define the propose and scope of information delivery while identifying the business needs and ideal scenario for specific actors and their roles in the process of building nZEBs.[4] Kreider and Messner (2013) define BIM use as ‘a method of applying Building Information Modelling during a facility’s lifecycle to achieve one or more specific objectives’.[5]

Figure 12 presents construction project stages and BIM uses that could be selected for definition of BIM for nZEB scope, including the areas covered by BIMplement (airtightness, ventilation, and energy efficiency), as well as the accordingly required qualifications and competences. One group of BIM Use Cases (Development of Current conditions model, Functional, volumetric, and planning layouts developments and Design/Modelling) are important as Information suppliers for nZEB developments and improvements. Another group (Economic, quantity take off and cot calculations, Energy analysis, Lighting analysis) are directly related to nZEB related calculations, technologies’ selection and technologies’ implementation in different processes. After implementation of Quality Assurance related BIM Use Cases, other different use cases (related with Construction site planning, Logistics, and Implementation onsite) could be efficiently used by demand.

Figure 12. Construction project stages and BIM use cases (uses) (EXAMPLE for Project Quality Assurance related stages)

[4] Source: https://ucm.buildingsmart.org/use-case-management
[5] Kreider, Ralph G. and Messner, John I. (2013). “The Uses of BIM: Classifying and Selecting BIM Uses”. Version 0.9, September, The Pennsylvania State University, University Park, PA, USA. http://bim.psu.edu, https://www.bim.psu.edu/download/the_uses_of_bim.pdf

	BIM project development stages (RIBA approach)		S1	S2	S3	S4	S5	S6	S7		
		Feasibility Study	Project program	Concept project	Design Technical project	Detail design	Construction	Construction closure	Use and maintenance	Needed Software or CDE	Responsible person
1	**Economic / quantity take off and cost calculations**	S0.1	S1.1	S2.1	S3.1	S4.1	S5.1	S6.1	S7.1		
2	**Development of current conditions model**		S1.2	S2.2	S3.2	S4.2	S5.2	S6.2	S7.2		
3	**Planning project stages**		S1.3	S2.3	S3.3	S4.3	S5.3	S6.3	S7.3		
4	**Land plot analysis**		S1.4	S2.4	S3.4						
5	**Functional, volumetric and planing layouts development (S2)**		S1.5	S2.5							
6	**Project visualization and reviews**		S1.6	S2.6	S3.6	S4.6					
7	**Design / Modeling (S3-S4)**			S2.7	S3.7	S4.7					
8	**Engineering calculations and analysis**			S2.8	S3.8	S4.8					
9	**Energy analysis**			S2.9	S3.9	S4.9					
10	Sustainability Assessment			S2.10	S3.10	S4.10					
11	**Structural analysis and design**			S2.11	S3.11	S4.11					
12	Lighting Analysis			S2.12	S3.12	S4.12					
13	**Analysis of engineering systems**			S2.13	S3.13	S4.13					
14	Other cases of analysis			S2.14	S3.14	S4.14					
15	Conformity assessment / project expertise			S2.15	S3.15	S4.15	S5.15				
16	**3D coordination**			S2.16	S3.16	S4.16	S5.16				
17	**Planning a building site (building site plan)**					S4.17	S5.17	S6.17			
18	Health and safety planning					S4.18	S5.18	S6.18			
19	Structural-technological analysis					S4.19	S5.19	S6.19			
20	Construction Technologies (Technological Schemes) and simulation of the installation process					S4.20	S5.20	S6.20			
21	Building Logistics Planning						S5.21	S6.21			
22	**Modeling and management of building processes**						S5.22	S6.22			
23	Digital Production						S5.23	S6.23			
24	**Technical supervision of construction works**						S5.24	S6.24			
25	**Fill-in model**						S5.25	S6.25			
26	**Data Model**							S6.26	S7.26		
27	**Planning for building maintenance**								S7.27		
28	Analysis of structural (engineering) systems								S7.28		
29	Energy Cost Analysis								S7.29		
30	**Asset Management**								S7.30		
31	Spatial management and monitoring								S7.31		
32	Sustainability monitoring and analysis								S7.32		
33	Accident Prevention								S7.33		

Remark: BIM use cases collar definitions:

- Preferred use; High priority
- Recommended for use. Secondary Use. (Some impossible without implementation of high-priority use cases)
- Used in BIMplement (BIM and nZEB scope)
- Related to BIMplement (Information Support) (BIM and nZEB scope)

Prepared by Vaidotas Šarka and Donatas Aksomitas

Table 2 presents the relationship between the BIM model and nZEB-related technical systems along with a list of related construction and engineering technologies that can be assigned to specific tasks and the according task-based qualifications.

Table 2. BIM model with nZEB-related technical systems and technologies

Model tree structure coding		BIM Model tree (Based on ISO81346) - Later USE BIMAXON for Mapping all Tree		EXAMPLE: Build Up Skills ENERGOTRAIN Technology list
		Systems/Elements		Technologies/Operations (Types)
AA. Functional systems	A	Ground system		
AB. Technical systems	**AB**	Foundation construction		
AC. Element		*Insulation element*		
BA. Technology			?	*Insulation technology*
AB. Technical systems	**BB**	Foundation structure		
AB. Technical systems	**AC**	Slab construction		
AB. Technical systems	**BC**	Slab structure		
AB. Technical systems	**BG**	Ceiling structure		
AB. Technical systems	**BF**	Floor structure		
AA. Functional systems	B	Wall system		
AB. Technical systems	**AD**	Wall construction		
AB. Technical systems	**?**	Insulation and facade finishing		
BA. Technology			?	*Ventilated facades installation*
AB. Technical systems		Insulation and facade finishing		
BA. Technology			?	*ETIC facades installation*

AB. Technical systems	**BD**	Wall structure		
AC. Element	*QQA*	*Windows*		
BA. Technology			*QQAn*	*Windows installation*
AC. Element	*QQC*	*Doors*		
BA. Technology			*QQCn*	*Doors installation*
AB. Technical systems	**AD**	Wall construction		
BA. Technology			*AD02*	*Glass aluminium facades*
AB. Technical systems	**AF**	Stairway construction		
AB. Technical systems	**BG**	Ceiling structure		
AB. Technical systems	**AH**	Balcony		
AB. Technical systems	**BC**	Slab structure		
AA. Functional systems	C	Slab system		
AB. Technical systems	**AC**	Slab construction		
AB. Technical systems	**BC**	Slab structure		
AB. Technical systems	**BG**	Ceiling structure		
AA. Functional systems	D	Roof system		
AB. Technical systems	**AE**	Roof construction		
BA. Technology			*AE01*	*Flat roofs installation*
BA. Technology			*AE02*	*Pitched roofs installation*
AB. Technical systems	**BC**	Slab structure		
AB. Technical systems	**BG**	Ceiling structure		
AB. Technical systems	**BE**	Roof structure		
AA. Functional systems	F	Water and fluid system		
AB. Technical Transporting systems	**JB**	Water distribution system		
AA. Functional systems	G	Drainage and waste system		
AB. Technical Transporting systems	**JD**	Liquids outflow system		
AB. Technical Transporting systems	**JE**	Solids outflow system		
AA. Functional systems	H	Cooling and heating system		
AB. Technical Transporting systems	**JF**	Cooling distribution system		
AB. Technical Transporting systems	**JG**	Heating distribution system		
BA. Technology			*JG01*	*Low-temperature radiant heating systems*
BA. Technology			*JG02*	*Floor heating, radiator and convection heaters*
BA. Technology			*JG03*	*Renewable energy sources for heating*
AB. Technical Transporting systems	**JH**	Combined heating and cooling distribution system		
AB. Technical Transporting systems	**HD**	Heating supply system		
AB. Technical Transporting systems	**HC**	Cooling supply system		

AB. Technical Transporting systems	**HE**	Combined heating and cooling supply system		
AA. Functional systems	J	Ventilation system		
AB. Technical Transporting systems	**JJ**	Air distribution system		
BA. Technology			JJ01	Mechanical ventilation systems
AB. Technical Transporting systems	**HF**	Ventilation plant		
AA. Functional systems	K	Electrical system		
AB. Technical Transporting systems	**HH**	Lighting system		
AB. Technical Transporting systems	**JK**	Power distribution system		
BA. Technology			*JK01*	*Low voltage systems*
AB. Technical Transporting systems	**HG**	Power supply system		
BA. Technology			*HG01*	*Photovoltaics on roofed installation*
AA. Functional systems	L	Automation system		
AA. Functional systems	M	Information and communication system		
AA. Functional systems	Q	Lighting system		
AB. Technical Transporting systems	**JH**	Lighting system		

Structural element coding descriptions:
AA. Functional systems structure element (1 letter); AB. Technical systems structure element (2 letters); AC. Element/component mapping (3 letters) – USE ISO81346.
BA. Construction or engineering system technology structure element; BB. Operation (smallest work item (activity) in construction technology process).
C. Resources; CA. Work (role) name (white- or blue-collar worker competence); CB. Materials; CC. Mechanism.

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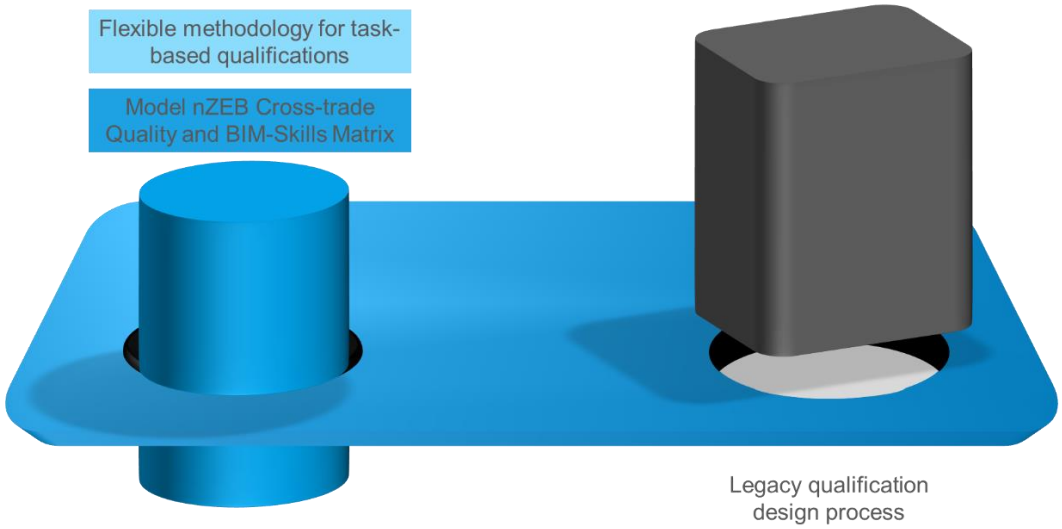
3.2.2 BIMplement Task-Based Qualification Framework

D5.2. A self-instruction guide for implementing new technical or conceptual topics and for implementation in other member states. The BIMplement Task-Based Qualification Framework consists of a flexible methodology for task-based qualifications along with the Model nZEB Cross-trade Quality and BIM-Skills Matrix.

Figure 13 Model nZEB Cross-trade Quality and BIM-Skills Matrix



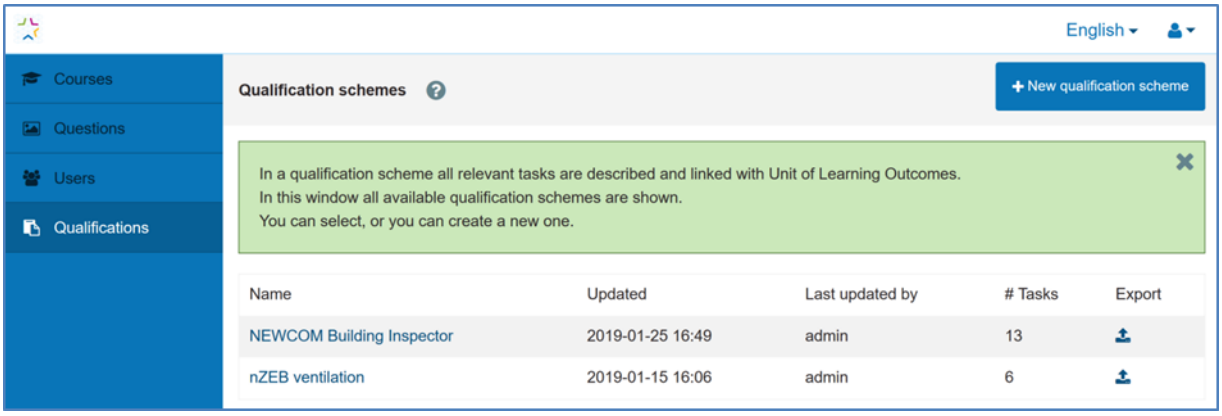
A flexible methodology allows for a definition of skills and required competences based on tasks and may be included into the BUILD UP Skills Advisor app qualification database. The database will in future link competences to available course supply. A user manual is available for download, embracing the BUILD UP Skills Advisor app functionality.

Following the BIMplement methodology, a general task-based qualification was developed that addresses all relevant building/process phases and all the professions/actors involved. Subsets from the qualification can be published for practical use in a qualification scheme addressing one or more project phases and one or more professions. For example, a subset of tasks and subtasks for a craftsman that installs the converter of a solar photovoltaic system (PV) could be published.

The Model nZEB Cross-trade Quality and BIM-Skills Matrix link the content of the qualifications into a process-oriented workflow for implementation in construction projects. The matrix enables thorough preparation of changes that will be made in the process to create the right context for upskilling and the application of newly acquired competences.

For each technology, the corresponding BUILD UP Skills Advisor app units of learning outcomes (ULOs) database identifies which professions and specialisms are involved in each phase along with the necessary skills, competences, and descriptors, including the related qualifications and what training, courses, and learning materials are available.

Figure 14 Screenshot of the qualification/ULO database



In Figure 15 it is shown how BIMplement experimented with linking ISO 81346 and BIM-objects to elements in the BIMplement qualification. More information on this can be found in D2.1: Methodology for a BIM enhanced Qualification Framework and D2.2: Five national results of usability testing.

Figure 15. Experiment of linking tasks in a qualification with BIM.

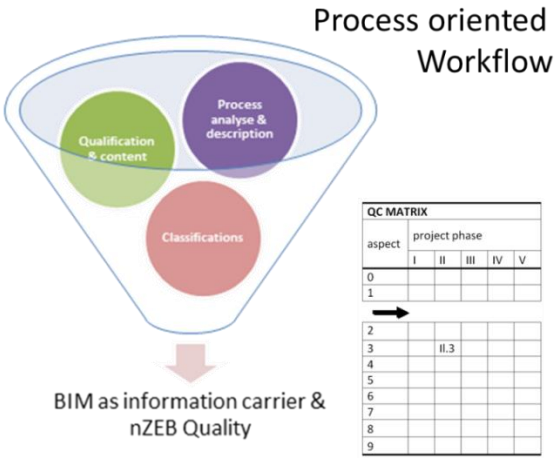
Relevant technology (according to ISO 81346)	Project stage	BIM object	Task	Actors	Subtask	Code	Task class
JJ-Ventilation system	S5	Warning sign	Instructions read out				
	S5	Every component is link	Check the delivery				
Decentralized Ventilation System with Heat Recovery Type e² mini	S5	Tube and outer grill		Installer of the ventilation system	Read the instructions	JJ-S5-0	BAS
http://www.lunos.lt/sites/	S5	Tube and outer grill		Installer of the ventilation system	Check the delivery with regard to completeness and perfect condition!	JJ-S5-1-1	BAS

After checking content and quality, the new qualification can be entered and normalised with the support of the ULO database. When entering the qualification into the database, the database displays comparable items. An Excel template for creating draft versions is also available for download.

3.2.3 Model nZEB Cross-trade Quality and BIM-Skills Matrix

To facilitate the timely, accurate, and fit-for-purpose delivery of learning and/or inspection content, a process-oriented workflow is needed. This need is addressed by the Model nZEB Cross-trade Quality and BIM-Skills Matrix (Figure 16).

Figure 16 Elements of the process-oriented workflow



Source: D5.2 A self-instruction guide for implementing new technical or conceptual topics and for implementation in other member states

The BIMplement Model nZEB Cross-trade Quality and BIM-Skills Matrix is a structure for overall quality control that helps to analyse and optimise the linkage between processes, qualifications, and classification schemes. It can be applied to control the production process, including specifications, design, construction, hand-over, and operation. Overall, it is an instrument for controlling the entire process of creating building services and can be applied to advanced ventilation systems and concepts (i.e., ventilation systems related to properties of the building and other building services). It contains all the operational techniques and activities necessary to achieve a defined level of quality.

To build nZEB, the activities and competences of all individual construction process actors should be aligned. Quality control in BIMplement (through the Model nZEB Cross-trade Quality and BIM-Skills Matrix) is based on a general model that can be applied to all kinds of processes (building, building services, industrial processes, etc.). The BIMplement Quality and BIM-Skills Matrix is a structure that follows all the process phases, enabling the inclusion of several strategic decision and quality control moments in the construction or renovation processes and assessing whether a ventilation system meets the targets and requirements as defined in the programme phase.

Nine different quality control aspects form the basis of the BIMplement Model nZEB Cross-trade Quality and BIM-Skills Matrix. In the following figure (Figure 17), the horizontal axis covers the entire lifecycle of the building, while the vertical axis indicates the aspects of quality control.

Figure 17 Construction phases and quality control aspects

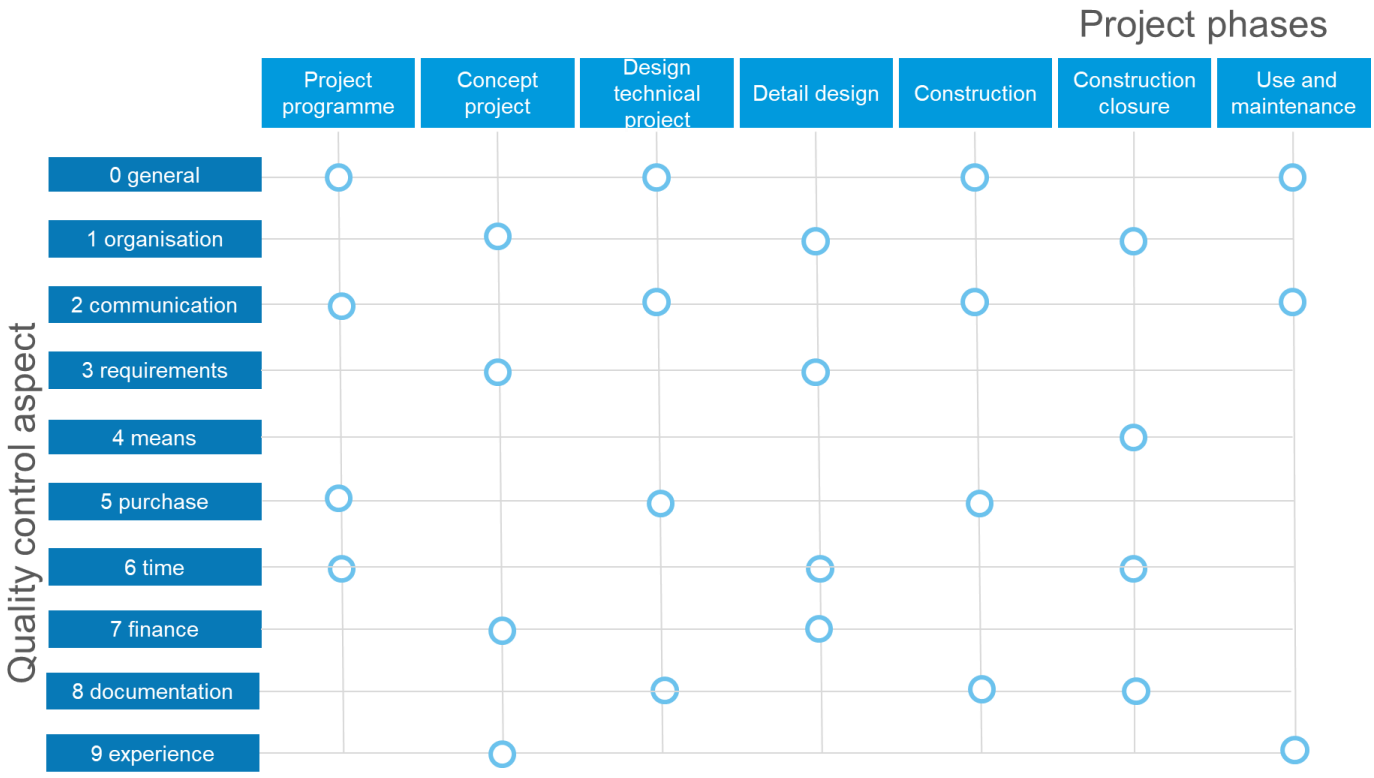


Table 3 presents the quality control goals and processes and proposes possible uses of the software.

Table 3. Quality control goals and example processes

REVIEW	GOALS	RESPONSIBILITY	APPLIED SOFTWARE	Frequency
VISUAL review	Follow development of BIM model structure. Software could be used for a comparison.		BIMSYNC.com	1 time/week
Clash detection	Identify clashes, evaluate influence, set priorities, and provide team information. Followed by the development of solutions.		Solibri checker, Navisworks	1 time/1–2 weeks, when models for few different disciplines were created for different zones
Verification of standards	Ensure compliance with BIM and CAD principles, standards and requirements.		Could use Solibri checker	Every time before a decision for documentation development based on the model
Model integrity and quality check	Check for missing, incorrectly defined, or duplicated items. Provide reports on the occurrence of such elements and corrective actions.		Solibri checker, Navisworks	Every time before decision for documentation development based on the model.

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3.2.4 BIMplement KIT (training program)

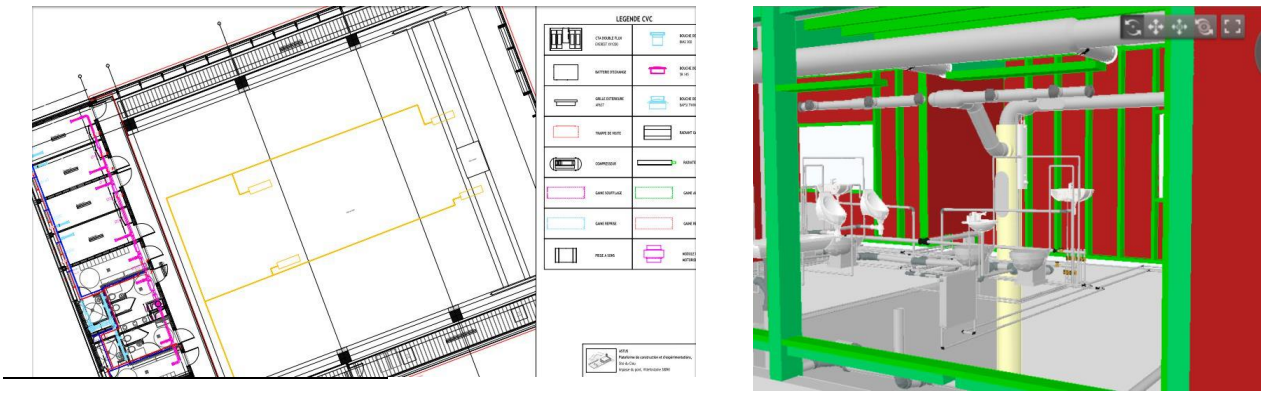
BIM training for on-site workers[6]

One of the challenges addressed by BIMplement is to reduce the gap between the promised energy savings calculated in the design phase of buildings and the real energy consumption.

These issues usually stem from differences/misinterpretations/errors between an optimised design done with a BIM process for complex nZEB buildings and real-life on-site implementation. This may stem from one of the following factors:

- Often only 2D plans not suited to the complexity level of the process are available on the construction site (Figure 18)
- Technical guides and details are not readily available at the construction site
- There may be limited communication with design offices
- It may be difficult to understand interactions with other batches

Figure 18. Example of 2D-plan and 3D BIM model of the same project



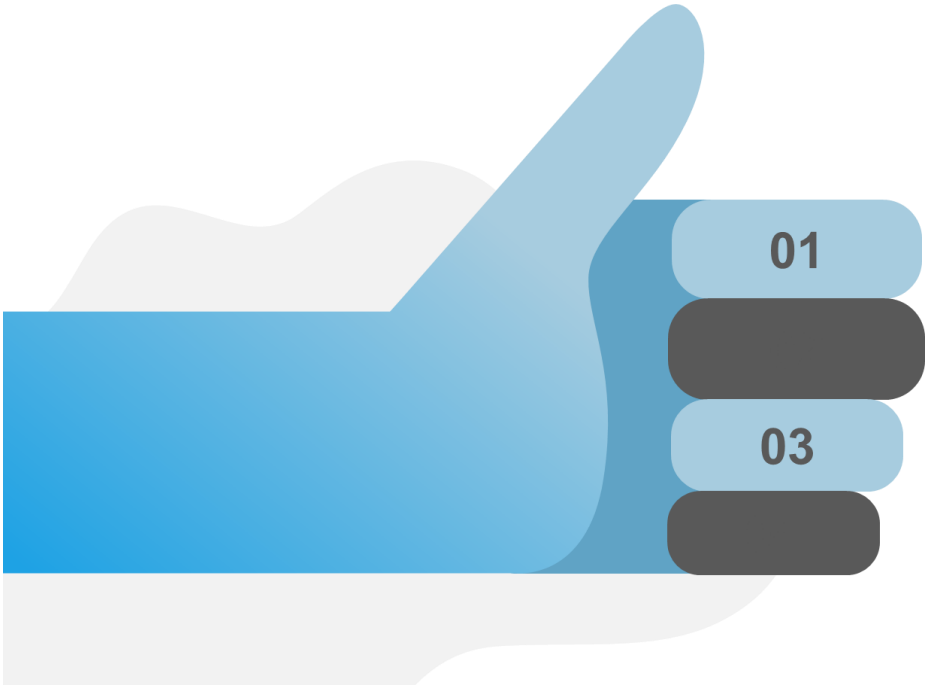
[6] Source: D4.5 Tools, training content, and qualification schemes for BIM workplace trainers

BIMplement helps on-site workers, from site managers to operators, implement a project as close as possible to the designed plans. It does so by offering them the opportunity to:

- get a better view of what will be implemented by different batches
- gain access to technical documentation directly related to implementation
- have exchanges with all stakeholders and receive direct feedback on the project

The main tools will:

- explain to all the project's stakeholders the interest of a global BIM process for an improved on-site implementation
- use BIM freeware viewers to visualise a 3D or BIM model(s) of the project in addition to the use of 2D plans
- train building companies' employees, especially the blue-collar workers



Training will aim to develop the ability to:

- manipulate freeware viewers and visualise a BIM model
- find useful information
- insert implementation documents
- communicate via notes and documents linked to the model's 'classical' training duration given by a training centre on their premises

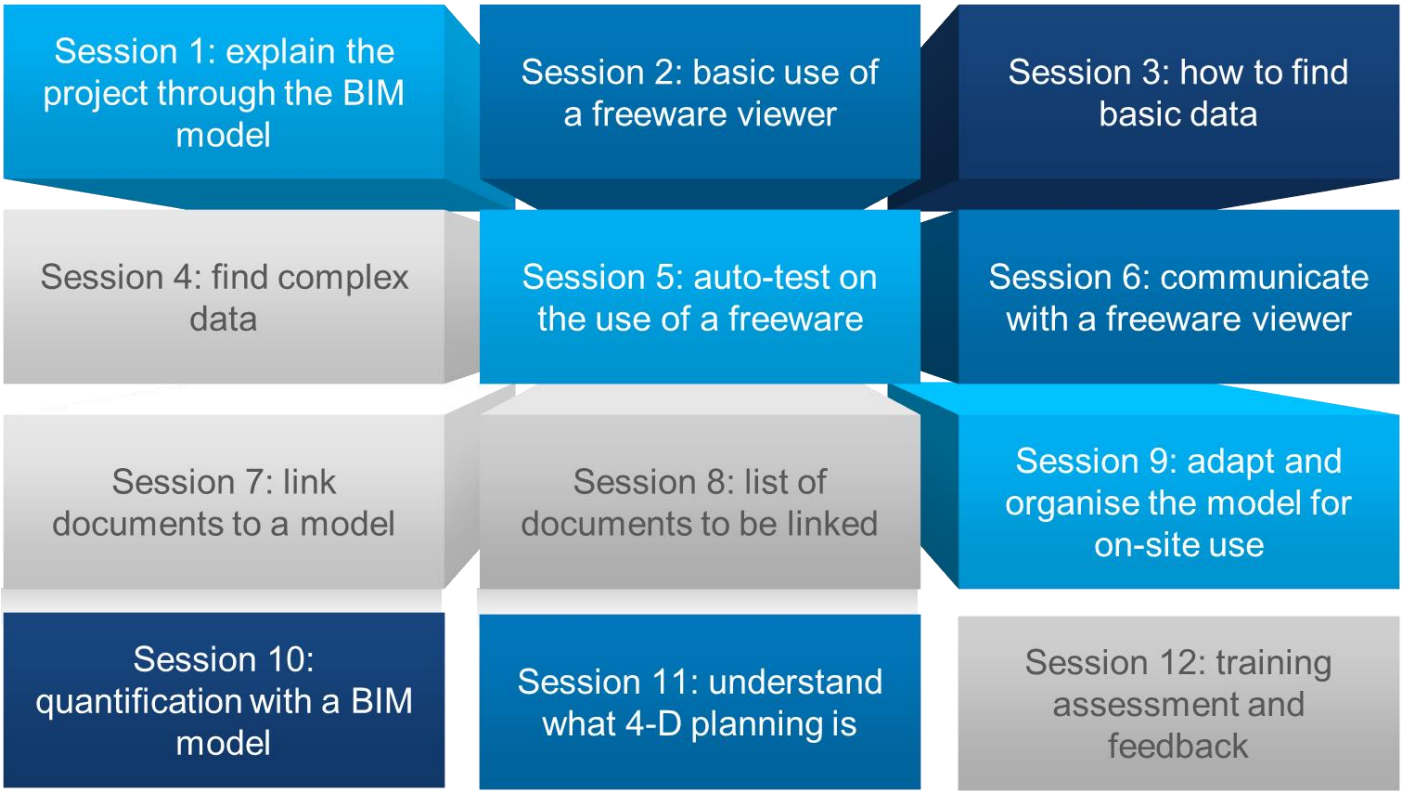
One day will be given to acquire the knowledge and one day for practice.

BIMplement Kit

To make involving blue-collar workers into training activities more attractive to building companies, it is recommended that they apply the BIMplement Kit approach. Training sessions for blue-collar site workers, including the team manager, operators, and craftsmen, shall be implemented in the following way:

- on the construction site, in direct relation with their project
- when the time is available (one hour per session)
- with a trainer that belongs to the building company (not to a training centre)

Training content, including BIM examples and videos, have been developed for each session.



The BIMplement Kit can be found here.

4 Success stories from BIMplement

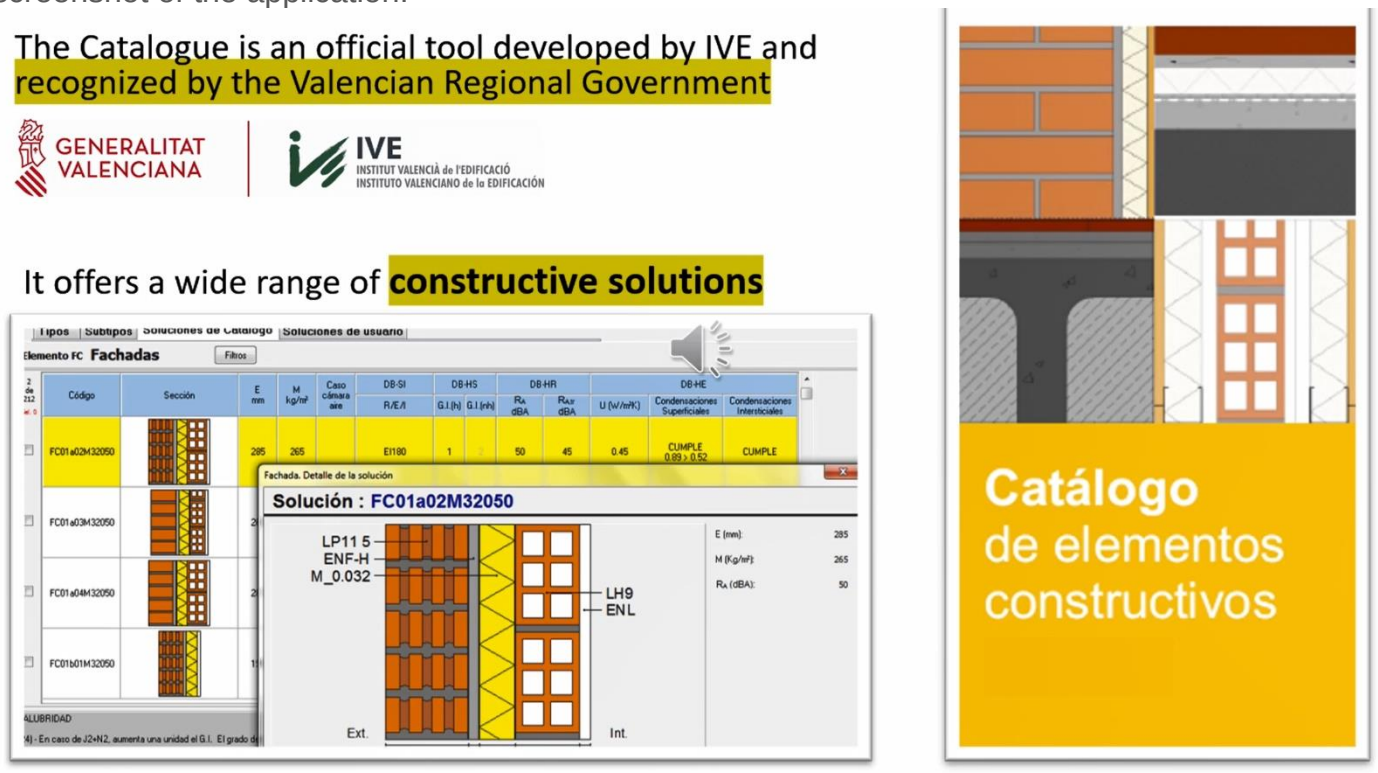
4.1 BIMplement catalogue of constructive elements (Spain)

The construction sector is undergoing a progressive digitalisation with the main objective being to improve quality throughout all stages of the construction and renovation process of buildings while promoting interaction between the different agents who are part of the process.

BIM has emerged in the sector as a collaborative work methodology that allows for the use of a single model to generate and manage all the information on a project throughout its entire life cycle and by all the agents involved.

Member states and regional governments of the European Union are encouraged to join this trend. For this reason, the Valencian Regional Government, through the Valencia Institute of Building (IVE), is betting on the development of training and qualification programs with BIM skills and on adopting its tools in new technologies (see Figure 19). The Spanish success story to highlight is the “Catalogue of constructive elements”. You can find reduced information on the web: https://www.bimplement-project.eu/project/catalogue/

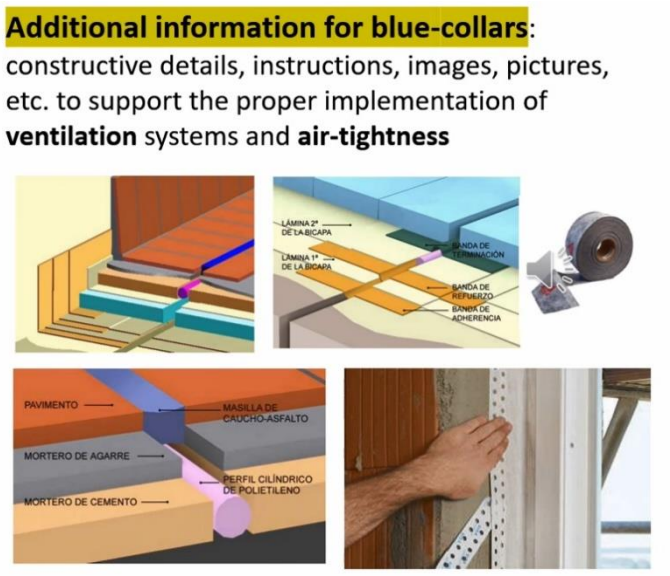
Figure 19. Catalogue of constructive elements: logos of entities involved (GVA + IVE), cover and screenshot of the application.



The catalogue of constructive elements has an online application and BIM export (IFC & Revit) functionality. It also complies with current regulations and has extended information for blue-collar workers (see Figures 20 and 21). Figures 20 shows workers using the Catalogue on-site in a BIMplement pilot building. Figure 21 shows extended information for blue-collar workers on construction details including assembly instructions.

Figure 20. Information-rich BIM model

Figure 21. Extended information for blue-collar workers



4.2 BIMplement FIT2.0 mobile container training (France)

An innovative mobile training platform (BIMplement FIT2.0) was used in France to address the challenge of energy efficiency in the construction industry through the implementation of improved airtightness (Figure 22). BIMplement FIT2.0 allowed for direct feedback from all stakeholders, clients, and building companies.

Figure 22. FIT 2.0 container

Based on the experimentations that have been implemented during the BIMplement project, several facts and findings need to be considered to get the best out of this device (mobile training container):

- SME and craftsmen do not feel, at first, that they need any upskilling of their everyday practices, –> so only if they are obliged to do so, they will spend time to take a training course,
- clients, whether public or private, or general contractors, are the sole stakeholders that can enforce in their contract training for site workers, to guarantee that companies would reach energy efficiency in their project
–> but they need to be previously convinced that it was their interest that blue-collar workers had been trained so to improve their skills in terms of airtightness and ventilation.

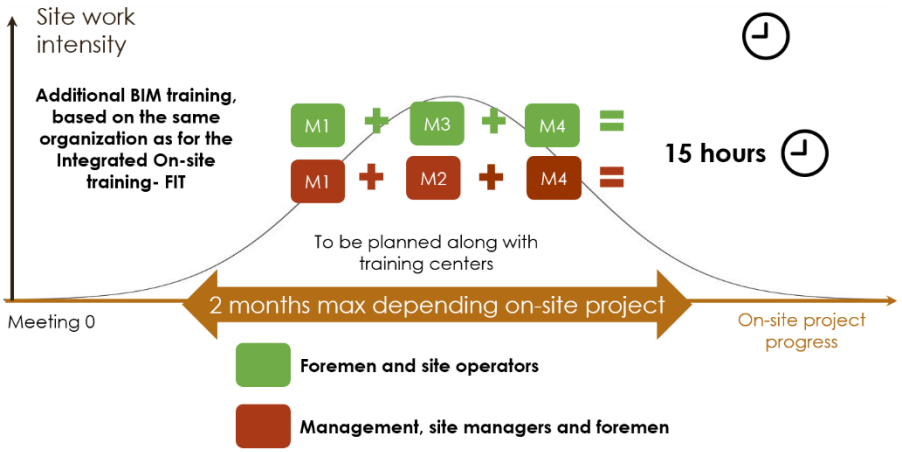
Awareness campaigns toward clients is the most important phase and depending on their level of awareness in terms of energy efficiency and impact of airtightness on nZEB energy consumption, it may take quite some time. The best way to implement training session in the mobile container is to convince the client or general contractor to make this on-site training compulsory for any company concerned with airtightness.

Following the experiments done during the BIMplement project, blower door tests gave 2-to-3-times better results than when no training was given. Therefore, the public authorities and social landlords in charge of building renovation, and who tested the training process, have decided to enlarge this training process to all future projects.

From the companies' point of view, while they were backing away from this training, they all were impressed with the training contents and considered afterwards that it was worthwhile, and even that it would be good for their employees to take the session again for another project.

The original training platform was updated with digital tools and content (FIT container fully modelled under Revit). The new BIMplement+ FIT training aimed to merge both hands-on training and the on-site use of BIM models to ensure the quality of the construction result and a match with the expected design. Four short modules were selected to complete the FIT trainings on site (Figure 23).

Figure 23. FIT training module structure



4.3 BIMAXON & statreg.lt (Lithuania)

BIMAXON

For the presentation of the BIM model BIMAXON and the development, simulation, and coordination of other BIM models, visualisation software has been used in several different cases in Lithuania allowing better alignment of qualifications with nZEB requirements and providing White-Collar and Blue-Collar workers with direct access to BIM data, including construction quality requirements and instructions provided by technology or material suppliers.

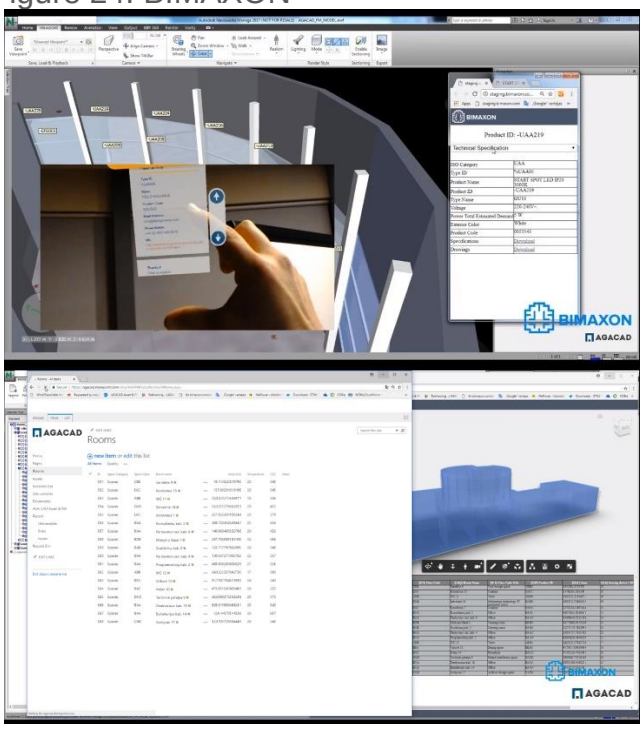
For these cases, the following workflow was learned:

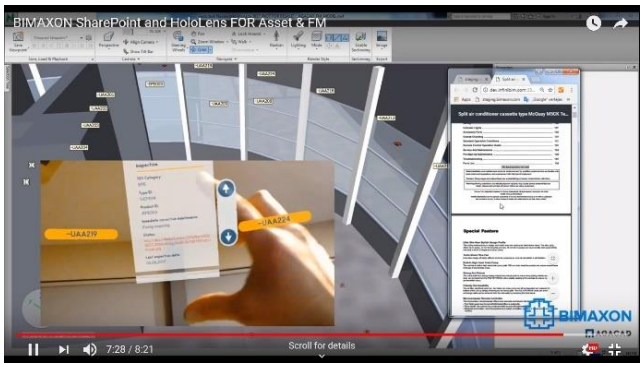
1. 3D laser scanning
2. Modelling in Revit
3. Syncing with BIMAXON CDE in Navisworks
4. Syncing with MS SharePoint in BIMAXON WEB
5. Asset management in SharePoint Online (Included in the Office 365 package)
6. Asset analysis in smartphone and Microsoft HoloLens

The same workflow is used for new BIM projects except for the first task (3D laser scanning).

A video of BIMAXON can be found at https://youtu.be/WvwB7Z4UXns.

Figure 24. BIMAXON





Source: D3.4 Selected tools and learning methods implemented in five national frameworks

STATREG

BIMplement qualifications and competences in Lithuania will be mainstreamed, while using STATREG in a standardised manner. STATREG is a new system for voluntary assessment of the competences and qualifications of construction sector employees and acts as an information portal, a register of competences, and as a tool for analysing the needs of the entire construction sector. In the new competence framework, STATREG (https://statreg.lt/) will be used for registration of those who go through training and would like to validate their competences at the sectorial level. Those who wish to enter the builders' register and receive a builder's card will first need to sign up and specify the desired competences as well as the required data. Card samples are provided in pictures below (Figure 25).

Figure 25. Builder's card

Front Back

Source: D3.4 Selected tools and learning methods implemented in five national frameworks

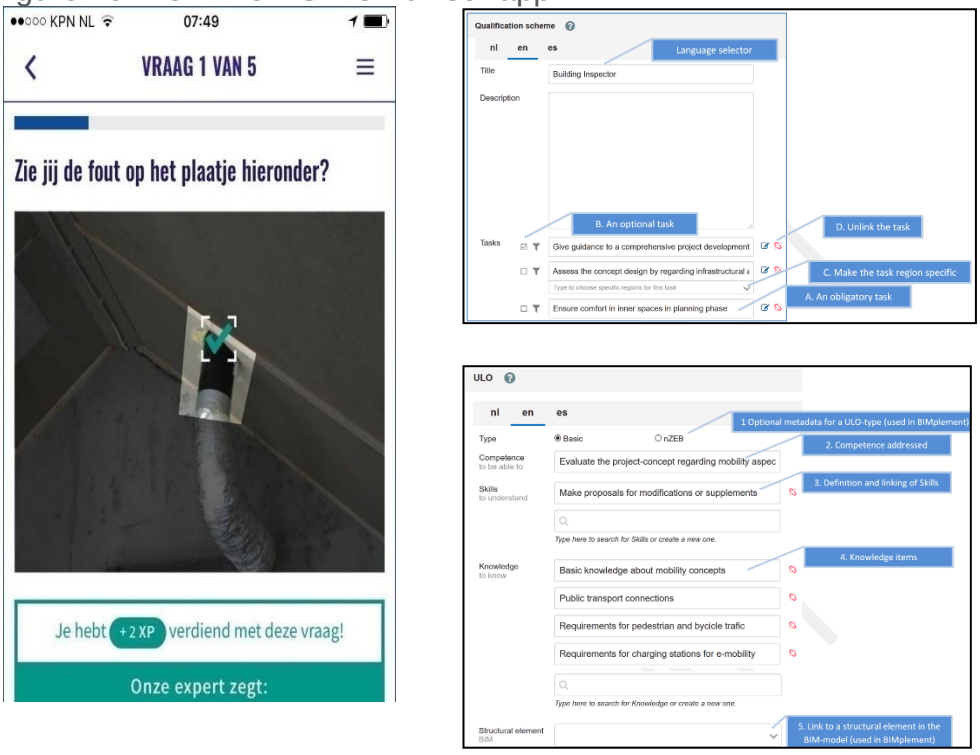
The portal will also contain information on all the trainings planned and implemented during the BIMplement project. Customers and prospective employers will be able to check the portal to see the qualifications and competences of their staff. A builder's card or personal permission provided by the builder will be used for this purpose. The data can be viewed using the quick response (QR) code reader on a smart phone or through a personal password or code. Employers can manage the qualifications, competences, and training of its employees and can also invite tenderers to reference the STATREG register. Employers will be able to find information on training in accordance with the required competences. The portal also provides an opportunity to search for builders who are not currently working but have required and validated competences. Finally, the portal will help to forecast preliminary needs for labour resources, training, and qualifications along with other useful information regarding the competences and qualifications of the construction sector staff.

4.4 BUILD UP Skills Advisor app (Netherlands)

The BUILD UP Skills Advisor app used in the Netherlands can help to obtain insight into current nZEB qualifications. In line with gaining insight on the current BIM qualifications, workers can also obtain information on their current nZEB qualifications as well as on which qualifications are needed for certain roles/functions. The tool allows developing new task based qualifications.

The tools for obtaining nZEB insight include learning from building errors (BUILD UP Skills Advisor app). Below, an example of the Dutch version of the app with Dutch content is presented (Figure 26). The BUILD UP Skills Advisor app is also available in English and Spanish, and content can be created in English too.

Figure 26. BUILD UP Skills Advisor app



BUS advisor app. Source: ISSO. D3.4 Selected tools and learning methods implemented in five national frameworks

5 Appendix

5.1 Glossary of terms used

List of acronyms and abbreviations

Abbreviation	Meaning
BIM	Building information model
CPD	Continuing professional development
ECTS	European Credit Transfer and Accumulation System
EHEA	European Higher Education Area
EQF	European Qualification Framework
IAQ	Indoor air quality
ISO/IEC 81346	International Standard 81346. Published jointly by IEC and ISO, it defines classes and subclasses of objects based on a purpose- or task-related view of the objects together with their associated letter codes to be used in reference designations.
nZEB	Nearly zero-energy building

5.2 Definitions

Term	Meaning
Accreditation	Accreditation is a quality assurance process under which services and operations of educational institutions or programs are evaluated by an external body to determine if applicable standards are met. If standards are met, accredited status is granted by the appropriate agency (*Wikipedia*).
BIMAXON	BIMAXON is a human-readable classification of BIM element properties that facilitates communication, helps fill in gaps in the BIM process, and makes it easier for every actor to obtain and understand the information that they need at any given moment. It is based on BIM use cases and the needs of specific BIM actors to ensure that deliverables are right for every drop point and to provide exactly the right set of information to each actor at each moment.
Building stages & RIBA	A building life cycle consists of several stages. The RIBA Plan of Work is the definitive UK model for building design and construction processes.
Competence	A competence is the ability of an individual or organisation to do something effectively. It consists of a cluster of related abilities, commitments, knowledge, and skills that enable a person (or an organisation) to act effectively in a job or situation.
Initial education	Initial education is training received before entering the labour market. In general, it is based on qualification documents and corresponds to professional competency profiles. These qualification documents are drawn up nationally by the knowledge centres of the various professional sectors. Completing initial education results in the earning of a particular European Qualifications Framework (EQF) level and a diploma with unlimited validity.
Multi-layered qualification	A multi-layered qualification is a description of tasks that shall be performed effectively. It consists of a layer with basic tasks and one or more layers of context-specific tasks (e.g. nZEB-related tasks, BIM-related tasks, or indoor air quality (IAQ) tasks).
Occupation	An occupation is a job or profession.
Post-initial training	Post-initial training is training individuals receive after they have completed initial training. In general, professional post-initial training is based on demand from market parties for retraining. These short trainings most times result in a certificate with limited validity. They do not result in the earning of a particular EQF level.

Profession	A profession is a specialised occupation characterised by profession-specific education and training.
Recognition	Recognition in this context includes the pass of an examination or the official completion of a course, especially one conferring status as a recognised practitioner of a profession or activity.
Qualification	A qualification is a set of one or more qualification schemes.
Qualification scheme	A qualification scheme describes what a participant in education should know and master by the end of a (intermediate vocational training) course. A qualification scheme describes the level of beginning professional workers (school leavers).
Qualification structure	A qualification structure is a formal system describing qualifications. It makes visible which qualifications or sets of competences are sought by the labour market, education, and society so that an individual can secure a job, begin further studies, or participate in society.

Term	**Meaning**
Skill	Skill is the ability to do something well or an expertise.
Skill level	0 – Not applicable/no knowledge or skills 1 – Has little knowledge and skills with respect to the relevant field/technology (i.e. mostly has outside the field of expertise), understands basic principles and is able to take part in project team discussions 2 – Understands basic knowledge and has practical skills regarding the field/technology; is able to solve simple problems by selecting and applying basic methods, tools, materials, and information (mostly outside of the field of expertise) 3 – Has comprehensive, factual, and theoretical knowledge and skills within the field/technology and is capable of solving standard problems within the field 4 – Has advanced knowledge involving a critical understanding of the theories, principles, and skills required to solve complex and unpredictable problems within the field and is aware of the boundaries of the field 5 – Has specialised knowledge and problem-solving skills, partly regarding the forefront of knowledge in the field, and can develop new knowledge and procedures and to integrate knowledge from different fields
Specialism	A specialism is a technology or the application of several combined technologies to a specific set of tasks.
Task	A task is a piece of work to be done or undertaken.
Taxonomy	A taxonomy defines classes of objects and relations among them.
Training scheme	A training scheme is a scheme for teaching people skills in a particular field or profession.
Trias energetica	Trias energetica is a concept based on 3 steps. First, we need to limit energy demand through energy saving. Second, renewable sources should

	be used to meet the remaining energy demand. Finally, fossil fuels should be used as a last resort and as efficiently and cleanly as possible.

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