



# BIMplement

Towards a learning building sector by setting up a large-scale and flexible qualification methodology integrating technical, cross-craft and BIM related skills and competences.

[www.bimplement-project.eu](http://www.bimplement-project.eu)

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<b>Report:</b>	D2.2 Five national results of usability testing
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Date:	2019-31-1
Partners involved	IVE, ISSO, AVE, Mostosal and RIMC



This project has received funding from the European Union's h2020 framework programme for research and innovation under grant agreement no 745510

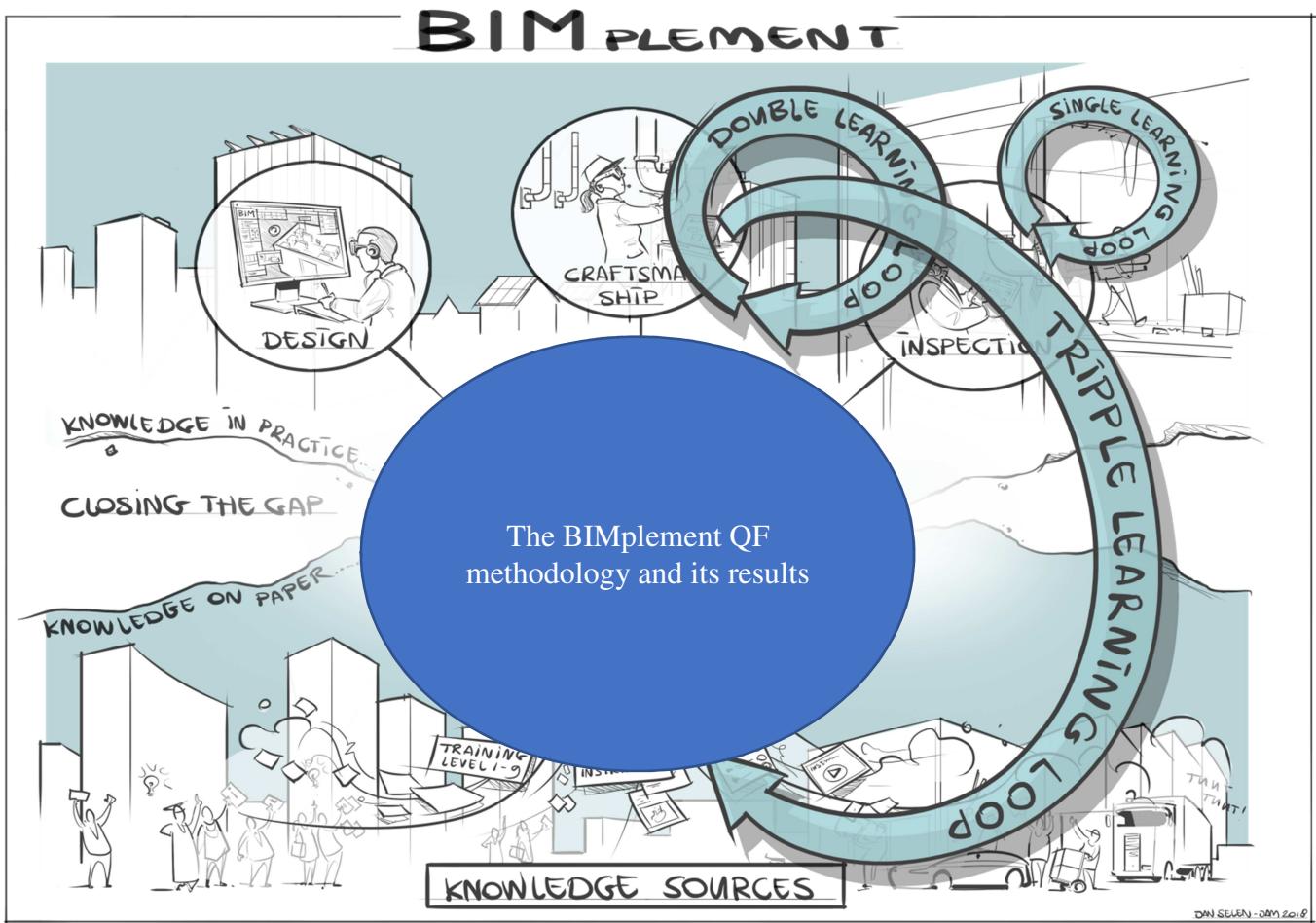
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## 1. Introduction

Objective of BIMplement workpackage 2 was to develop a BIM-enhanced Qualification Framework (QF) empowering nZEB construction and renovation. This as the engine needed to led relevant instructiona and inspection content flow to the right person, on the right time and on the right spot.

And also to enable and facilitate several 'learning loops.



An initial version of the methodology was developed in three iterations during T2.1 'Drafting the methodology'. During implementation within the consortium four additional improvement iterations have been made. As last step in T2.3 the methodology is finalized and a Qualification database is developed in co-production with H2020 NEWCOM and documented in an easy to use userguide.

Goal of this deliverable is to document the validation of the methodology in an iterative dialog with National stakeholders in Poland, France, the Netherlands, Lithuania and Spain. Because the iterative character of the development process it was decided to postpone a dialogue with national stakeholders. As a result not only the drafted methodology the methodology and the results of the iterations in T2.1 are discussed with national stakeholders, but also the results of WP3 iterations.

### Reading guide

In the next chapter the followed approach for the stakeholder interviews is given. After that for each country the results are collected in a chapter for each country.

## **2. Followed approach for the stakeholder interviews**

As a preparation for the stakeholder interviews a Powerpoint presentation has been developed that addresses visually the goal of BIMplement, iterations in the development process and the to be expected results.

In each BIMplement country at least one stakeholder interview has to be done. These interviews are countrywise documented in the remainder of this deliverable.

The elements of the interviews are structured in the following indicative agenda:

1. Introduction of BIMplement (using the BIMplement presentation) 15 minutes
  2. A step-by-step presentation of the developed aspects within the methodology  
Using the D2.2 presentation 30 minutes

Some indicative questions that can be answered:

- a. Do you understand the presented elements of the methodology?
  - b. Are there elements missing?
  - c. How do you estimate the chance of connecting the QF to the BIM-model?
  - d. Do you have suggestions for connecting the QF with the BIM-model?
  - e. How do you think a methodology that involves blue collars will improve the final quality of buildings?
  - f. Ventilation and air tightness are key for nZEB buildings. What are the most common mistakes that you find in the construction of buildings regarding these topics? Do you think that presented methodology of the BIMplement can help solve these problems?
  - g. Feel free to add more questions!

3. Looking forward to implementation of the methodology  
minutes



For more background information take with you a copy of D2.3 and when stakeholders are also interested in the technical content a copy of D3.1.

### 3. Results from Spain

Meeting with representative on INNOVACIÓN TECNOLÓGICA BIM Group

This group is working on the level of implementation of BIM in the Valencian Community, specifically on how to implement this technology in public procurement.



#### Main conclusions:

- Methodology is clear enough. The approach is good since skills and competences required are different depending on the professional activity and the stage in the construction process. For instance: public procurers don't need to know how to model a project in BIM, but they need to understand the model, use viewers, understand how to include BIM criteria in public procurement, etc.
- BIM training for blue collars is something that is not happening in Spain and could have an added value. Training for them, as well as tools, should be simple in order to get them involved (viewers, check lists, etc.)
- In the Valencian Community, training for professionals should be focused on the advantages that BIM offers to each stakeholders in each stage. There are many courses for BIM modelling. This will depend on the level of BIM implementation in each country.
- RIBA workplan doesn't include demolition as one of the stages in the construction process. It would be good to consider also this stage in the methodology. Even though it is not directly related to nZEB, it is useful to consider effective construction and demolition waste management practices to favour a circular economy. Quantitative waste prediction is crucial for waste management. BIM can support the collection and management of information of materials through smart processing of data in the pre-demolition stage. It can be also used for drafting waste audits, for instance, actual waste streams that will be produced depending on the processes planned (disassembly, removal, demolition) for the different elements in the building.

## 4. Results from France

Stakeholder interview on developed methodology for BIM-enhanced Qualification Frame work empowering nZEB construction and renovation

Meeting with representatives of CONSTRUCTYS

The french organisation which, among other missions finances the trainings of SME's white and blue collar workers in the building sector & analyses the training needs

They Provide information and advice on training schemes



Main outcomes

- The methodology is clear and logic.
- Airtightness is a cultural issue, that has to be shared by all the crafts.
- Each craft has to take care of what other crafts are doing
- The use of new materials contributing to airtightness requires specific skills.
- What competencies are needed to use BIM at the workplace ? This is a key point.
- The trainings contents have to be adapted (« contextualised ») to each workplace : this means that « fils rouges » (a script ?) have to be written for each of them.
- BIMplement has to take into account the fact that the cultures of white and blue collar workers are not the same in the « latin » countries and in the « nordic » countries.
- The workplace trainers have to be flexible and pragmatic – not « academics ».
- The QF should not be « set in the marble », but take into account the outcomes from the workplaces.
- One important problem is linked with the competencies of involved architects and engineers, as well as of the clients. These competencies have to be taken into account by BIMImplement.
- BIM can/should be a tool that helps the crafts/workers to better cooperate/collaborate at the workplace

## **5. Results from The Netherlands**

The Netherlands have a lot of specialized organizations who are working on improving BIM use, information quality and worker skills. With several front runners on BIM there have been meetings to assess the needs of the industry and if the BIMplement methodology and results would fit these needs. Amongst others, these companies are:

- Root BV (high end BIM modelling company)
- Solidu (consultancy on BIM use on the construction site)
- Based (consultancy on BIM implementation in construction and engineering companies)
- BIMPuls (consultancy and training in BIM for installation companies)
- Anno1809 (training technical and social BIM skills)
- BuildingChanges (BIM consultancy on cooperative knowledge transfer)
- BIR (national Building Information Council)

In general, BIM maturity in the Dutch construction sector is high, but mainly focusses on white collar workers. Only a few companies have taken steps thus far, to make BIM usable for blue collar workers. This is mainly due to cultural difference between white and blue collar workers and the focus on technical skills, rather than digital skills. However, more and more companies are turning their sights to using BIM based tools for quality control and transferability and reuse of information (by creating a 'digital twin' of the building).

There is a growing need for professional education and training. But right now, BIM training and education is structured, nor fully mature and (lack of) funding is a serious issue. Aside from software vendors (who train technical, software skills mostly), there are only a handful of trainers and educators. For clients (contractors, engineers, etc) it is not easy to discern between suppliers of training and education. However, both clients and suppliers feel they will benefit if there were a structured qualification framework. Clients will be helped with educating their workers structurally and can choose the best form to help them, and suppliers will be helped to create the best content and develop new and better training materials. If such a qualification framework was to be integrated in IFC models, it would surely help to get the 'right man/woman for the job' and also help the industry to develop a good supply and demand in BIM training and education.

Sustainability in The Netherlands is a rapidly evolving business in the built environment. The government is implementing more and more strict laws on energy efficiency, used materials and reusability. Every new building from 2020 on needs to be nZEB and the industry is working hard to meet these demands. With BIM (almost always) being the norm in every project, software vendors and front runners are developing solutions to integrate nZEB with BIM.

All consulted companies applaud the BIMplement approach as they see it as a great help in taking the next step in creating better (nZEB) buildings. They are especially interested in how the flow of information (during the life cycle of the building) can be linked to a qualification framework, so every organization that is involved can benefit.

The main risks that are identified are related to culture (how do we get blue collar workers in a proactive mode?), to finance (who is willing to pay for this?) and to flexibility (how do we make the results usable in every project and for every person).

## **6. Results from Poland**

Results from meetings organized at construction sites:

- Methodology is clear enough. However there is a fear on who will introduce the necessary data to the BIM models and whether that person will do it in the correct way.
- BIM training for blue collars is something that is not happening in Poland. Construction companies that do their work using own craftsmen may have bigger interest in training of employees compare to the General Contractors that subcontract companies. However training for all stakeholders about using basic BIM tools can have a positive impact.
- White and Blue collar workers do not have enough trust to BIM models and information insert.
- To convince construction workers to use BIM tools we must show clearly what benefits it will bring in their daily work.
- Implementation of BIM technology on construction site requires changes in the current style of work. The social aspect of adopting new solutions is very important and should be taken into account before start trainings.
- The big challenge is to show how the money invested in BIM tools will provide benefits at a later stage.
- BIM tools should be presented as something that will bring benefits for construction workers and not as a next additional tasks for which they will have to spend more time. Whether the BIM tasks replace some of their previous traditional tasks?
- In Poland there is still no formal regulations regarding the BIM, so all stakeholders still need to work using 2D documentation according to the present regulations.
- Lack of knowledge on how to include BIM aspects in the contracts with subcontractors leads to the problem with the enforcement of using the BIM methodology.
- Presenting works using 4D BIM models can bring benefits in better understanding of the sequence of work by construction workers.

## 7. Results from Lithuania

For the BIMplement implementation in experimental sites, at the end of 2018 (December) Regional Innovation Management Centre and Lithuanian Builders association started a round of contacts to find place for pilot projects that could fulfill the BIMplement team developed initial criterions for the selection of projects. Main priority for selection of contractors for Experimental sites in Lithuania was selection from Lithuanian companies that already have initial experience within NZEB and BIM related projects. Also, as priority for selection there were included some contractors that have started their journey within some real BIM projects now and are planning to finish them till the beginning of 2020. (Remark: Energy efficiency improvement requirements, NZEB (A++ and higher) are compulsory from the government for all new buildings from 2019 in Lithuania). The Initial list of potential contractors for BIMplement experimental sites was taken from WEB page [www.digitalconstruction.lt](http://www.digitalconstruction.lt), from the "BIM awards" and "Companies creating BIM" in Lithuania lists <https://skaitmeninestatyba.lt/imones/>. First contacts and initial "go for the BIMplement experimental site" were agreed with YIT Lietuva.

During the conversations with YIT Lietuva the BIMplement aims and methodology is presented to have an initial reflection of possible needs of the company as well as they willingness to test the methodology at real construction sites. As an example, during the meeting YIT Lietuva expressed their intention to apply methodology at their construction site, while indicating the need to use BIM for quality control of the work of the subcontractors including those operating in Ventilation and air tightness areas. The company already has good examples of the use of BIM and building of NZEB buildings, and, therefore, is very well aware of issues related to BIM and involvement of different types of employees into the process. It also uses a specialized software, thus, there will be a need to use suggested methodology, while tailoring it to the company's needs and the technology base that they already have. Futher exploration of methodology will only be possible when real implementation steps will be started.



Picture from the meeting with YIT Lietuva (3 January 2019)

# COLOFON

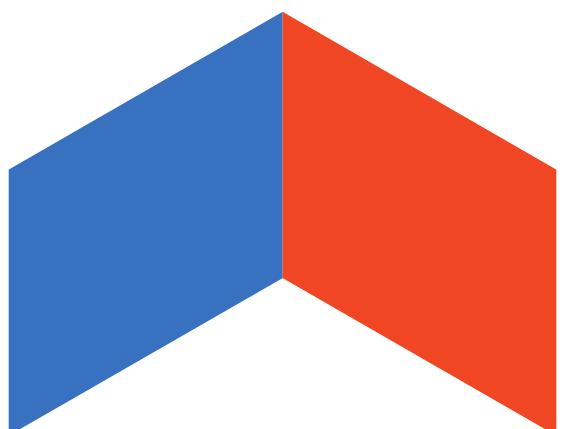
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# STAKEHOLDER INTERVIEW ON

## Developed methodology for BIM- enhanced Qualification Framework empowering nZEB construction and renovation

JANUARY 2019



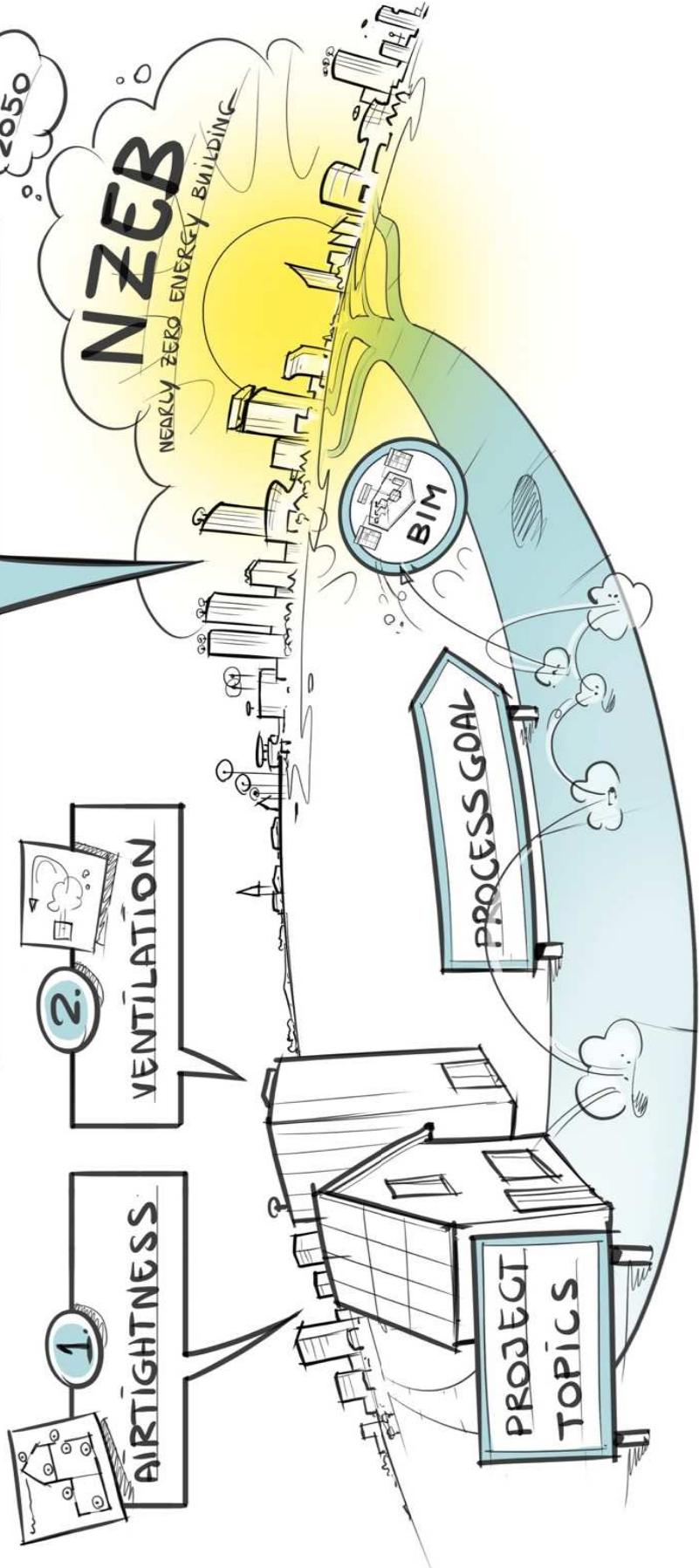
Jan Cromwijk, ISSO

## INDICATIVE AGENDA

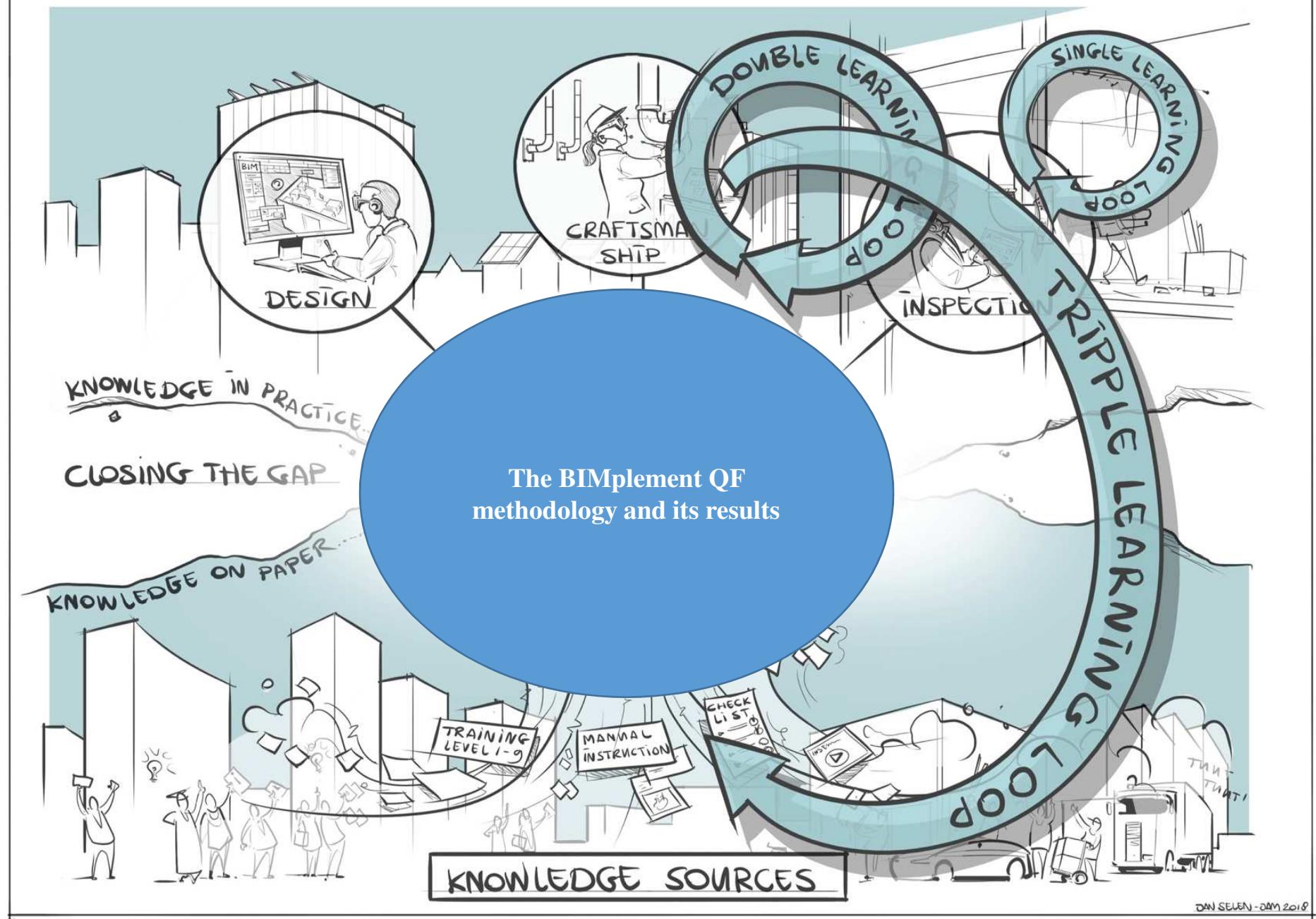
- |  |            |
|--|------------|
| 1. Introduction of BIMplement (using the BIMplement presentation / animation)                      | 15 minutes |
| 2. A step-by-step presentation of the developed aspects within the methodology (this presentation) | 30 minutes |
| 3. Looking forward to implementation of the methodology  | 15 minutes |
| 4. Making of a photo, as proof of the Interview  | 5 minutes  |

# BIM PLEMENT

ENSURE  
SYSTEMATIC QUALITY CONTROL  
THROUGH THE PROCESS



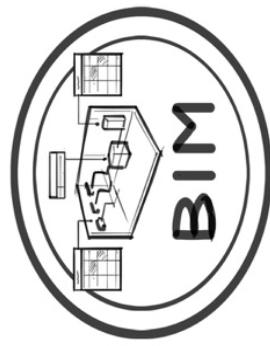
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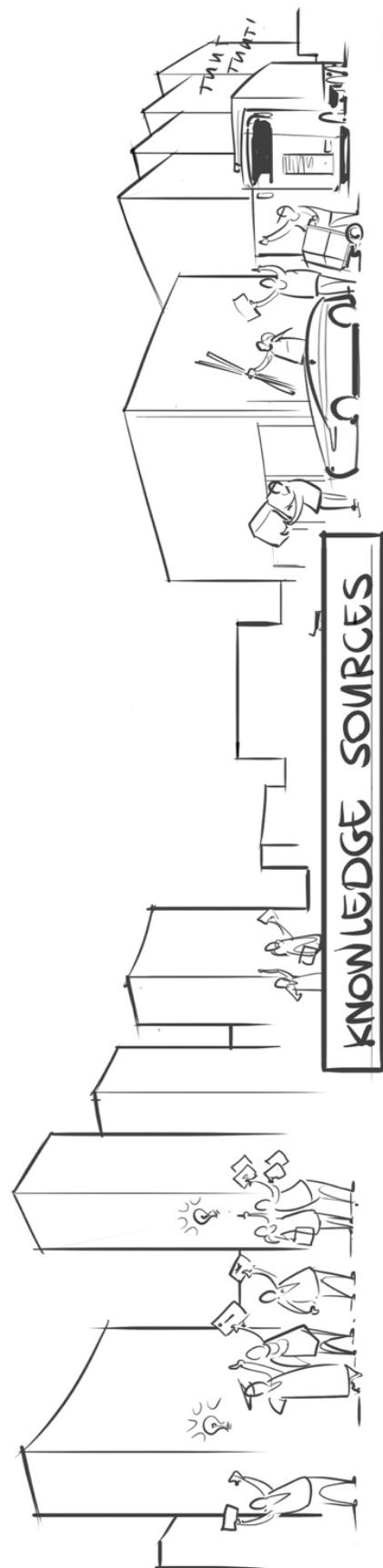
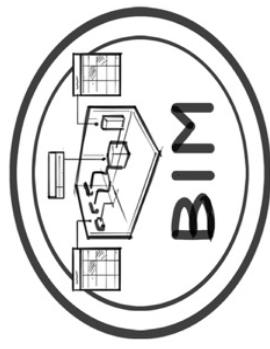
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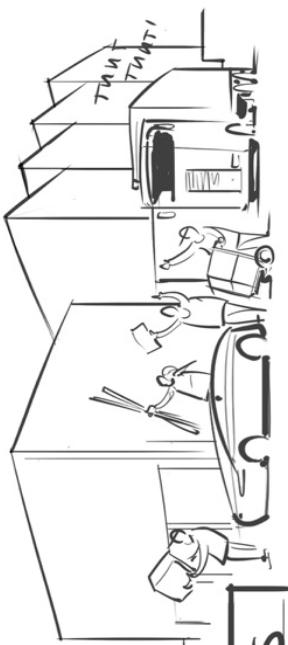
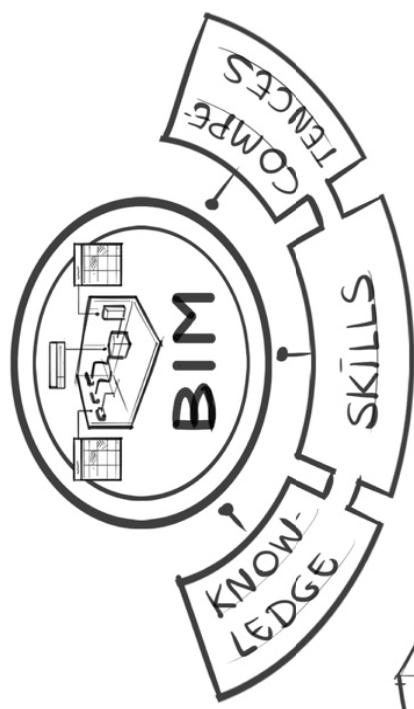
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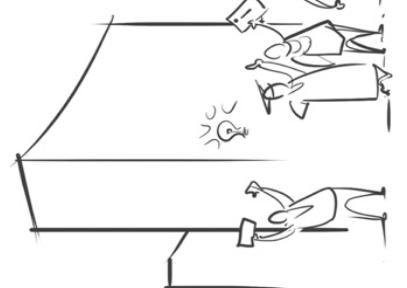
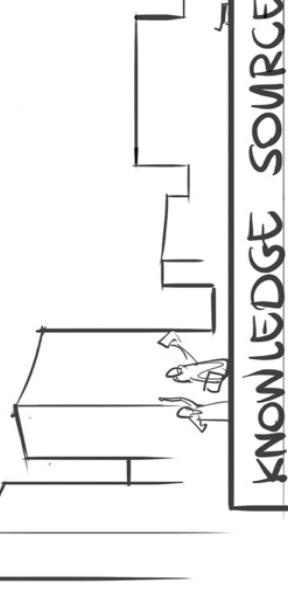
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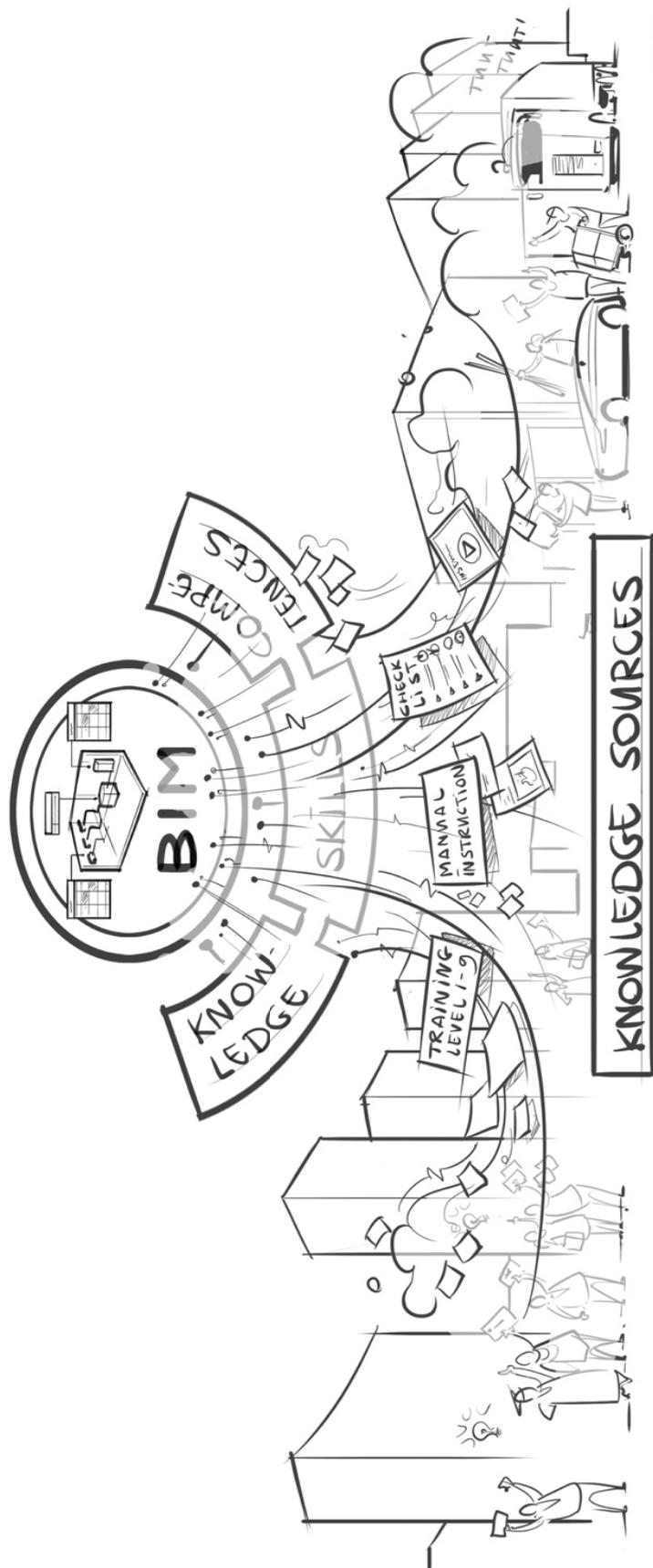
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KNOWLEDGE SOURCES



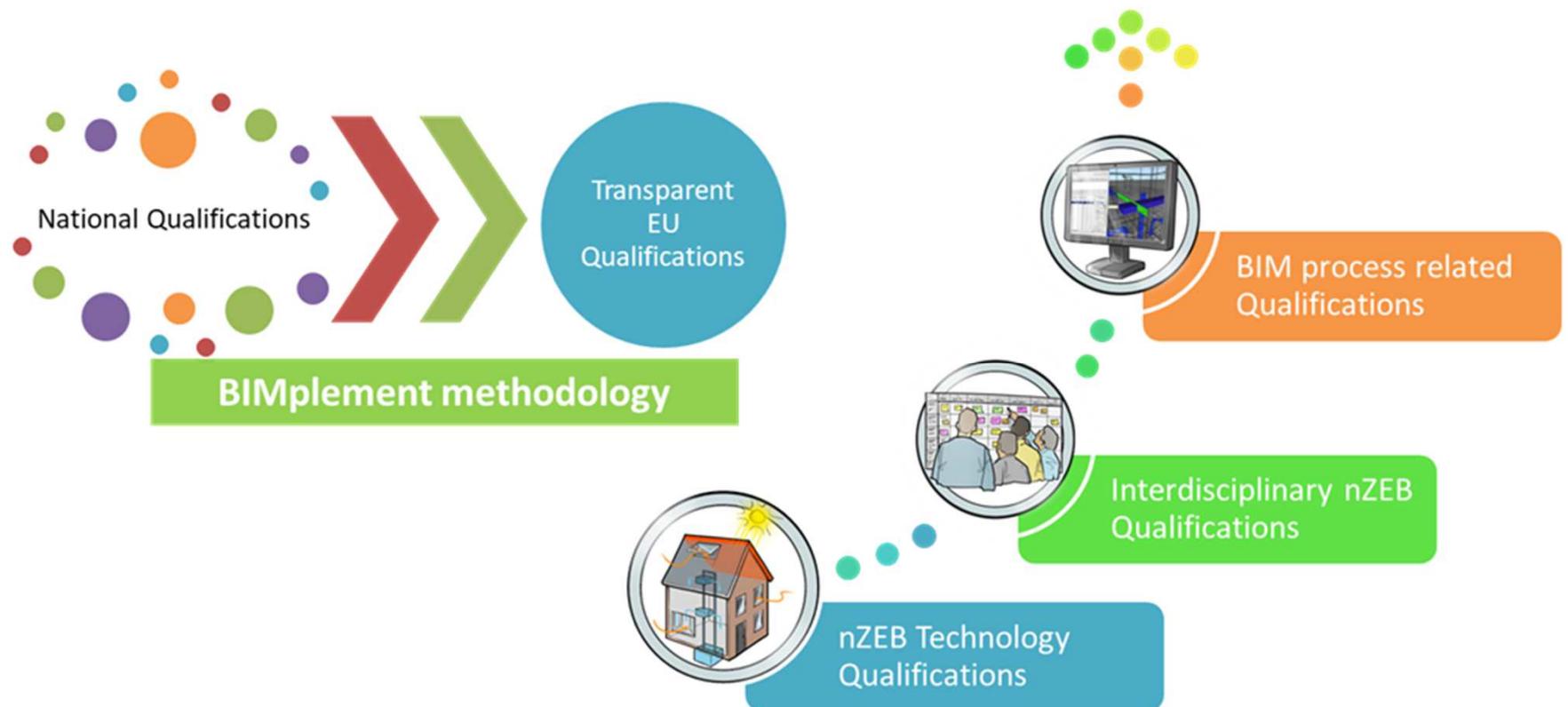
# BIM PLEMENT



## DEVELOPMENT OF THE METHODOLOGY

1. Starting point
2. Iterations made
3. Final results

## OUR STARTING POINTS FOR QF DEVELOPMENT



## SETUP OF THE FIRST DEVELOPMENT ITERATION

nZEB Specialisms		Professions/occupations involved						
	Short description of the specialism							
		M-Installer	E-Installer	Carpenter	Bricklayer	Process manager	E-Engineer	M-Engineer
Heatpumps								
Type of	Proces-Phase	Tasks related	Classification					
Water-water	Programme	Task 1	nZEB	x			x	
		Task 2	Interdisciplinary	x	x	x	x	
		Task 3	BIM					
		Task n						
	Design							
	Elaboration							
	Realisation							
	Operation							
	Maintenance							
Water-air	Programme							
	Design							
	Elaboration							
	Realisation							
	Operation							
	Maintenance							
Air-Air	Programme							
	Design							
	Elaboration							
	Realisation							
	Operation							
	Maintenance							



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# RESULT OF THE FIRST DEVELOPMENT ITERATION

nZEB Specialisms		Workfields involved																																																																																																																																																																		
Ventilation of homes	<p>A ventilation system is necessary to guarantee fresh indoor air climate. The energy use of this system is very much dependent of the type of system, and the quality of engineering and construction. The types addressed are: mechanic ventilation, decentral ventilation and balanced ventilation.</p> <table border="1"> <thead> <tr> <th>Type of</th><th>Proces-Phase</th><th>Tasks</th><th>Subtasks</th><th>Architecture</th><th>Building management</th><th>Construction management</th><th>Electrical engineering</th><th>Mechanical Engineering</th><th>Structural engineering</th><th>Financing and procurement</th><th>Bricklayer</th><th>Carpenter</th><th>E-installer</th><th>Concrete/masan borer</th></tr> </thead> <tbody> <tr> <td>Decentral</td><td>Programme</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr> <td></td><td>Design</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr> <td></td><td></td><td>Make an air balance for the building</td><td></td><td></td><td>X</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr> <td></td><td></td><td></td><td>Determine ventilation requirement per room</td><td></td><td>X</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr> <td></td><td></td><td></td><td>Determine airflow rate from one room to another</td><td></td><td>X</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr> <td></td><td></td><td></td><td>Divide flow rate(s) over suction points</td><td></td><td>X</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr> <td></td><td></td><td></td><td>Determine percentage of outside air for each room</td><td></td><td>X</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr> <td></td><td>Elaboration</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr> <td></td><td>Realisation</td><td></td><td>Installation of a local balanced</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>X</td></tr> </tbody> </table>														Type of	Proces-Phase	Tasks	Subtasks	Architecture	Building management	Construction management	Electrical engineering	Mechanical Engineering	Structural engineering	Financing and procurement	Bricklayer	Carpenter	E-installer	Concrete/masan borer	Decentral	Programme															Design																Make an air balance for the building			X													Determine ventilation requirement per room		X													Determine airflow rate from one room to another		X													Divide flow rate(s) over suction points		X													Determine percentage of outside air for each room		X											Elaboration															Realisation		Installation of a local balanced											X
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## SETUP OF THE SECOND DEVELOPMENT ITERATION

An example of the use of classifications to build up the multilayered qualification

**Technology**      **Ss Systems - 30 July 2017 - v1.7**

- Ss\_65\_40\_33\_? Decentral balanced ventilation system

**Main task / Main activity**

- Installation

**When: (BIMAXON-STAGES)**

S5 STAGE 5: Construction (extra activities needed to ensure protection of the installed system)

S7 STAGE 7: In Use (extra activities needed for ensuring minimal dust-release)

**Sub-task / Sub activity**      **BIMplement taxonomy**

**SIT** = Self Inspection Task

**BIT** = BIM task from BIM USES - BIMAXON taxonomy

**WOT** = Work Task from BIMplement taxonomy



# RESULT OF THE SECOND DEVELOPMENT ITERATION

## Example of a result of the second iteration



**Basic Task:** check if there are cables or tubes in a wall

- K1: what to know (there can be existing cables or tubes in a wall)  
K2: what to understand (drilling through existing cables or tubes can be risky & costly)  
K3: what activities to be able to  
1. use a wire/tube finder (=separately stored task)  
2. read a drawing (=separately stored task)

# RESULT OF THE THIRD DEVELOPMENT ITERATION

## Illustrative result of the third iteration

BIMplement (Task classes) for subtasks

BAS Basic task

(we do not detail these tasks, they are only mentioned)

BIT BIM task

(all tasks to BIM empower the work to be done (more efficient))

nZT nZEB Task

(all tasks concerning application of nZEB technologies)

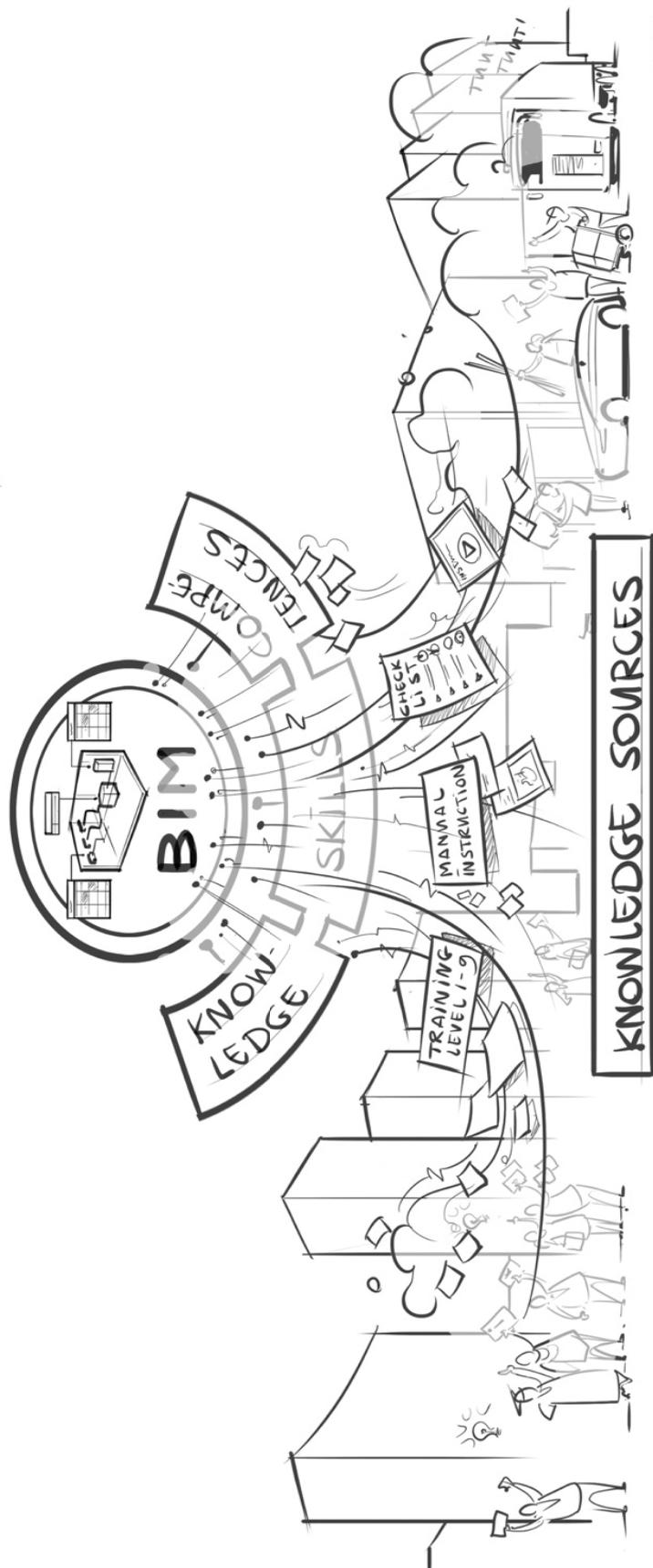
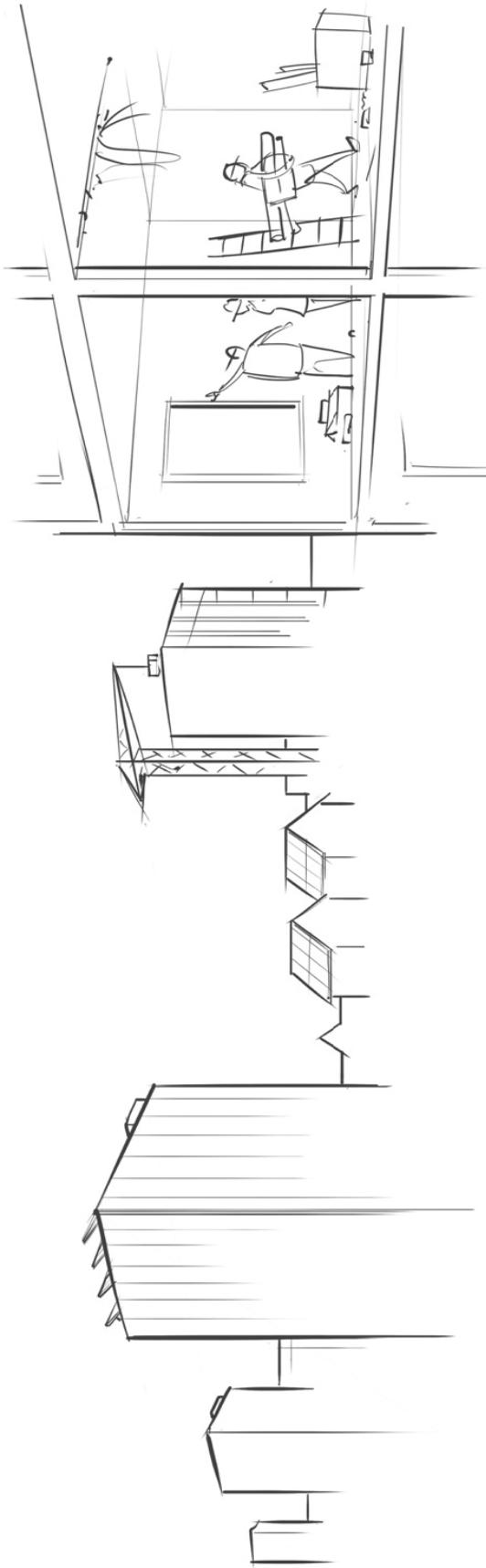
Aspects of quality control are integrated into the task descriptions

S5 STAGE 5: Construction

1. Field / manage tracking Check if this is the right moment in the planning
2. Safety planning Check if safety measures are in place
3. Create wall passages for supply and exhaust air
  - e. Determine the location where the system must be mounted
    - i. check how many connections have to be made to the system (supplier documentation)
    - ii. determine the needed space for the system (supplier documentation)
    - iii. determine stiffness of the wall
    - iv. check if there are cables or tubes in the wall
  - f. Mount the drilling template
    - i. Check with Augmented Reality measuring if the drilling template is placed correctly
  - g. Drill needed holes : Ø 300 – 350 mm in the wall
4. Install ducts in the wall (air and water tight)
  - h. Realize air- and water-tightness
    - i. Make photo's between the steps that have to be performed to realize air- and water-tightness
    - ii. Measure the airtightness with a Sound-brush

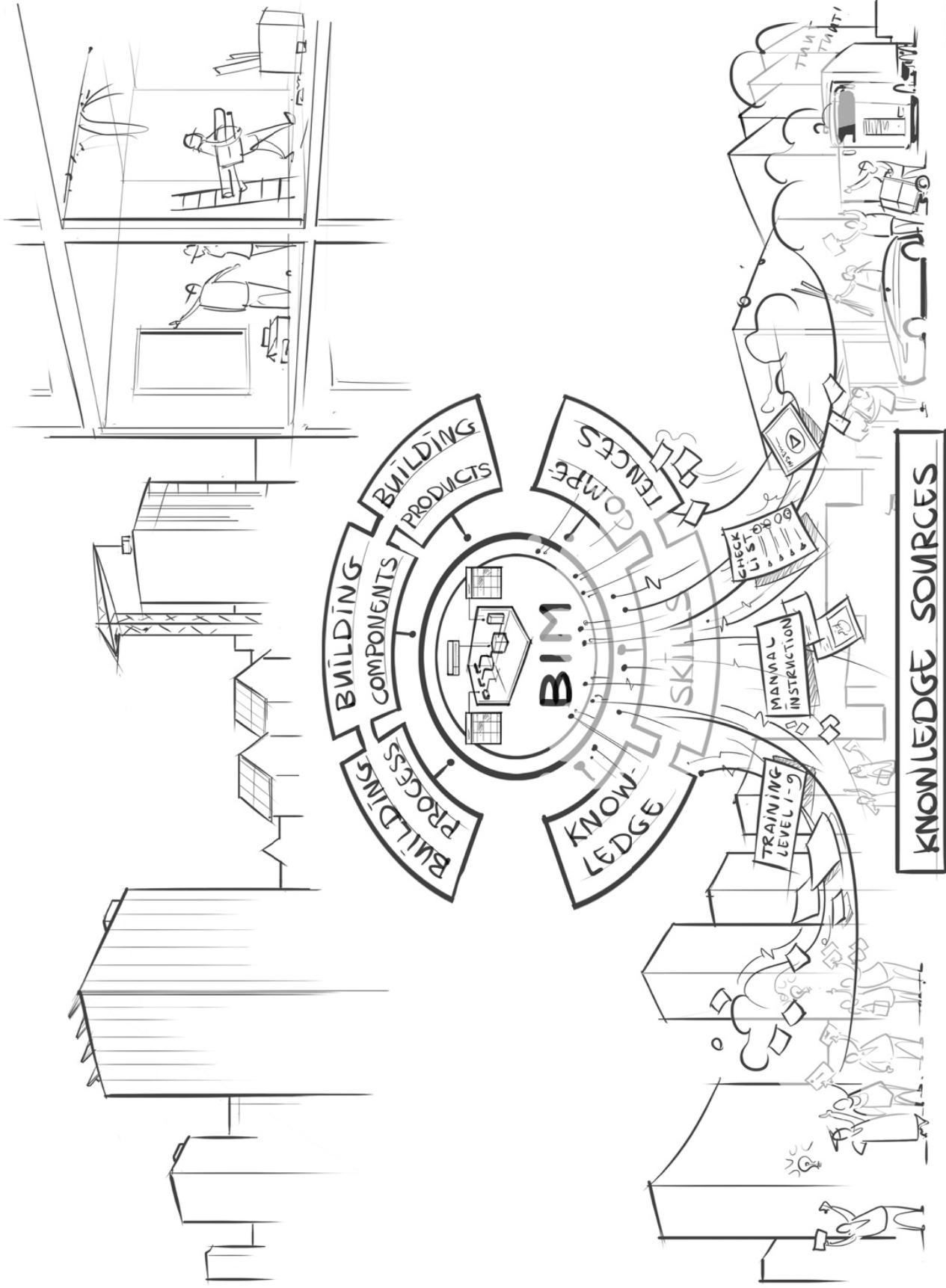


# BIM PLEMENT



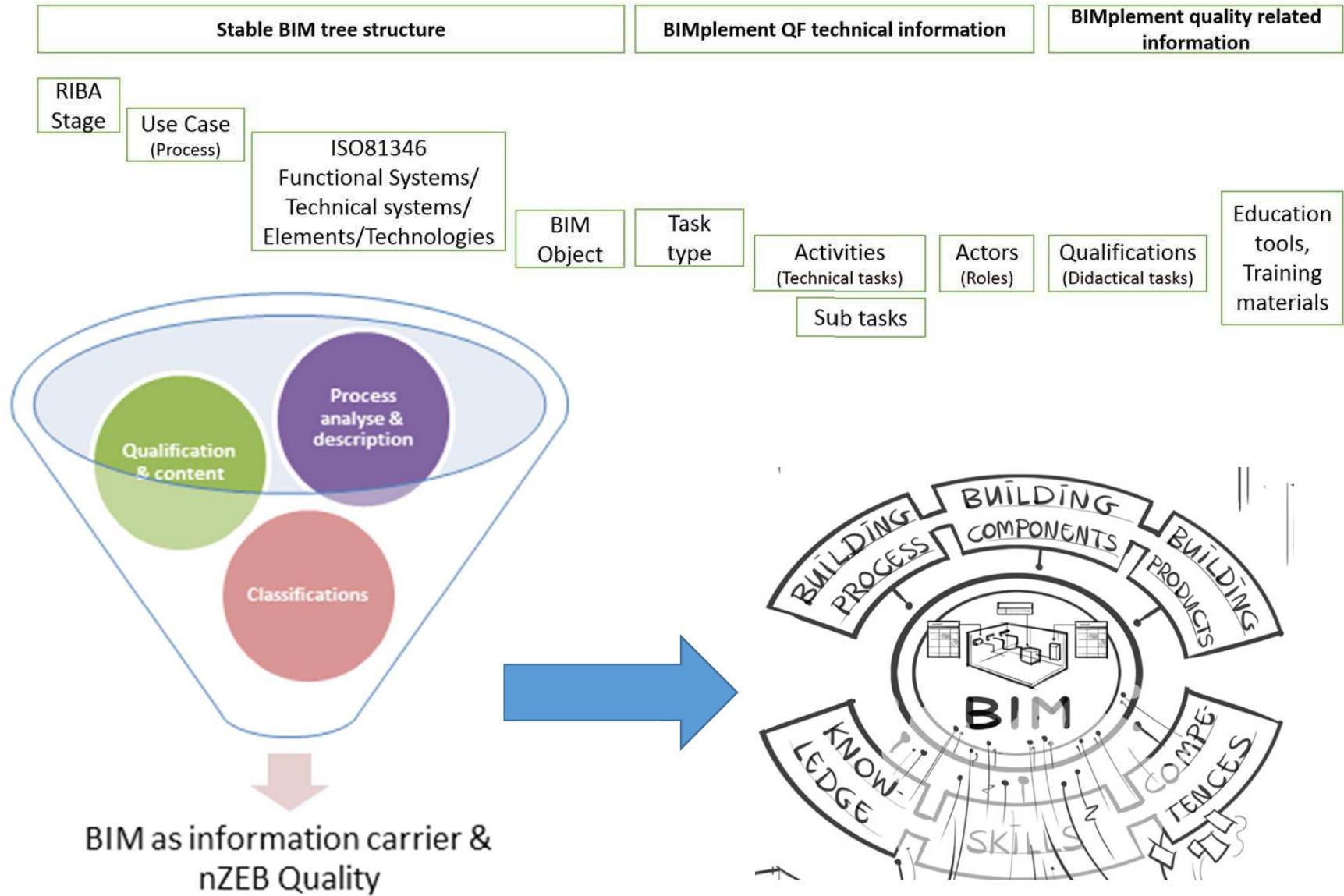
KNOWLEDGE SOURCES

## BIM PLEMENT



## **KNOWLEDGE SOURCES**

# DEVELOPED METHODICAL APPROACH & LESSONS LEARNED

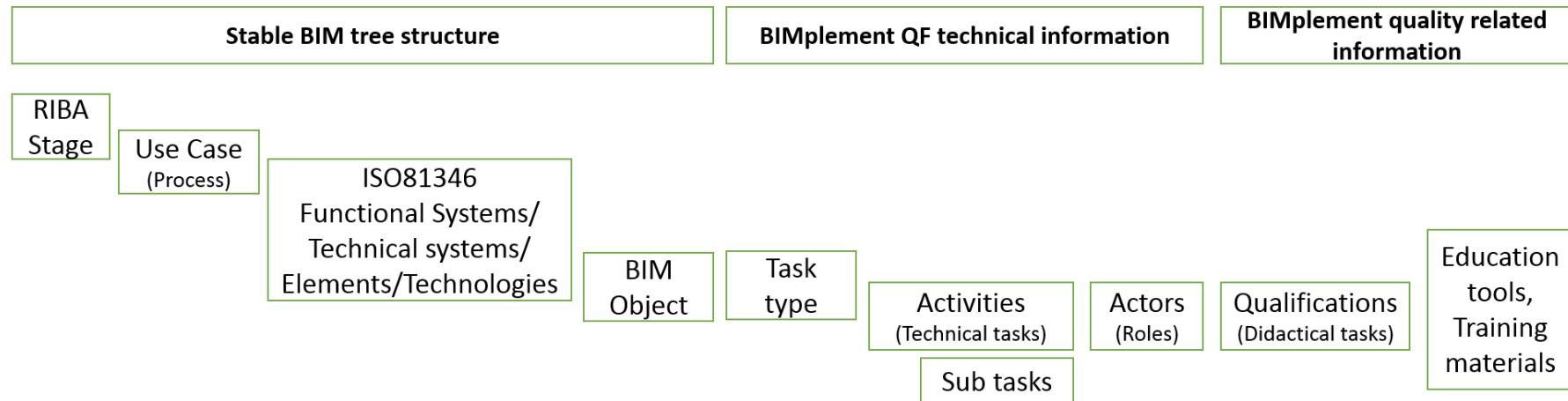


## RESULT OF THE FOURTH DEVELOPMENT ITERATION

Relevant technology (according to ISO 81346)	Project stage	BIM object	Task			
JJ-Ventilation system	S5	Warning sign	Instructions read out			
	S5	Every component is link	Check the delivery			
Decentralized Ventilation System with Heat Recovery Type e <sup>2</sup> mini	S5	Tube and outer grill	Installer of the ventilation system	Read the instructions	JJ-S5-0	BAS
<a href="http://www.lunos.lt/sites/">http://www.lunos.lt/sites/</a>	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



## RESULT OF THE FIFTH DEVELOPMENT ITERATION

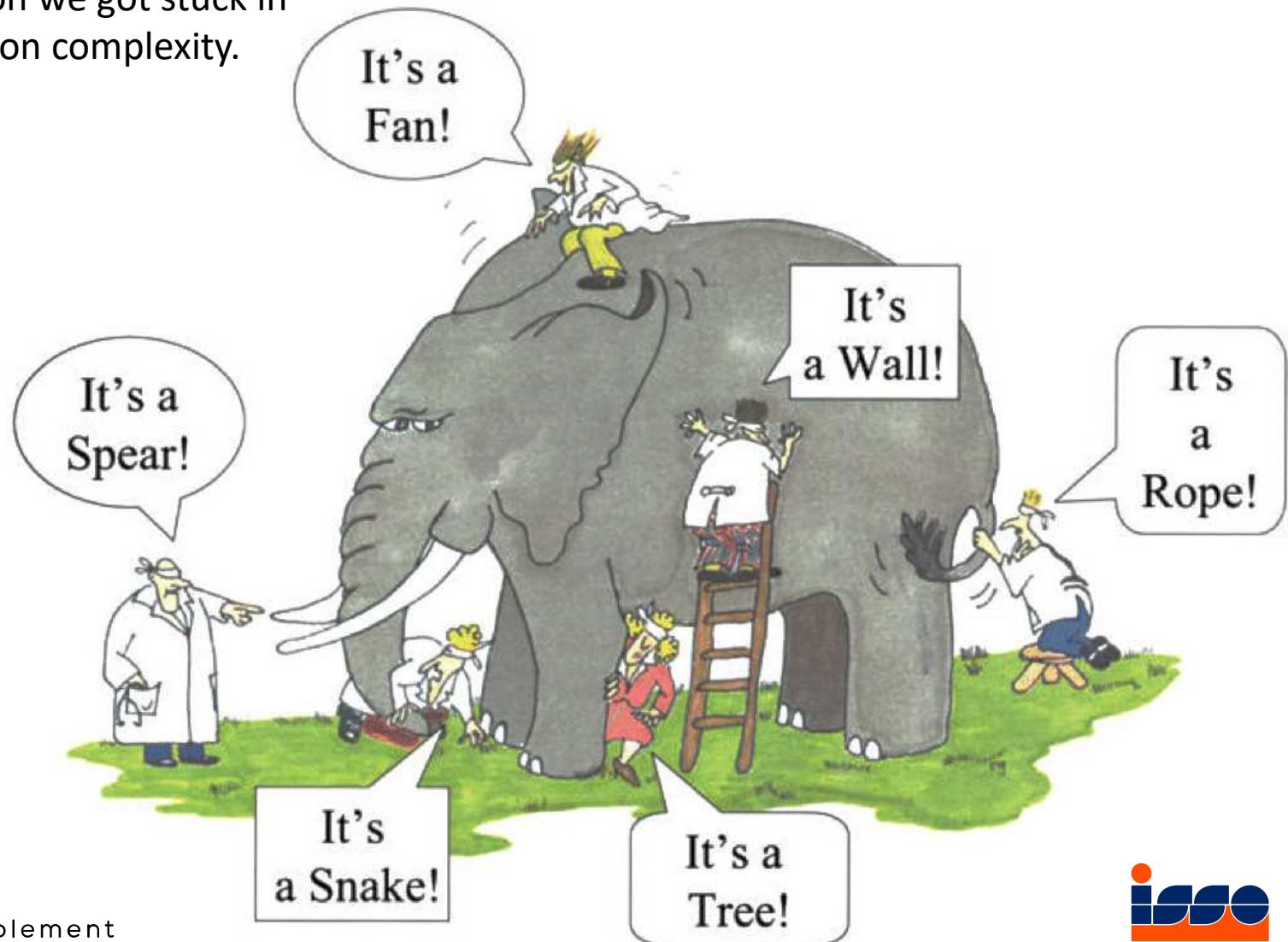


In this version of the BIMplement QF structure a split has been made between:

1. the BIM-tree structure
2. the technical information about tasks, subtasks and actors
3. the Unit of learning outcomes and related education tools and training materials.

## RESULT OF THE SIXTH DEVELOPMENT ITERATION

In this iteration we got stuck in implementation complexity.



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# RESULT OF THE SEVENTH DEVELOPMENT ITERATION

Project phase	Tasks	Sub-tasks	ULO Nr.
Execution phase	<b>Making holes in wall(s) and/or floor(s)</b>		
		check/mark position and dimensions of the recess in the wall	12.1
		make the recess or correct the sizes if necessary	12.2
	<b>Install air ducts</b>		
		construct the duct system (supply and discharge)	13.1
		fix ducts in floors against flooding	13.2

## ULOs for the NZEB Ventilation

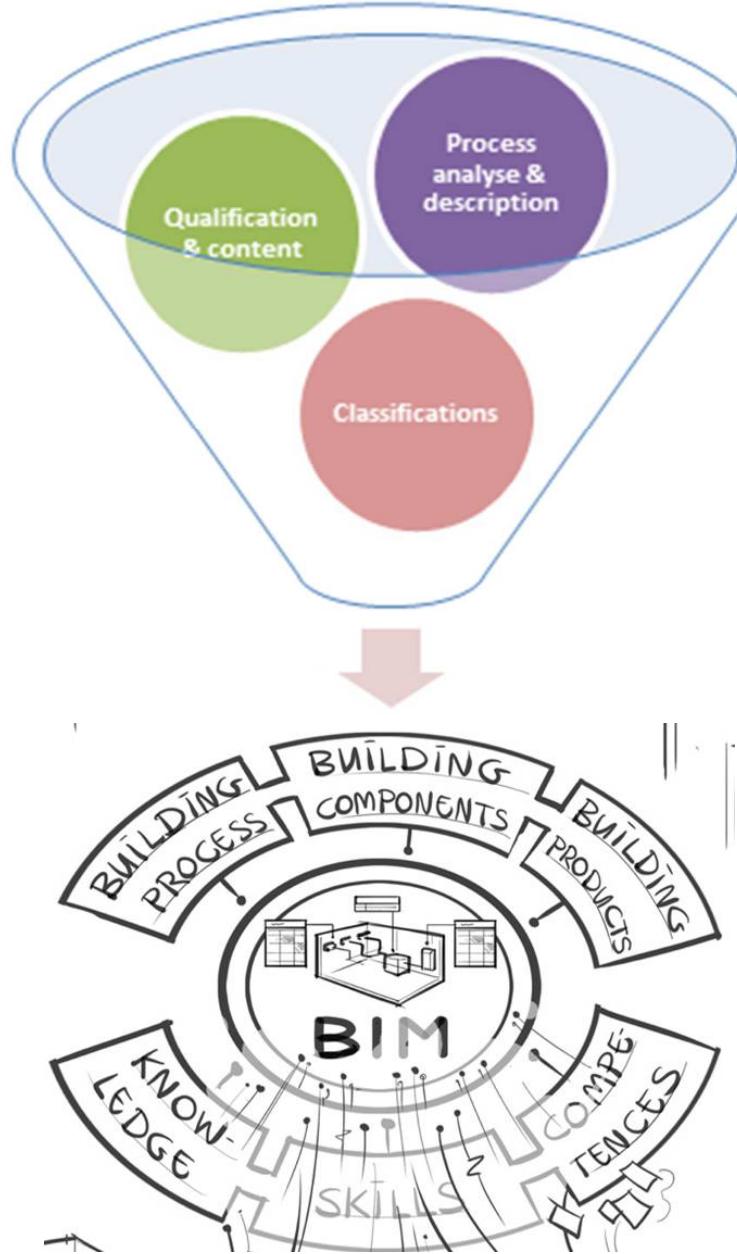
Nr.	Fields of knowledge /Course	Knowledge	Skills	Competence	Actor
12.2	Installing ducts	knowledge of making holes in walls/floors	drilling techniques	necessary	Constructor
13.1		knowledge of airtight of connecting ducts	know how to make airtight connections and the difference between the types of ducts	constructing a duct system	Installer
13.2		knowledge of fixing ducts against flooding	know how to fix ducts against flooding	fix ducts in floors against flooding	Constructor
13.3		knowledge of measures during pouring concrete of floorslab	know how to pour the concrete	produce the adjoining screed / finishing passages in walls	Constructor
13.4		knowledge installing supply valves and preset them	influence of valve on airflows in rooms and influence of air speed on comfort	set up and mount supply valves	Installer
13.5		knowledge of making airtight connections in ducts	necessaty of airtight connections	make airtight connections	Installer
13.6		knowledge installing exhaust valves and preset them	influence of valve on airflows in rooms and influence of air speed on comfort	set up and mount valve	Installer
14.1	Mount centrally ventilation unit	knowledge of vibration-free assembly of units	describe the mounting of the ventilation unit	mounting the ventilation unit	Installer
14.2		knowledge of airtight of connecting ducts	know how to make airtight connections and the difference between the types of ducts	connecting the ventilation unit to the duct system	Installer
14.3		knowledge of waste water systems	know how to connect the unit to the waste water system	system	Installer / adjust expert
14.4		knowledge of airtight connecting ducts	know how to make airtight connections and the difference between the types of ducts	assembling silencers between unit and duct system	Installer
14.5		vapor-tight insulation	insulating air ducts and know when and how to do so vapor-tight	isolating channels from the outside to the unit in systems with heat recovery	Installer / isolator
14.6		knowledge of building decree regarding electricity	making a safe and reliable power supply and/or data communication	construct facilities such as electricity and data cables	installer / electrician



New qualification schemes  
to build high quality



## RESULT OF THE SEVENTH DEVELOPMENT ITERATION



BIMplement



# RESULT OF THE SEVENTH DEVELOPMENT ITERATION

Qualification scheme [?](#)

nl en es Language selector

Title Building Inspector

Description

Tasks

- B. An optional task**
  - Give guidance to a comprehensive project development
  - Assess the concept design by regarding infrastructural aspects
    - Type to choose specific regions for this task
  - Ensure comfort in inner spaces in planning phase
- D. Unlink the task**
- C. Make the task region specific**
- A. An obligatory task**



**NEWCOM** New qualification schemes  
to build high quality



# RESULT OF THE SEVENTH DEVELOPMENT ITERATION

ULO ?

nl en es

Type  Basic  nZEB

Competence to be able to

Evaluate the project-concept regarding mobility aspect

Skills to understand

Make proposals for modifications or supplements

Skills search bar

Type here to search for Skills or create a new one.

Knowledge to know

Basic knowledge about mobility concepts

Public transport connections

Requirements for pedestrian and bicycle traffic

Requirements for charging stations for e-mobility

Knowledge search bar

Type here to search for Knowledge or create a new one.

Structural element BIM

Link to a structural element in the BIM-model (used in BIMplement)

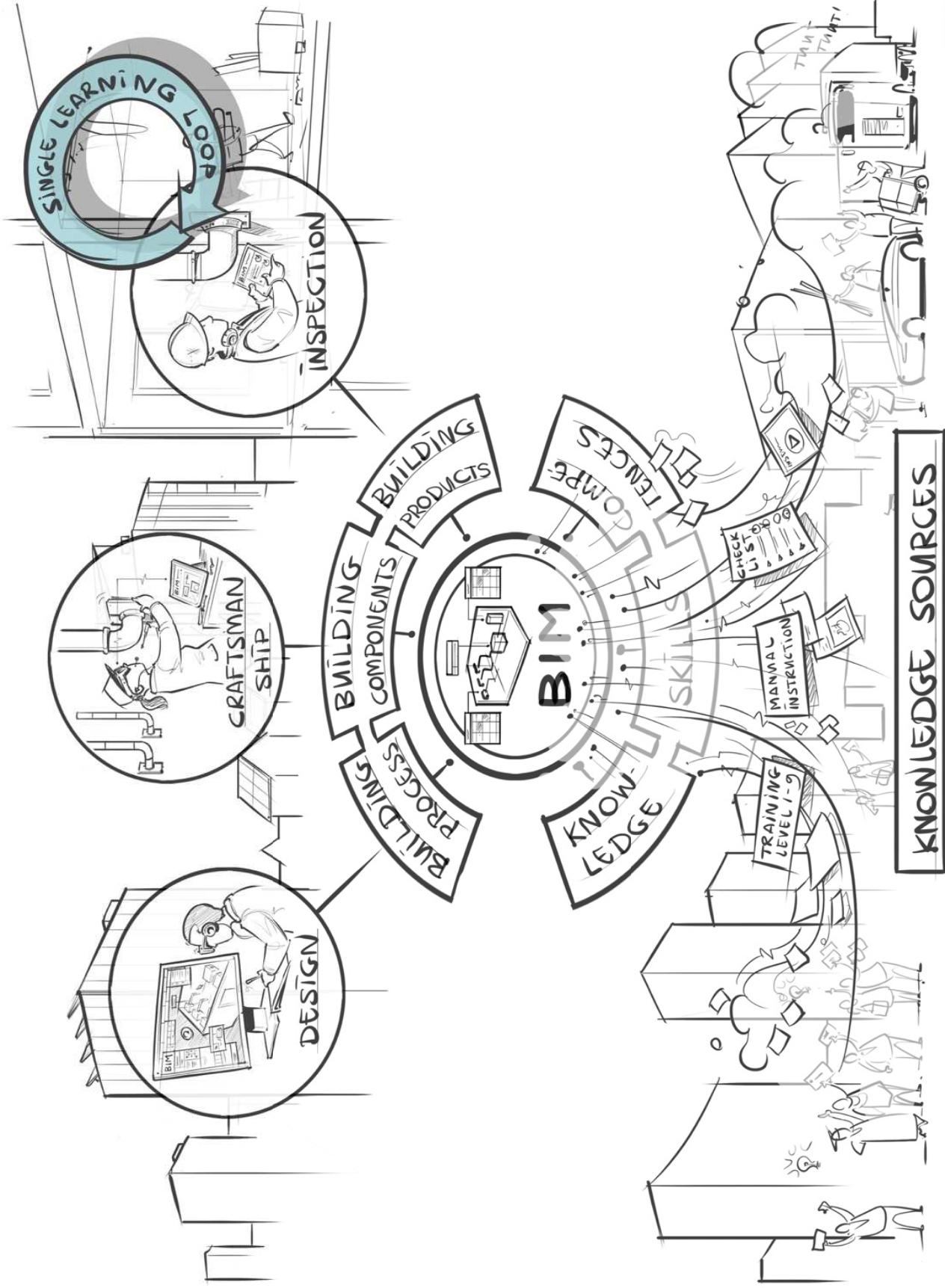
- 1 Optional metadata for a ULO-type (used in BIMimplement)
2. Competence addressed
3. Definition and linking of Skills
4. Knowledge items
5. Link to a structural element in the BIM-model (used in BIMimplement)



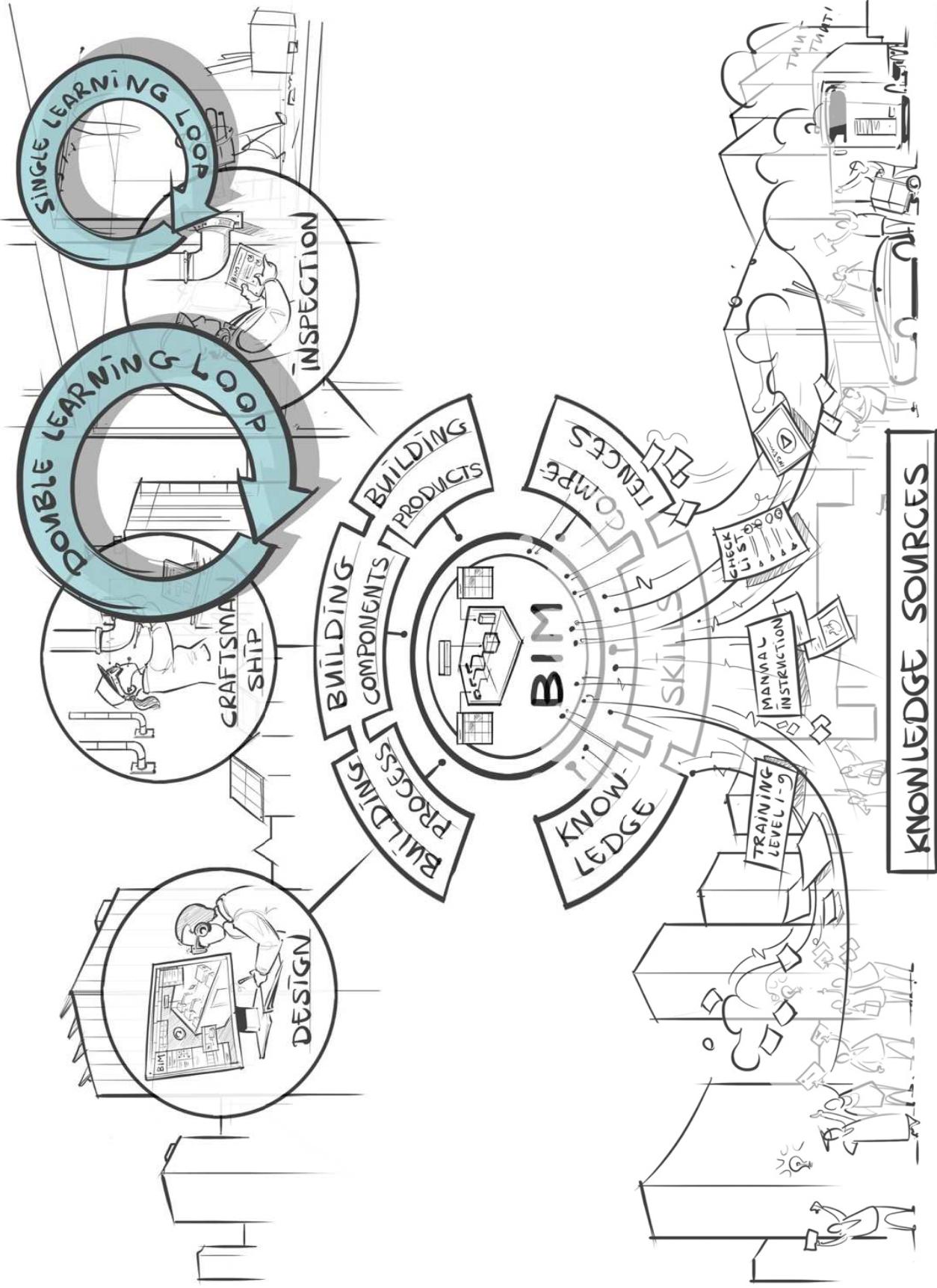
**NEWCOM** New qualification schemes  
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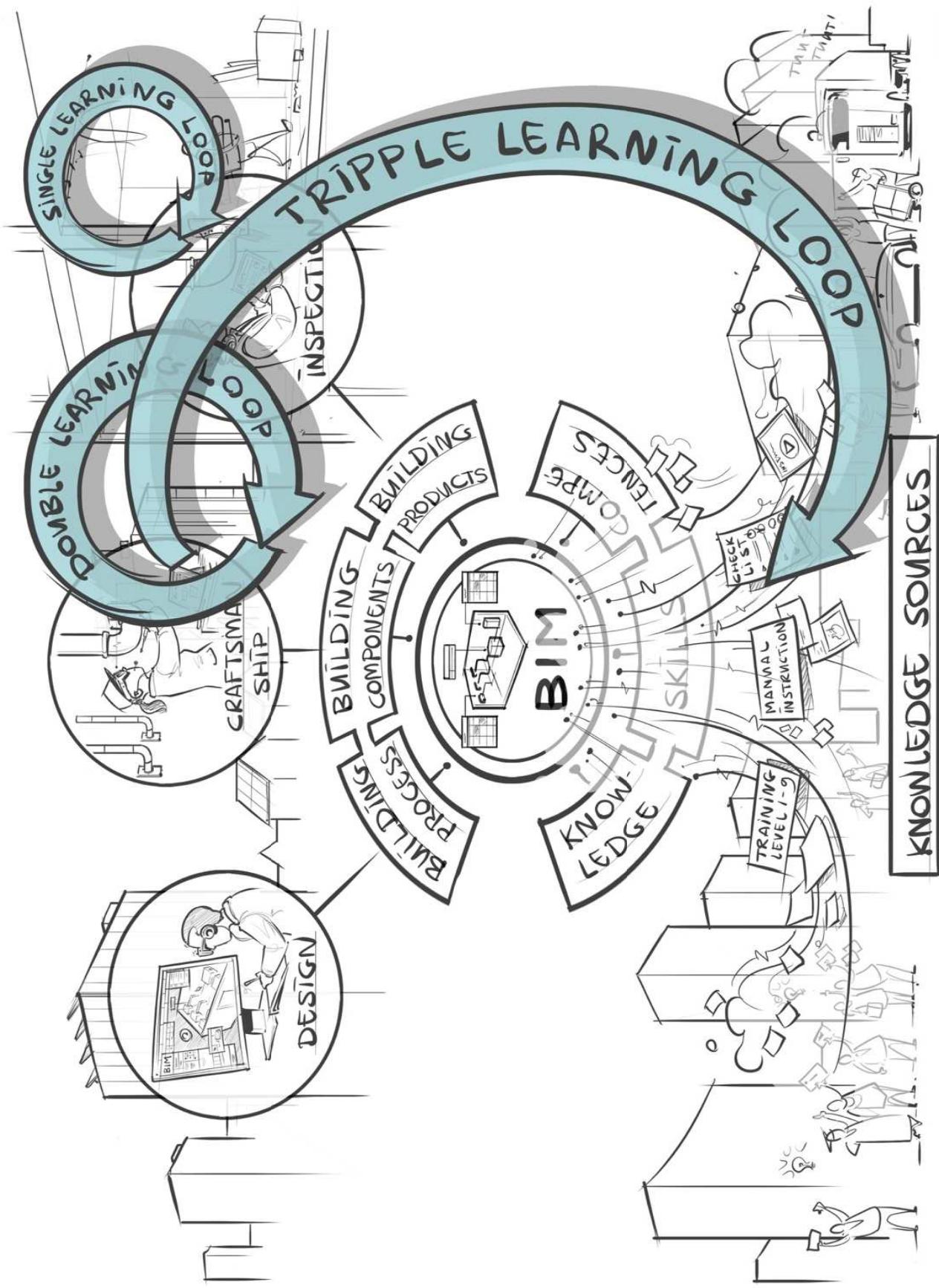
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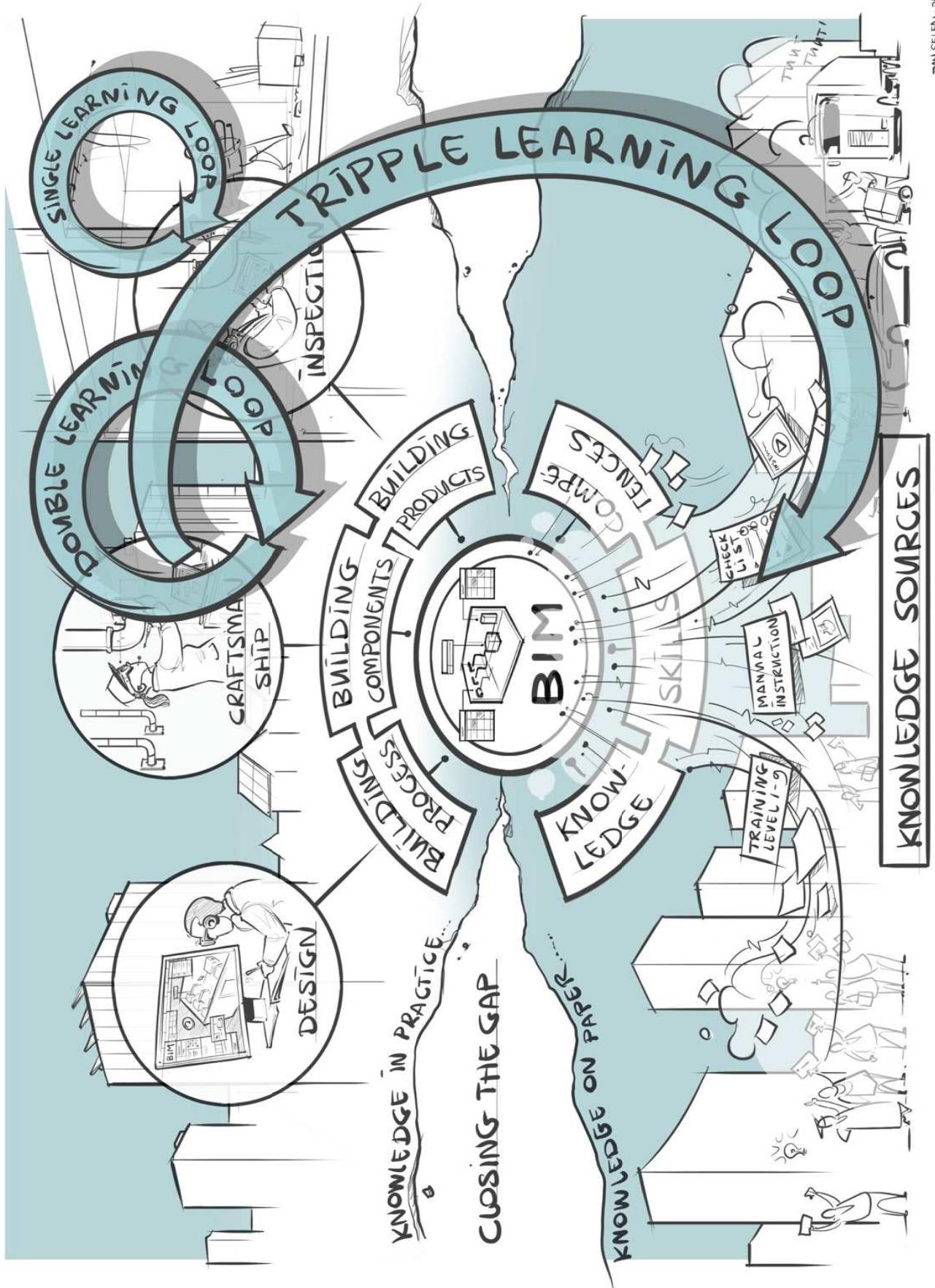
# BIM PLEMENT



# BIM PLEMENT

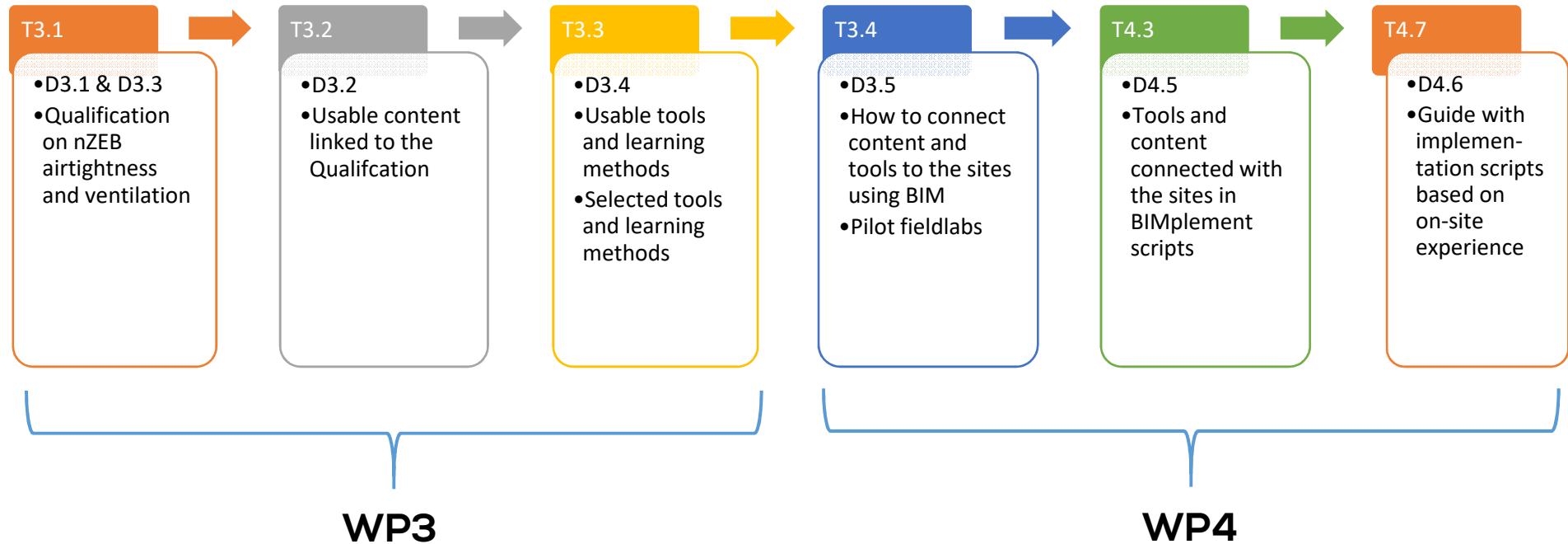


# BIM PLEMENT

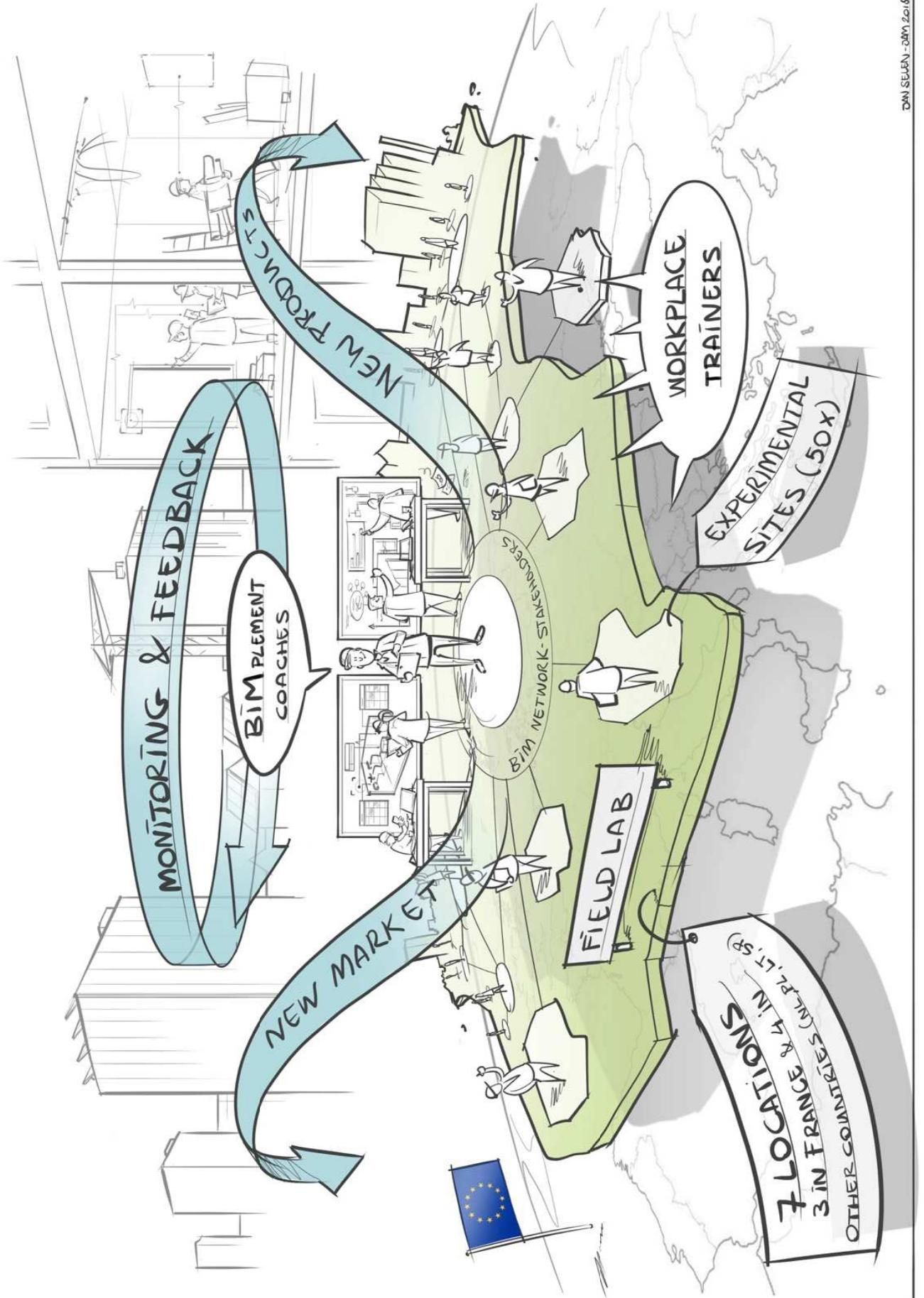


KNOWLEDGE SOURCES

## LOOKING FORWARD TO IMPLEMENTATION



# BIM PLEMENT



**COLOFON**

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# Thanks you for your attention.



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