SKILLS
INSTRUCT
INSTRUMENTS
CONSTRUCTION

Taxonomy of current training offers for energy efficiency in the EU

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D2.2 Taxonomy of current training offers for energy efficiency in the EU

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Revision and history chart

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1.0	2021/02/16	Sami Kazi, Tarja Makelainen	Quality review: comments and suggestions
1.1	2021/02/26	Nico Mack, Annie Guerriero, Sylvain Kubicki	Inclusion of Review comments

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1 Summary

The INSTRUCT project aims to act at a market level by providing an operational framework and set of services serving **a new generation of skilled and certified workers and fitters** as well as paving the way to legislative changes that overall will stimulate the demand for energy skills across lifecycle and supply chains. The main objective of Task 2.2 consists in establishing a taxonomy of current training offers in the field of energy efficiency within the European Union.

In the last decades indeed, policies in relation with our built environment's Energy Efficiency, Digitalisation and Occupational Safety and Health have been implemented, with a required impact on skills. A meta-framework is developed and aims at embracing a large set of training initiatives, and associated qualification frameworks, with a focus on energy efficiency, digital skills and Building Information Modelling (BIM). The taxonomy provided in this deliverable aims to define the common ground for INSTRUCT partners to address the demonstration pilots, with a focus on training and skills requirements.

2 Introduction

The European Union has demonstrated through the past years' programs and activities (namely the Build Up Skills initiatives) a strong will to "equip the next generation of construction sector workers with skills and knowledge needed to ensure building and renovation projects meet stringent energy-efficiency requirements"(EuropeanCommission 2019)[1]. The construction sector is affected by structural changes that include internal changes in the structure of the population, but also by increasing migration and mobility trends. Moreover, the employment in construction represents a large share of the overall employment in the Member States.

The European Centre for the Development of Vocational Training (CEDEFOP) highlighted in 2016 that about **1 million new and replacement workers will be needed by 2025** (cited in (European Construction Sector Observatory, 2020)). The same report highlights also that "the skills needed in construction are likely to **change to meet the demands for "green" and energy-efficient buildings"**. In the meantime, there is a need to increase the EU and MS capacity to deliver adequate training to cope with the growing demand.

Through its actions the European Skills Agenda[2] aims to achieve ambitious objectives by 2025 as highlighted in Figure 1.

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

Figure 1: The quantitative objectives set by the EU Skills Agenda for 2025.

Amongst the others, one can see the high ambition of the EU to **offer unemployed adults (in the age 25-64) with learning experience**, and also to focus on **training for low-qualified adults**. These objectives completely align with the needs and gaps perceived in construction, and target several

[1] Extract from the CORDIS Results Pack presenting some of the EU-funded projects that have designed and implemented upskilling programmes, available from https://op.europa.eu/en/publication-detail/-/publication/11ec9f62-6222-11e8-ab9c-01aa75ed71a1/language-en/format-PDF/source-71672294. Last accessed February 5th, 2021.

[2] European Skills Agenda. Information and table extracted from https://ec.europa.eu/social/main.jsp?catId=1223&langId=en. Last accessed February 5th, 2021.

domains amongst which the digitalization, the energy efficiency (including highly efficient renovation) and the OSH (Occupational Safety and Health).

In construction, the Build Up Skills initiative evaluated that **3 to 4 million blue collar workers will need upskilling in Energy Efficiency** (alone) to achieve the ambitious EU target as set in the Green Deal.
Citing the European Construction Technology Platform (ECTP)'s Strategic Research and Innovation Agenda (SRIA) 2021-2027[3] about addressing the shortage of construction workers, "[upskilling] solutions include making the professions safer and more attractive for **youth** and the **female workforce**, which potentially could close the gap of youth unemployment and inequality at the same time. […] Life Cycle Thinking and asset management must be integrated in curricula through a cross-disciplinary approach."

In addition, even if blue collar workers and white-collar professionals are often mentioned, a specific attention must be given to the **highest levels of qualification** (equivalent to EQF[4] level 8) where "the most advanced and specialised skills and techniques, including synthesis and evaluation, required to solve critical problems in research and/or innovation and to extend and redefine existing knowledge or professional practice"[5]. The EU universities and Research and Technology Organisations (RTOs) need indeed to **sustain a highly competent workforce** to drive the research and innovation in construction and the built environment, increasing the sector productivity, drastically reducing its environmental impacts, improving the safety of EU infrastructures, and ultimately improving the health conditions and well-being of the citizens. Keeping the EU talents, and even attracting world-wide recognized researchers, is a necessity.

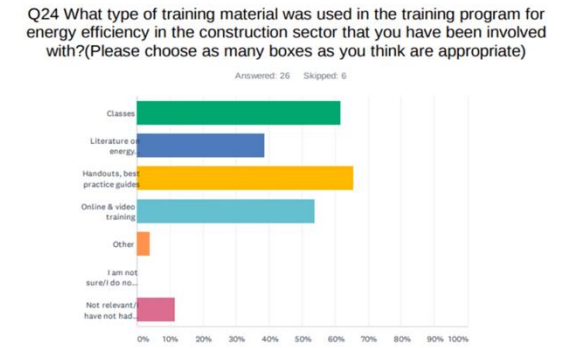
In INSTRUCT project, the main objective of Task 2.2 consists in establishing a taxonomy of current training offers in the field of energy efficiency within the European Union.
This D2.2 report situates the need for a taxonomy in the wider landscape of upskilling initiatives in the EU (section 4), with a focus on the Member States involved in INSTRUCT: Finland, Poland, France, Luxembourg, Italy, United Kingdom and Bulgaria. In particular, it analyses the existing Skills & Qualification Frameworks used throughout EU in multiple training initiatives, including sister H2020 projects.
An initial review of training offers, and their associated frameworks, enables the formulation of a method to align and map the related roles and skills (section 5).
The taxonomy is then formulated (section 6), covering the whole landscape of knowledge and information that needs to be captured for further activities within the INSTRUCT project.
The data collection process will be initiated by collecting training data from the 7 consortium partner countries, using an Excel sheet to capture the required data (presented in section **Błąd! Nie można odnaleźć źródła odwołania.**). In a second phase, the scope of the collection process will be widened to all countries of the European Union by leveraging the INSTRUCT stakeholder network.

[3] http://www.ectp.org/resources/publications/, last accessed February 4th, 2021
[4] European Qualification Framework
[5] https://europa.eu/europass/en/description-eight-eqf-levels, last accessed February 4th, 2021

3 Scoping and methodology

The INSTRUCT project aims to act at a market level by providing an operational framework and set of services serving **a new generation of skilled and certified workers and fitters** and paving the way to legislative changes that overall will stimulate the demand for energy skills across lifecycle and supply chains.

In order to address this aim, several challenges are to be faced. First the industry needs evidence that corroborates the correlation between skills and education and energy performance and quality. This is the focus of INSTRUCT's deliverable D2.1.
T2.1 also delivers very useful insights with regards the status of Vocation Education and Training (VET) in construction. From the interviews conducted, for instance, one can see (Figure 1) that the training delivery modalities still mainly rely on "classes" (on-site learning) which remain predominant (61,5), while "online & video training" are increasingly available (54%). This shift in training delivery requires more and more structure and coherence to help the industry in understanding the offer and make the adequate choices for the staff, according to the multiple constraints.



ANSWER CHOICES	RESPONSES	
Classes	61.54%	16
Literature on energy efficiency	38.46%	10
Handouts, best practice guides	65.38%	17
Online & video training	53.85%	14
Other	3.85%	1
I am not sure/I do not know	0.00%	0
Not relevant/I have not had experience with training	11.54%	3
Total Respondents: 26		

Figure 2: Extract from INSTRUCT D2.1 interviews [Extract]

Interestingly, a specific approach developed as part of BIMEET[6] project aimed at a dynamic discovery of roles and skills (Hodorog et al. 2019). The method developed for "social media analysis'' showed that the resulted list of roles and skills is novel and can bring new insights into the process of BIM training and education.

Then, addressing the question of training, with a focus on Vocational Education and Training, and the associated professional skills, one can see that in the last years a growing number of qualification frameworks and their associated roles and competency matrices have appeared in the market. They are usually linked to the commercial training offers and can focus in various sub-domains associated

[6] BIM-based EU -wide Standardized Qualification Framework for achieving Energy Efficiency Training, Grant agreement ID: 753994, https://cordis.europa.eu/project/id/753994

with building's energy efficiency. Even if they help in structuring the training, understanding the outcomes and competencies gained, they are often too complex to be handled by industry players, and lack alignment that would help in comparing professional competencies across construction and real estate-related disciplines and across EU member states.

In a nutshell, the usual approach to formulating such qualification frameworks starts from the identification of professional profiles, the breakdown into domain-specific responsibilities or tasks, and is followed by the derivation or identification of learning outcomes (LOs) to be addressed by training programmes and training material.

While previous H2020 projects formulated new sets of roles and skills, like BIMEET which focused on the use of BIM for Energy Efficiency, initiatives like PROF-TRAC[7], continued through Net-Ubiep[8] or BIMPlement[9], aimed at re-using sets of learning outcomes across training institutes, programmes and even member states.

The approach suggested in INSTRUCT aims at formulating the right competencies associated with the demonstration pilots foreseen in WP5. To achieve it, a project-wide taxonomy (section 6) is required as several domains and application are to be addressed, from BIM to Near-Zero Energy Buildings (NZEB) skills, and from training to regulations and requirements in public tendering.
While T2.3 adopts a quite classical approach, aiming at formulating those learning outcomes following a bottom-up approach, T2.2 suggests to consider a novel method where all the available and useful qualification framework can be considered, and a process to create and maintain the links to these original competency matrices is developed. To be efficient and used in later phases of the project, and beyond, this process should be semi-automated, thus requiring minimum human intervention.
In D2.2, the section 5.3 provides a demonstration of this process implementing these links (through curation, mapping, and similarity indexing).

[7] PROFessional multi-disciplinary TRAining and Continuing development in skills for NZEB principles, Grant agreement ID: 649473, https://cordis.europa.eu/project/id/649473
[8] Network for Using BIM to Increase the Energy Performance, Grant agreement ID: 754016, https://cordis.europa.eu/project/id/754016
[9] 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, Grant agreement ID: 745510, https://cordis.europa.eu/article/id/411695-bim-trained-on-site-workers-deliver-better-nearly-zero-energy-buildings

4 The status of VET and construction workforce upskilling in the Member States participating in the INSTRUCT consortium

In its deliverable „Status Quo and Sectorial Skills Strategy"[10], the Construction Blueprint project[11] consortium defines the key areas of intervention for developing Vocational Education and Training with a view of upskilling the construction workforce. Those areas include 1) digitalization, 2) circular economy and 3) energy efficiency.

Through an extensive review of the status-quo in several countries, the authors conclude on 1) the **importance and ongoing development of training offer related to digitalization**, mentioning that it goes beyond the BIM, 2) the "**lack of specific skills on circular economy** within the construction sector" preventing a wider development of the practices and training offer, and 3) the **growing offer associated with energy efficiency**, aligned to regulations, including the Energy Performance in Building Directive (EPBD) and its Member States (MS) implementations, **but in a low pace compared to the need for professionals, consultants and workers** qualified on this topic.

4.1 Gaps and barriers

Interestingly, the report highlights the following general gaps:

- "Inadequate offer of qualified craftsmen."
- "Skills gaps in all building trades."
- "Lack of candidates available for apprenticeship."

Barriers are also mentioned, through a review of several areas: political/legislative, economic/social, structural, and education. 4 out of the 5 INSTRUCT consortium countries are covered in the report, and few highlights are mentioned below:

- Finland faces a low availability of labour force. Envelopes funding the vocational training have been cut in the recent years as well.
- France has a low investment situation when it comes to energy efficient renovation, as investors face a low return on investment pace. This has an impact on the renovation companies and the recourse to skilled workers.
- Italy faces a lack of national-level regulations associated with urban regeneration. The regulated demand being low, it even creates a loss of employment in the sector.
- Poland faces a situation where "there are still no legal regulations ensuring high quality of non-formal (out-of-school) education and training. There are also still insufficient legal regulations to recognize the results of informal learning". Besides the report mentions the lack of national budget and reluctance of employers to invest in skills.

Overall the lack of flexibility of the educational system (both initial learning and vocation training) is considered a barrier to develop rapidly and with agility the skills in the construction industry, at all levels of qualifications.

[10] https://constructionblueprint.eu/wp-content/uploads/2020/12/D3.-StatusQuo-Report-on-Sectoral-Skills.pdf, accessed February 4th, 2021

[11] Construction Blueprint is a European project, belonging to the Erasmus+ Programme, for implementing a new strategic approach to sectoral cooperation on skills. We are a partnership formed by 24 partners from 12 countries, led by Fundación Laboral de la Construcción (Spain). We are working to establish a new Strategy on Construction Skills in Europe. https://constructionblueprint.eu

More broadly, it is also recognized that the low predictability of the construction sector, associated to low operational margins of construction companies, the large share of Small & Medium size Enterprises (SMEs) and the fragmented nature of the sector created the conditions for a staffing model characterized by a large share of temporary employment contracts, which limits the incentives for long-term investment in the workforce (European Construction Sector Observatory, 2020).

4.2 INSTRUCT countries: extract from ECSO fact sheets

The following section provides key highlights associated with upskilling and training, and extracted from the European Construction Sector Observatory (ECSO) reports for the countries directly addressed by INSTRUCT consortium.

4.2.1 Finland, October 2020

Finland[12] performs well when it comes to skills, education and training, with several indicators standing above the EU-28 average. Adult participation in education and training in the broad construction sector has been increasing since 2010, particularly, in the narrow construction sub-sector. In Finland, **two out of three adults participate in formal or non-formal learning every year**. The 2020 OECD report also highlights challenges on **maintaining the current level of continuous learning and of adapting the skills development system**. The challenges are lack of upskilling opportunities for adults with vocational qualifications and the lack of availability of short courses relevant to the labour market.

It can be mentioned additionally that the ECSO report describes the **reform of the VET system**, with a view of streamlining vocational training for youth and adults and simplifying vocational qualifications. The demonstration #1 planned in INSTRUCT can contribute to this initiative by clarifying and increasing the demand for certification.

4.2.2 Poland, September 2020

In Poland, the ECSO country profile[13] published in 2020 mentions that life-long learning is still undeveloped, with adult participation in education and training standing only at 3.4% in narrow construction sub-sector and 7.3% in real estate activities sub-sector in 2019.

The report also mentions that the Polish government, in June 2018, announced a plan to allocate PLN 103.0 billion (over EUR 22.7 billion) to finance thermo-modernization. The Program will target **individual homeowners**. The majority (around two-thirds) of the funds will be disbursed as grants and the rest - as loans. According to the plan, the government will renovate **four million homes and buildings** over the next 10 years with **better insulation and more efficient heating systems**.

These statements reinforce the identified need to develop a collaboration framework between different groups in the value chain (producers, retailers and contractors) on how to promote and benefit from energy skills recognition (demonstration #3), as well as to strengthen energy skills recognition in policy making, e.g. by linking grants to desired (or requested) qualification of companies (demonstration #4).

[12] https://ec.europa.eu/docsroom/documents/44169, last accessed February 4th, 2021
[13] https://ec.europa.eu/docsroom/documents/43987, last accessed February 4th, 2021

4.2.3 France, January 2020

The ECSO country profile for France[14] was published in January 2020, so prior to the COVID-19 pandemic situation and effects. It starts on a pessimistic note on the growth of the broad construction sector, which is expected to slow down.

When it comes to adult participation in education and training in the construction sector, France demonstrates very good results in the recent years (Figure 3).

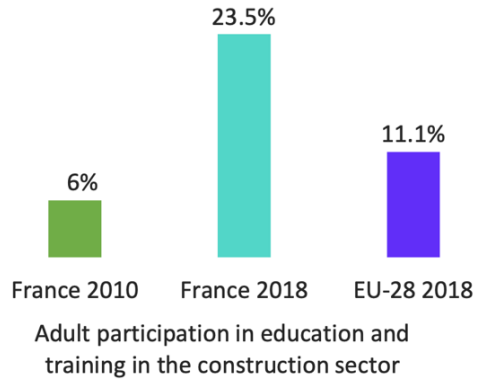


Figure 3: Adult participation in education and training in the French construction sector (Extract ECSO report 2020)

The report highlights even a need to strengthen this trend when it comes to digital skills: "According to estimates, France needs to train up to 80,000 workers in Building Information Modelling (BIM) by 2020, i.e. about 27,000 per year. According to a recent study from the National Institute of Statistics and Economic Studies (INSEE), 50% of companies in the building sector cite skills mismatch as a barrier to hiring."

France is not directly involved in the management of INSTRUCT pilots, but the report indicates that continuing the effort started within BIMEET[15] or BIMplement[16] H2020 projects would make sense.

4.2.4 Luxembourg, September 2020

The ECSO country profile for Luxembourg[17] reports that the country has implemented "various strategies to promote the **uptake of strategic digital technologies by businesses** including the Data-driven Innovation strategy and the Artificial Intelligence (AI) strategy. […] Among other sectors, the Luxembourgish government also wants to promote the adoption of digital strategies in the construction sector". To achieve this aim, the Luxembourg Digital Innovation Hub (L-DIH) "is an industry- led platform including on-demand solutions providers, which focuses on boosting the industrial digitalisation process for companies of any type and size based in the country".

It can be mentioned that the construction sector associations organised a transversal (cross-discipline) and national training initiative in relation with BIM, built around the national BIM Guidelines[18] published by CRTI-B. While a significant number of training modules are now delivered, in French and German, the training organisations are broadening the scope of training, including BIM-based energy performance, or construction management. They are also addressing blue collar workers and construction SMEs.

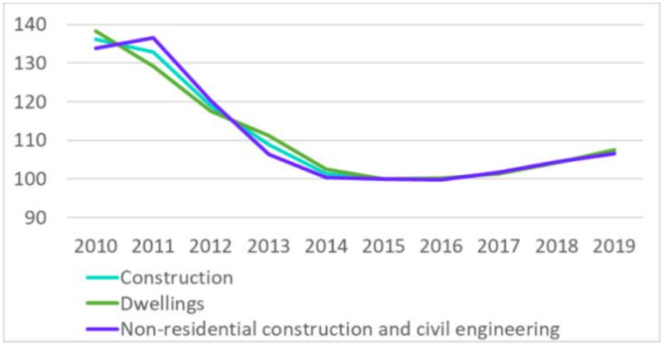
[14] https://ec.europa.eu/docsroom/documents/40289, last accessed February 9th, 2021
[15] https://cordis.europa.eu/project/id/753994, last accessed February 9th, 2021
[16] https://cordis.europa.eu/project/id/745510, last accessed February 9th, 2021
[17] https://ec.europa.eu/docsroom/documents/44608, last accessed February 9th, 2021
[18] http://www.digitalbuilding.lu/guide-application-bim, last accessed February 9th, 2021

INSTRUCT's demonstration #2 is directly aligned to support this aim with innovative schemes and content, following BIMEET project's early initiatives.

BIMEET results, focused on BIM for Energy Efficiency in Buildings, are usefully described in (Alhamami et al. 2020), introducing the general requirements capture methodology, and (Suwal et al. 2019). The later focuses on defining roles and responsibilities construction project stakeholders have for the energy efficiency measures along the different project phases. It also provides an outlook for the development of the learning outcomes based on knowledge, skills and competence (KSC) framework as well as systematically presents the base for harmonization

4.2.5 Italy, September 2020

Skills shortage in Italy, as well as a low and even decreasing renovation rate, are important challenges mentioned in the country profile report[19] from ECSO.
However, the investment in the Italian construction sector seems to rebound lately, as shown in Figure 4, extracted from the report.



Source: AMECO, 2020.

Figure 4: Investment index in the Italian construction sector between 2010 and 2019 (extract from ECSO report Italy)

Regarding skills the report highlights that Italy "prioritises integrating the training and employment of young people in a dual system by reinforcing those apprenticeships linked with the education and training system for 2016-2020".
Initiatives raising awareness in the fields of renovation and skills are therefore useful, as planned in INSTRUCT's demonstration #5.

4.2.6 United Kingdom, September 2020

In the United Kingdom, according to the ECSO country profile[20], **adult participation in education and training** in the narrow construction sub-sector went down from 19.1% in 2010 to 17.1% in 2019, well below the peak of 20.6% in 2008. The UK construction sector suffers from **skilled labour shortage** which is **hindering its overall growth**. As per the Royal Institute of Chartered Surveyors (RICS), the shortfall in skilled construction workers is currently at the highest point since 2007. RICS estimates that at least 200,000 new workers need to be recruited by 2020 to even be on the track announced by the government.
The report also highlights the "growing importance of digital skills among construction workers. CITB aims to develop digital competencies for various roles by way of both structured training and

[19] https://ec.europa.eu/docsroom/documents/43988, last accessed February 9th, 2021
[20] https://ec.europa.eu/docsroom/documents/43985, last accessed February 9th, 2021

continuous learning." It is interesting to note that "the government has defined a **Building Information Modelling (BIM) strategy** to develop digital techniques in construction and improve its transformative potential, particularly related to **recycling infrastructure and CDW[21] valorisation**".

In INSTRUCT, the demonstration #2 focused on BIM Skills will align to these initiatives.

4.2.7 Bulgaria, September 2020

The ECSO report on Bulgaria[22], mentions that "the Bulgarian economy faces a **growing shortage** of workers despite decline in the unemployment rate since past few years", moreover the country faces a "**decreasing working age** population". Moreover "enrolment in vocational education and training (VET) system remains marginally above the EU-28 average".

In Bulgaria, there are two recently adopted state educational standards, which are partially adapted to the current needs of the construction sector and includes the nZEB relevant skills, knowledge and competences.

The first one is for profession 522030 "Electrical equipment and installations technician", in force since 15.02.2019,. It is valid for specialties 5220301 „Heating Energy", 5220302 „Nuclear Energy", 5220303 „Hydroenergy", 5220306 „Gas Installations", 5220308 „Renewable Energy Sources" and 5220309 „Heat, air conditioning, ventilation and refrigeration", targeting 4th EQF level. Considering the content, it is perceived that no changes are required regarding specialty 5220308 „Renewable Energy Sources" at the current stage. However, although the standard provides a generally comprehensive set of learning outcomes for specialty 5220309 „Heat, air conditioning, ventilation and refrigeration", the nZEB-related specifics are not fully reflected. As further changes are not to be expected in the coming years, this deficiency could be overcome through integration of the relevant content in the training plans and programmes.

The second one is for profession 582010 "Construction Technician" (IV EQF level), in force since 11.03.2020, valid for specialty 5820101 "Construction and Architecture". The references are mainly to the Passive House standard, and although being relevant for achievement of LOs sufficient for reaching the national nZEB standard in real-life practice, they are too generic and do not emphasize on important aspects of cross-craft understanding. The deficiencies are however partially overcome through the introduction of a specific discipline in the training plan "Ecological and energy efficient construction" and the approval of a dedicated training aid.

It could be added that none of these recently updated state educational standards concerns the implementation of BIM technologies.

Unfortunately, there are no obligatory Continuing Professional Development (CPD) requirements in Bulgaria, neither for architects, nor for energy engineers, with the exception of certified energy auditors. The Chamber of Architects in Bulgaria has been promoting a voluntary CPD system and conducted with the support of external partners as the Association for Project Management in Construction BIM-related courses. As of recently, the digitalization of the construction has become a priority topic for the Bulgarian Construction Chamber, which may present an opportunity to integrate innovative training courses for the relevant professions. Of course, outside the national qualification framework, there are occasional training courses and conferences supported by BIM technology suppliers.

[21] Construction and Demolition Waste

[22] https://ec.europa.eu/docsroom/documents/43990, last accessed February 9th, 2021

In the area of energy efficiency, there are occasional course offerings targeted to designers by both the national Sustainable Energy Development Agency and the Chamber of Engineers in Investment Design. Unfortunately, institutionalized training course for certification of energy auditors, due to be delivered by technical universities around the country, hasn't taken place for more than 6 years. Other organizations systematically offering such training opportunities are EnEffect through the Bulgarian Building Knowledge Hub, Passive House Bulgaria, and the Bulgarian Association for Insulation in Construction. The major supply of upskilling courses is provided by suppliers of nZEB-suitable building materials, components and technologies.

In this context, the INSTRUCT's demonstration #7 aims at engaging the key stakeholders to stimulate the demand for energy skills. Also, the demonstration #8 will be useful, with a focus on developing capacity for the supply of continuing qualification services through blended learning.

4.3 Pathways for upscaling to the EU

Several of the remarks highlighted in section 4.2 apply broadly at the EU level, including the need to strongly accelerate the renovation rate, while relying on skilled professionals to carry on the job, thus contributing to employment growth. This summarizes the main objectives targeted by the demonstration pilots foreseen in INSTRUCT.
While the partners plan to focus on those demonstrations' regional areas, initiatives need to be carried on to expand and liaise with EU-wide activities. Those include:

- Sharing of best practice through dissemination activities
- BuildingSMART Professional Certification
- Sister projects communication, via the "Sustainable Energy Skills" joint activities, undertaken in 2020.

5 Skills & Qualification Frameworks analysis

A first analysis of the first batch of collected trainings has shown that work done in sister projects yielded multiple Skills & Qualification Frameworks. Except for the **PROF/TRAC** and **NETUbiep** projects, where an attempt was made to set up a mapping between both frameworks, the general rule appears to be that the **different frameworks coexist, without any links set up between them**. This does not imply that there are no potential overlaps. In the following sections we have a closer look at some frameworks to find potential similarities.

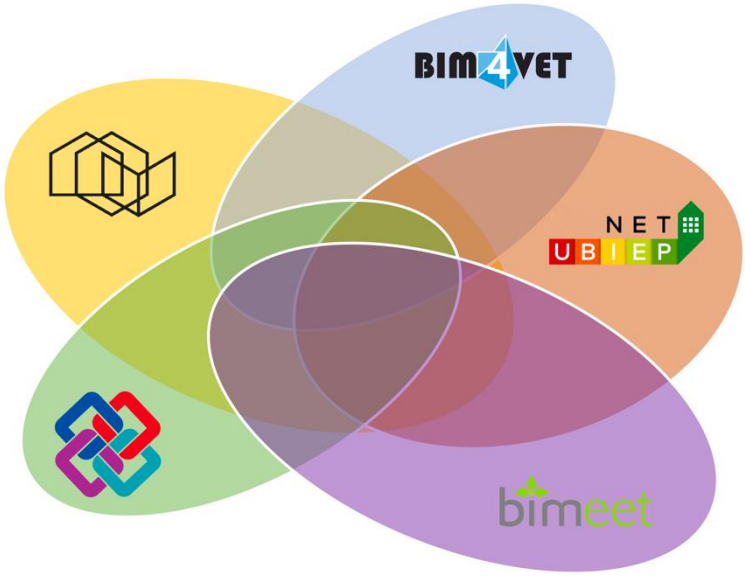


Figure 5: Potential Overlap of sample Qualification Frameworks

5.1 Similarities

A closer look at the various frameworks however revealed several structural similarities which we intend to use for the definition of a common training taxonomy.

5.1.1 Target Audience

All qualification schemes define a target audience, that is, specific professional profiles and disciplines which ought to be upskilled for achieving the goals set forth by the qualification scheme. Some schemes prefer to group the various profiles and disciplines in so called **target groups**, combining profiles and professions sharing a common field or domain. Knowing that the different schemes have different objectives, for instance, some schemes are more BIM-centric while others put an emphasis on blue collar workers, the addressed targets might be different. The following side by side comparison of the targets extracted from various schemes intends to illustrate this.

5.1.1.1 BIM4VET[23]

BIM Author	BIM Coordinator	BIM Manager
Junior		
Senior		

Table 1: BIM4VET Target Audience

5.1.1.2 BIMEET

Client & client advisors	Architectural design roles	Structural design roles	Building services design roles	Construction work roles	Maintenance work roles
Client	Architectural BIM coordinator	Structural design	HVAC & energy design	Site manager	Maintenance operator
Project manager	Architectural Chief designer	Structural BIM coordinator	HVAC & energy BIM coordinator	Construction site workers	Property manager
Client BIM manager	Architect	Structural Assistant designer	HVAC & energy Assistant designer		Caretaker
Client BIM coordinator	Architectural Assistant designer				
Briefing consultant					

Table 2: BIMEET Target Audience

5.1.1.3 NETUBiep

Public Administration	Professionals	Technicians	Tenants/Owners
Legislators	Architects	Engineer (Installer)	Users of the building
Civil servants	Civil Engineering	Installers (field)	
	Electrical Engineer	Facility engineers	
	Mechanical Engineer		

Table 3: NetUBiep Target Audience

5.1.1.4 PROF/TRAC

ARCHITECTURE	CIVIL ENGINEERING	ELECTRICAL ENGINEERING	MECHANICAL ENGINEERING	BUILDING MANAGEMENT	CONSTRUCTION MANAGEMENT	FINANCING & PROCUREMENT
Architect	Civil Engineer	Electrical Engineer	Mechanical Engineer	Facility Manager	Project Manager	Procurer
	Construction Engineer	ICT Engineer	Building Automation Engineer	Technical Energy Engineer	Cost Engineer	Project Developer
	Structural Engineer		Energy Engineer	Operator	Quality Assurance	

Table 4: PROF/TRAC Target Audience

5.1.1.5 BIMZEED[24]

Design	Building Management	Construction Management	Construction Work
Consultant	Facility manager	Construction manager	Construction workers
Designer	Technicians	Quantity surveyors	Craft workers
Specialist in green building		Site engineers	Site supervisors
			Apprentices

Table 5: BIMZEED Target Audience

[23] https://www.bim4vet.eu, last accessed February 26th, 2021

[24] Innovative training schemes for retrofitting to nZEB-levels, Grant agreement ID: 754059, https://cordis.europa.eu/project/id/754059/results, last accessed February 26th, 2021

5.1.2 Matrices organised by Profile/Discipline and Construction Phase

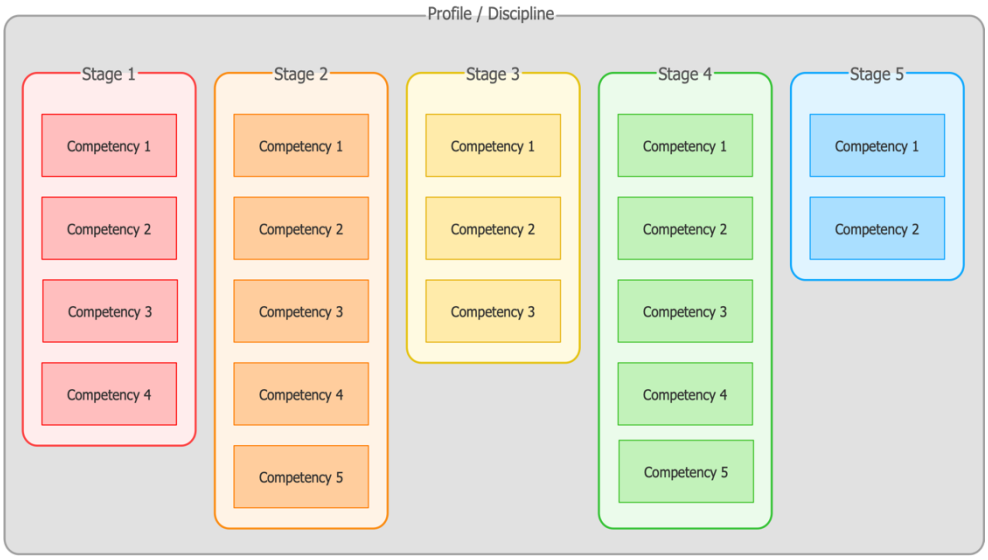


Figure 6: Discipline/Profile by Construction Stage

The qualification frameworks analysed so far do follow similar structures (Figure 6). They are mostly defined as matrices, putting the **target**, i.e., discipline or profile, in relation with the different **construction stages**. Even though not all frameworks rely on the RIBA Plan of Work for specifying their respective construction stages, mapping them to the later should be straight forward.

The matrices thus define for a given construction stage for each profile/discipline a set of **competencies**. Competencies are often organised in a hierarchical manner with one higher level and one sub-level. The **NetUBiep** project is particular in the sense that they define a competency as either **Knowledge** or a **Skill**.

C1	**Understand BIM tools**
C1.K1	Principle of economic subjects for the cost estimation and evaluation of energy refurbishment
C1.S1	Specialised skills to incorporate information into BIM Model, evaluating openBIM software
C1.S2	Stay up to date on BIM trends, current developments and new directions of BIM technologies
C1.S3	Decrease the life cycle cost of the building using methods described in ISO 15686-5
C1.S4	Evaluate and compare different plans and related Return of Investments using methods described in ISO 15686-5

Table 6: Excerpt of NetUBieb Matrix, with 1 Knowledge and 4 Skills

5.1.3 Grading System

Most analysed skills and qualification frameworks use some kind of grading system to define the expected level of knowledge and skill required for a given profile. Most frameworks define a proprietary grading system of 5 competency levels, very often similar to the **Dreyfus** model of skill acquisition. In some instances, namely the **PROF/TRAC** project (Cromwijk et al. 2017), links are established to the European Qualification Framework (EQF).

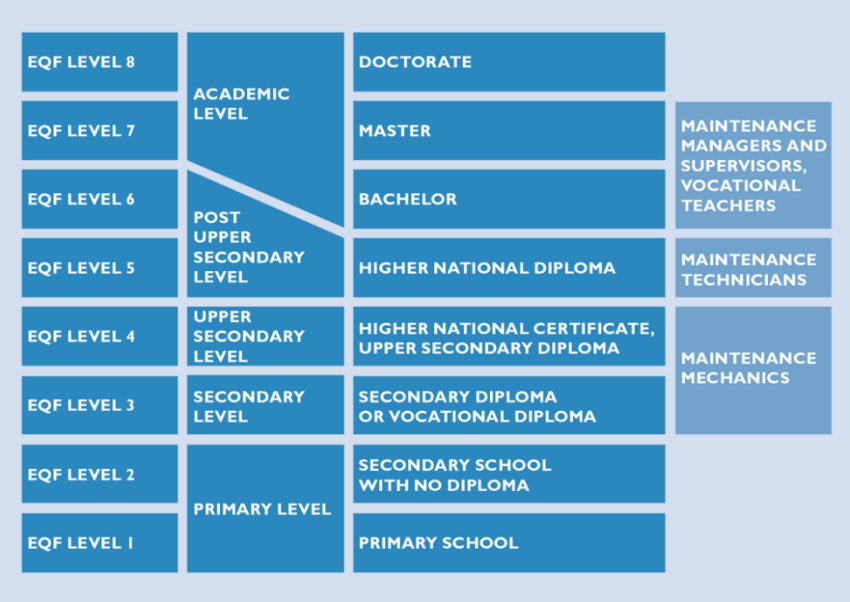


Figure 7: European Qualification Framework

5.1.4 Bloom's Taxonomy

Many of the analysed frameworks followed recommendations given by CEDEFOP (European Centre for the Development of Vocational Training) for the definition of their respective learning outcomes, that is, written in simple terms articulated following the action/verb/object/context format. Further analysis will be required to determine which ones follow Bloom's Taxonomy and which ones do not.

5.2 Collection Methodology

To provide as much input as possible for subsequent task T2.3, we propose to collect trainings with the highest level of granularity. This implies that we ask our partners supplying sample batches for their respective member country to specify learning outcomes if possible, by using applicable skills and qualification frameworks. We propose designing the training repository in such a way that it can model the different frameworks. Collecting data in this way will allow T2.3 to have access to highly granular and structured data.

5.3 Meta Framework

Task 2.3 builds upon data collected in Task 2.2 and aims at defining a Skills and Learning Outcomes matrix. In the following, we would like to share a couple of ideas how the data collected in T2.2 could be used in Task 2.3.

5.3.1 Manual Curation

As already noted earlier, disciplines and profiles represented in the various frameworks might differ. Their organisation in target groups also differs from framework to framework. Harmonisation of the various targets and targets groups thus entails finding a common denominator for organising the represented targets. One potential solution would be to use the **ISCO-08** classification structure

(http://www.ilo.org/public/english/bureau/stat/isco/isco08/index.htm) as the principal structure. The International Standard Classification of Occupation is maintained by the **ILO** (International Labour Organisation) and is intended as *a tool for organising jobs into a clearly defined set of groups according to the tasks and duties undertaken in the job*[25].

The same is true for construction stages, whish as already pointed out might not be aligned with the RIBA Plan of Work Taxonomy. However, we expect the number of items to be curated into a common meta framework to be small though and we believe that this step is best done manually.

5.3.2 Linguistic Analysis

Mapping learning outcomes in the various frameworks is a different matter altogether. Some of the frameworks define up to 270 individual learning outcomes. The sheer number of items precludes manual processing and calls for an automated or semi-automatic approach.

One potential approach could be the following. Knowing that learning outcomes generally follow the recommendations given be CEDEFOP[26], calling for learning outcomes to be defined in short sentences in action/verb/object/context format, linguistic analysis using parse trees should be relatively simple, yielding little ambiguity. Figure 8 shows how the sentence "the chef cooks the soup" is decomposed in its constituting parts:

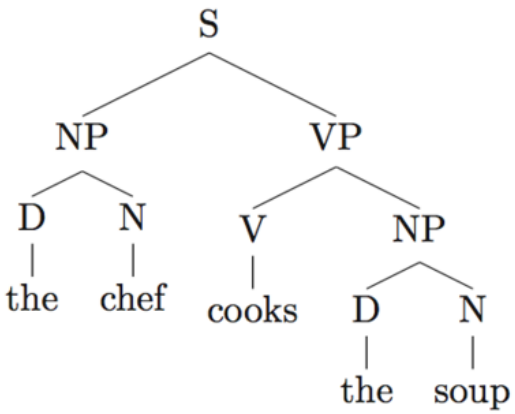


Figure 8: Linguistic Parse Tree

Sentence S is composed of a noun phrase (NP), including a noun (N) and a determinant (D), and a verb phrase (VP), in which a verb (V) and yet another noun phrase (NP) is stored. Analysis of the tree allows making sense of the meaning of the sentence. The advantage of this approach compared to regular editing distance methods like *Levenshtein*[27] distance is that the sentences "the chef cooks the soup" and "the soup is cooked by the chef" will be identifiable as being identical. By decomposing the learning outcomes of the collected qualification frameworks and applying a similarity scoring algorithm, we could flag outcomes with a high similarity as likely being identical. For this approach to succeed, we would need our similarity scoring algorithm to be aware of the semantics of the learning outcomes to

[25] https://en.wikipedia.org/wiki/International_Standard_Classification_of_Occupations#External_links
[26] https://www.cedefop.europa.eu/en/publications-and-resources/publications/4156
[27] https://en.wikipedia.org/wiki/Levenshtein_distance

compare, i.e. we would require a dedicated lexical database of semantic relations of words and expressions pertaining to construction activities and energy efficiency in particular.

We implemented a very rudimentary version of the similarity scoring algorithm using the NLPK[28] (Natural Language Processing Toolkit), using a standard English Wordnet lexical database to compare learning outcomes from two different qualification schemes. For instance, the comparison of the **NetUBiep** learning outcome "*Analyse the BIM model.*" and the **Bimzeed** learning outcome "*Define the property of the models.* ", yielded a similarity of **0.6957**, i.e. 69%. We wrote a little script which would compare each individual learning outcome from a qualification scheme X with each and every learning outcome from a qualification scheme Y. By arranging the individual similarity scores in a matrix like fashion and by assigning a colour to the respective similarity score, ranging from black for no similarity to yellow for high similarities, we were able to produce a similarity map of the given qualification schemes.

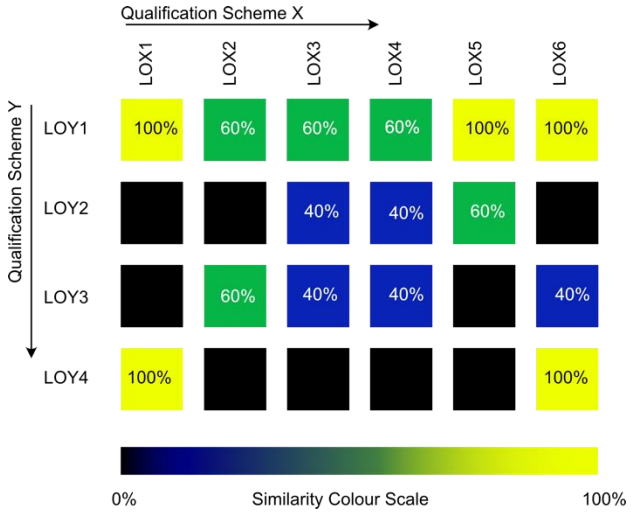


Figure 9: Arrangement of Similarity Map

[28] https://www.nltk.org/

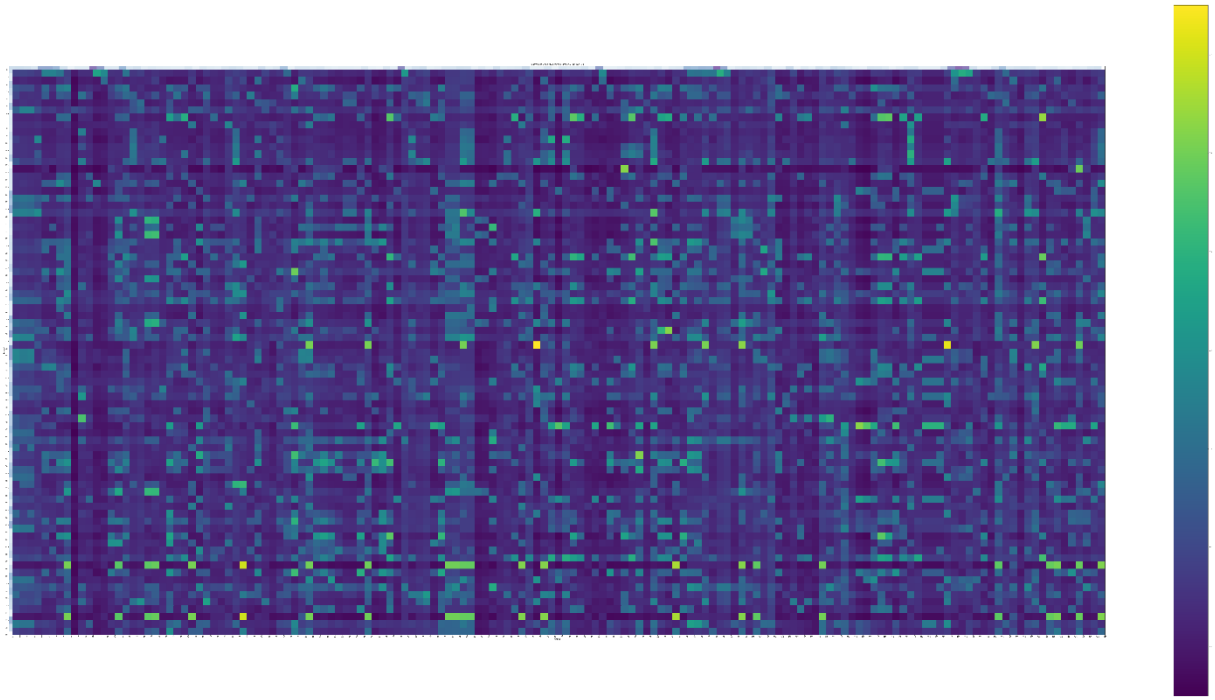


Figure 10: Similarity Map of Bimzeed and NetUBieb schemes

Another advantage of applying linguistic analysis to existing learning outcomes consists in the fact that we can find the action part of the outcome, identified by the verb. This would allow us to compile a list of all actions contained in the various learning outcomes. This list of actions would then in turn allow us to build a wheel of power verbs mapped to cognitive levels of Bloom's Taxonomy. This would eventually allow us to associate a given learning outcome with one or more potential EQF levels.

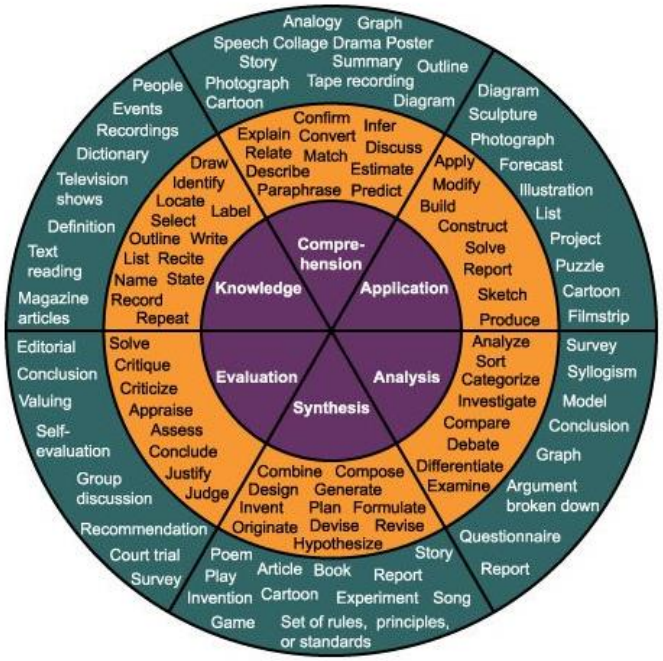


Figure 11: Example Wheel of Power Verbs

6 A taxonomy for INSTRUCT

6.1 Taxonomy

The Taxonomy for the INSTRUCT project will be based on the original taxonomy developed in the scope of the BIMEET project. The major difference between the BIMEET and the INSTRUCT taxonomy consists in the possibility of the later to accommodate trainings expressing their learning outcomes based on different qualification schemes. The description of the taxonomy will be split into two major sections for the sake of clarity, i.e. the section pertaining to trainings, modules and training events as the first one. The second section will be focused on the qualification scheme and representation of learning outcomes for the individual trainings.

6.1.1 Trainings, Modules and Training Events

Figure 12 (page 23) depicts the section of the taxonomy pertaining to trainings, modules and training events. Each Training is created by an **Institution** of a given **Institution Type** (e.g. *Academic, Training Centre, Professional Association*…). Each **Training** is composed of 1 to n **Modules,** where each module can have **Pre-Conditions** attached to it, e.g. another Module needs to be completed first, a certain certification needs to be achieved first, etc. Each module may also deliver upon completion 0 to n **Certifications.** Training institutions also have the possibility to attach **Support Materials** (e.g. *Slide decks, PDFs* etc) to individual modules. Each training will be of a given **Delivery Type** (*On site, online, on demand, etc*) and **Training Type** (*Qualification, Certification, Vocational, etc*). Trainings are very often given in a recurring manner and at different locations. The INSTRUCT taxonomy thus defines the concept of **Training Events**, linking available **Trainings**, **Modules**, **Venues** and **Tutors** while specifying the date and time information of when the event will take place and the required time frame. This gives training institutions great flexibility when scheduling training events and to customise trainings by including or excluding different modules as needed.

6.1.2 Qualification Frameworks and Learning Outcomes

Figure 13 (page 24) depicts the section of the taxonomy pertaining to qualification frameworks and learning outcomes. This section of the taxonomy was subject to most of the redesign effort with respect to the BIMEET taxonomy. As already mentioned earlier, the INSTRUCT taxonomy is able to accommodate multiple **Qualification Schemes** with different **Grading Systems** side by side. Since not all schemes cover all disciplines (**Profiles)**, the taxonomy allows assigning a subset of Profiles to individual schemes. **Learning Outcomes** can be assigned to **Roles** and **Profiles**, with an optional link to **RIBA Stage**, thus reflecting the structure introduced in Figure 6 (page 17).

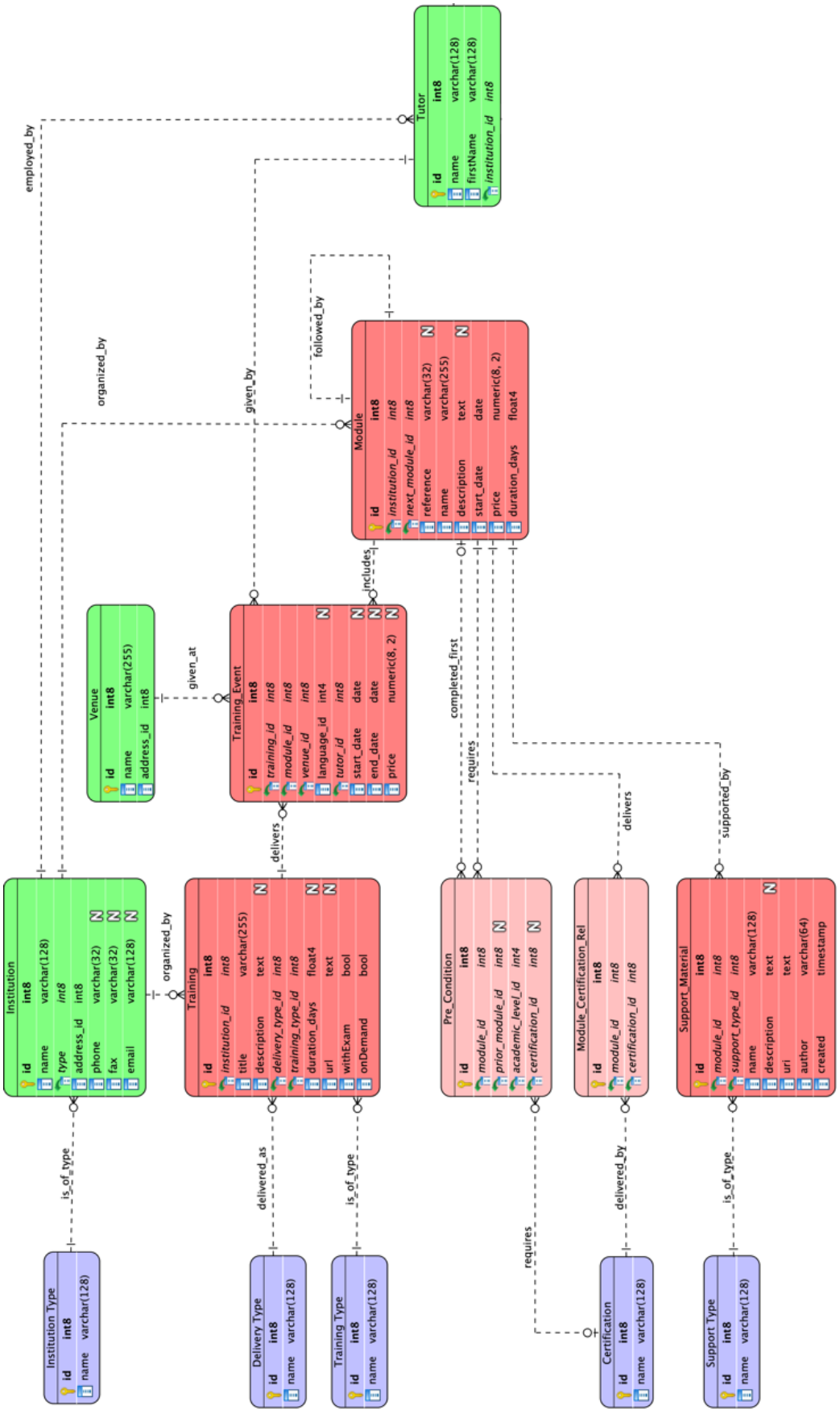


Figure 12: ERD Model of INSTRUCT Trainings

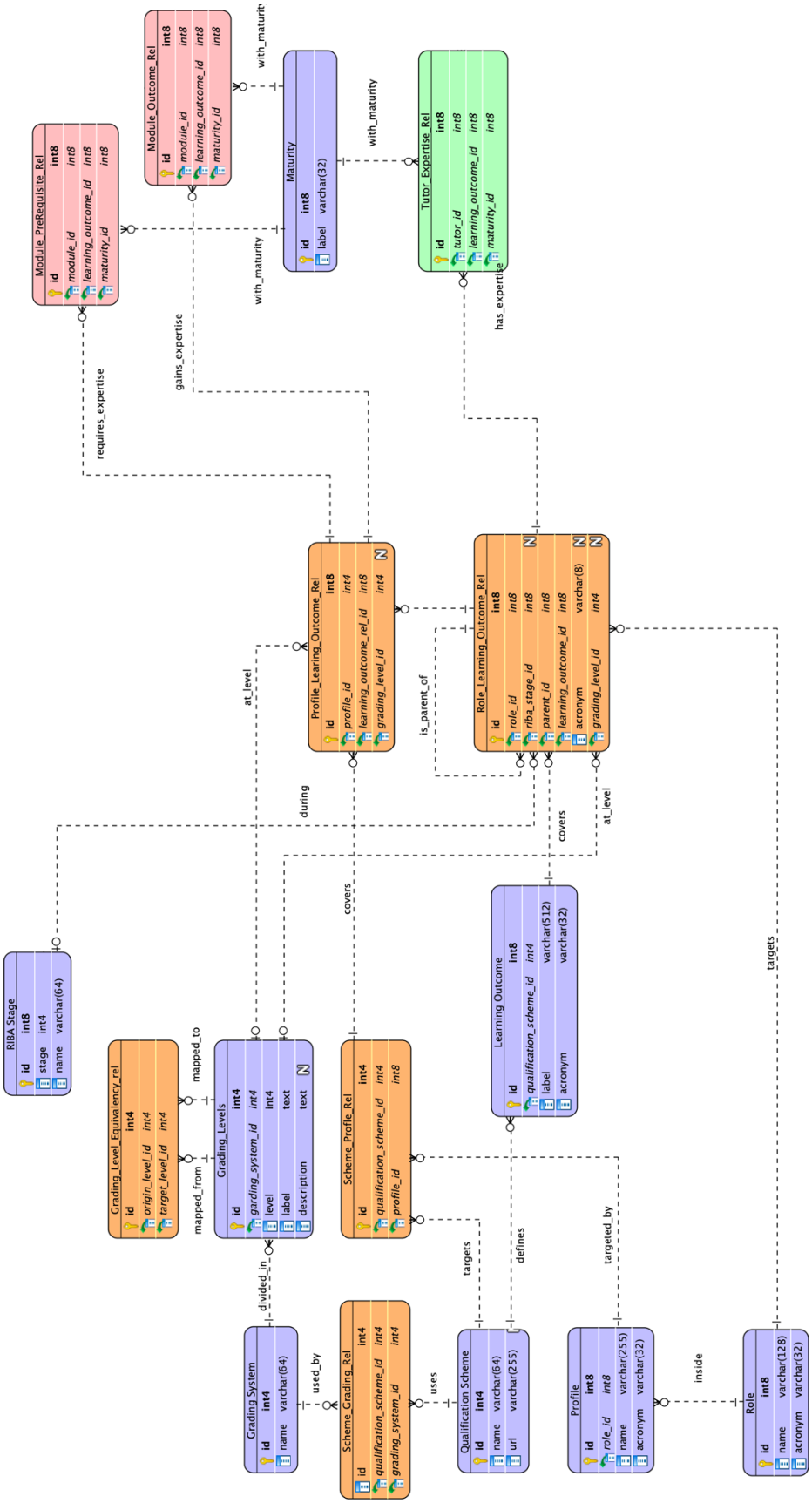


Figure 13: ERD model of qualification schemes and learning outcomes

We would like to illustrate how mapping of multiple qualification schemes can be achieved with the proposed taxonomy through a pair of examples.

6.1.3 Qualification Scheme and grading system

6.1.3.1 BIMEET Project Example

The first step in adding a new qualification scheme to the taxonomy consists in adding a new entry into the **Qualification Scheme** table. We call the scheme *BIMEET.* The BIMEET project used the EQF grading system. If the **Grading System** table already contains the EQF grading system, then we can directly link the BIMEET qualification scheme to the later (via the *Scheme_Grading_Rel* table). If the system did not yet exist, then a new entry would have to be created in the **Grading System** table and the various levels of the system would have to be created in the associated **Grading Levels** table. For the EQF grading system, for instance, we would have to add 8 new entries, specifying for each entry the numeric level, a short label and if available, a more detailed description.

Level	Label	Description
1	Level 1	Basic general knowledge.
2	Level 2	Basic factual knowledge of a field of work or study.
3	Level 3	Knowledge of facts, principles, processes and general concepts in a field of work or study.
4	Level 4	Factual and theoretical knowledge in broad contexts within a field of work or study.
5	Level 5	Comprehensive, specialised, factual and theoretical knowledge within a field of work or study, and an awareness of the boundaries of that knowledge
6	Level 6	Advanced knowledge of a field of work or study, involving a critical understanding of theories and principles
7	Level 7	Highly specialised knowledge, some of which is at the forefront of knowledge, in a field of work or study, as the basis for original thinking and/or research. Critical awareness of knowledge issues in a field and at the interface between different fields.
7	Level 8	Knowledge at the most advanced frontier of a field of work or study, and at the interface between fields.

Table 7: EQF Grading Levels

6.1.3.2 PROF/TRAC Project Example

The PROF/TRAC project uses a custom competence level system which defines the following levels:

Level	Label	Description
0	Level 0	Not applicable. No knowledge and competencies required.
1	Level 1	Has little knowledge and competencies with respect to the relevant field / technology (mostly outside the own field of expertise). Understands basic principles and is able to take part in project team discussions.
2	Level 2	Understands basic knowledge and has practical competencies within the field / technology, is able to solve simple problems by selecting and applying basic methods, tools, materials and information (mostly outside the own field of expertise).
3	Level 3	Has comprehensive, factual and theoretical knowledge and competencies within the field / technology, is capable of solving standard problems within the field.

4	Level 4	Has advanced knowledge involving a critical understanding of theories and principles and competencies, required to solve complex and unpredictable problems in the field and is aware of the boundaries.
5	Level 5	Has specialized knowledge and problem-solving competencies, partly at the forefront of knowledge in the field, in order to develop new knowledge and procedures and to integrate knowledge from different fields.

Table 8: PROF/TRAC Competence Levels

Adding the PROF/TRAC project to the INSTRUCT taxonomy thus entails defining a new PROF/TRAC entry in the **Grading System** table and adding the respective competence levels to the **Grading Levels** table. A particularity of the PROF/TRAC grading system consists in the fact that the system defines for each competence level a set of EQF equivalences. For instance, Level 3 is said to be equivalent to EQF levels 4 and 5. Having this kind of information is very helpful because it allows translating competence levels from one system to another. The INSTRUCT taxonomy allows keeping track of those equivalences via a dedicated *Grading_Level_Equivalence_Rel* table. For the example given earlier, two entries would be created in the said table, both entries having Level 3 of the PROF/TRAC system as their *origin* and having Level 4, respectively Level 5 of the EQF system as their *target*.

6.1.4 Target Audience

Looking at the side by side comparison of the target audiences for the different qualification schemes given in 5.1.1, all schemes *group* the various target professions hierarchically in a table like structure. The INSTRUCT taxonomy replicates this structure, by providing a **Role** table for the high-level groups of professions, i.e. the columns of the corresponding table, and a **Profile** table for storing the various professions included in that group, i.e. the rows of the table.

6.1.4.1 BIMEET Project Example

The BIMEET project for instance defines the following target groups; *Client & Client Advisors, Architectural Design, Structural Design, Building Services Design, Construction Work* and *Maintenance Work*. Each group will thus result in a dedicated entry in the **Role** table. The *Client & Client Advisors* role in turn, comprises the *Client, Project Manager, Client BIM Manager, Client BIM Coordinator* and the *Briefing Consultant* profile, each one represented by a dedicated entry in the **Profile** table, with a link to the enclosing Role. It is important to note that Profiles and Roles will be normalized across multiple qualification schemes, i.e. there will be no redundant entries. For instance, there will be exactly one *Architect* profile, and its inclusion in a particular qualification scheme or not will be governed by the *Scheme_Profile_Rel* table.

6.1.4.2 PROF/TRAC Project Example

The PROF/TRAC project on the other hand has a completely different set of target groups, which are; *Architecture, Civil Engineering, Electrical Engineering, Mechanical Engineering, Building Management Construction Management* and *Financing & Procurement*. Each group will again result in a dedicated entry in the **Role** table. With respect to the enclosed profiles, the *Architecture* role comprises an *Architect* profile (see Table 4: PROF/TRAC Target Audience) which coincides with the profile inside BIMEETs' *Architectural Design* role. (see Table 2: BIMEET Target Audience). As described earlier, the already existing Architect profile will be included in the PROF/TRAC scheme by referring to it via the *Scheme_Profile_Rel* table.

6.1.5 Learning Outcomes

As already stated in 5.1.2, qualification schemes commonly organise their learning outcomes (LO) in a matrix, defining for a given construction stage and for each profile/discipline a set of competencies or

learning outcomes. It is important to understand that competencies and learning outcomes are two educational terms which appear to be interchangeable, however they do not have the same meaning per se. As Hartel and Foegeding[29] wrote in 2004, ***competencies*** *describe the desired knowledge, skills and behaviours* whereas ***learning outcomes*** describe *what a learner will be able to do in some measurable way*. In the context of this taxonomy, specifically focused on training offers and qualification schemes, we will treat competencies and learning outcomes as one and the same though[30]. Another similarity encountered in the analysed qualification schemes is that LOs are often repeated for various profiles and applicable construction stages. The integration of a new qualification scheme into the INSTRUCT taxonomy thus requires a pre-processing step consisting in the creation of a list of unique LOs. This list of unique LOs will then be inserted into the **Learning Outcome** table with a link to the corresponding entry in the **Qualification Scheme** table.

6.1.5.1 Structuring of LOs

LOs are often, but not exclusively organised in a hierarchical manner with one higher level and one sub-level. The BIMEET qualification scheme is one example of hierarchically organised LOs.

CLLO1	**Learner is able to explain the fundamentals of BIM and the underlying principles of uses with respect to building life-cycle.**
CL1.1	Recall essential contents, summarize and give examples of BIM terminologies, definitions and standards.
CL1.2	Explain added value of BIM for energy efficient and sustainable projects.
CL1.3	Explain the potentials of different BIM-compatible assessment, simulation and optimization tools in achieving good energy and building performance.
CL1.4	Summarize the ideas of digital space and asset management.
CL1.5	Explain the added value of using open file formats (i.e. IFC) to ensure interoperability.
CL1.6	Explain the main contents and apply relevant parts of national BIM guidelines.

Table 9: Example of LO Hierarchy for BIMEET project

Some schemes on the other hand organise their LOs by construction stage. The PROF/TRAC qualification scheme for instance is an example of such a scheme.

Project phase	Short description	Detailed description of competencies
General	Understand smart grids in relation to energy performance	Has general knowledge and a holistic view on smart grids and buildings' energy profiles, understanding of its contribution to energy performance
General	Information management of smart grids in NZEB design	Can provide the (smart) grid manager with basic information on buildings' energy profiles
General	Holistic approach of smart grids in NZEB design	Can think in a holistic way concerning energy demand, energy supply, storage and is able to make trade-offs
Preparation	Determine smart grid concepts	Can perform a feasibility study to determine the basic concept within the project, based on energy saving contribution, costs, restrictions, etc.

[29] https://onlinelibrary.wiley.com/doi/epdf/10.1111/j.1541-4329.2004.tb00047.x

[30] Note : The rationale for this assumption stems from the fact that, even though some qualification schemes use the terms competencies and skills, the mere fact that they are part of a qualification scheme implies that they are measurable in some way.

Preparation	Perform energy simulations	Can perform energy simulations in order to define building energy profiles (such as heat load duration curves)
Preparation	Define energy profiles	Can define the energy profile of the building, i.e. the energy demand profiles, energy supply profiles, storage (in relation with heat pumps), based on input from team members.
Design	Engineer smart grids	Can design and calculate the smart grid system, based on heat load duration curves, energy simulations etc.
Construction	Specify smart grids in tender contracts	Can specify and describe the smart grid system in a tender contract, in a way that ensures the contribution to energy saving is realised.
Construction	Quality assurance of smart grids according contract	Can manage, instruct and audit contractors on site during the realisation of a smart grid system, based on information given in the tender documents and given by the designer.
Construction	Commission smart grids to ensure operation as planned	Can commission a smart grid system on its functionality and quality, and determine whether the system operates as planned. Make sure the foreseen contribution to energy saving is realised.

Table 10: Example of LOs organised by construction stage (PROF/TRAC project)

The design of the INSTRUCT taxonomy is flexible enough to accommodate both kinds of structure and can even handle taxonomies organising their LOs both hierarchically and by construction stage. The *Role_Learning_Outcome_Rel* table plays a pivotal role in this ability. The table allows mapping individual LOs from the **Learning Outcome** table to the **Role** table, thus establishing a link to a group of the target audience. The table furthermore allows the creation of a hierarchy of LOs by defining entries the *Role_Learning_Outcome_Rel* table as a *parent* entry. For instance, in the context of the BIMEET project, the *Role_Learning_Outcome_Rel* table would have one entry for the LO "*Learner is able to explain the fundamentals of BIM and the underlying principles of uses with respect to building life-cycle.",* another one for the LO "*Recall essential contents, summarize and give examples of BIM terminologies, definitions and standards*.", using the first one as a parent entity. Last but not least, each entry in the *Role_Learning_Outcome_Rel* table has an optional link to the Royal Institute of British Architects 's **RIBA Stage**[31] table, thus allowing to link LOs to a construction stage.

6.1.5.2 Grading of LOs

With the overall structure of individual LOs in place, the part that is still missing is the assignment of the proper grading levels to the different LOs.

[31] The Royal Institute of British Architects publishes its Plan of Work, which "organises the process of briefing, designing, constructing and operating building projects into eight stages and explains the stage outcomes, core tasks and information exchanges required at each stage". https://www.architecture.com/knowledge-and-resources/resources-landing-page/riba-plan-of-work

Client & Project manager (PROJM), Client BIM manager (CBMA), Client BIM coordinator (CBCO), Briefing consultant (BC)		PROJM	CBMA	CBCO	BC
CLLO1	**Learner is able to explain the fundamentals of BIM and the underlying principles of uses with respect to building life-cycle.**	**4**	**6**	**6**	**4**
CL1.1	Recall essential contents, summarize and give examples of BIM terminologies, definitions and standards.	4	6	5	4
CL1.2	Explain added value of BIM for energy efficient and sustainable projects.	4	6	5	5
CL1.3	Explain the potentials of different BIM-compatible assessment, simulation and optimization tools in achieving good energy and building performance.	2	3	3	5
CL1.4	Summarize the ideas of digital space and asset management.	6	3	3	5
CL1.5	Explain the added value of using open file formats (i.e. IFC) to ensure interoperability.	3	5	5	2
CL1.6	Explain the main contents and apply relevant parts of national BIM guidelines.	4	6	5	-

Table 11: Grading of BIMEET LOs

Table 11 gives an example of how the BIMEET project assigns an EQF level to individual LOs. It is interesting to note that individual LOs do not get assigned one overall EQF level but instead are being assigned individual levels for the various **Profiles** included in the target group (**Role**) the LOs have been defined for. The INSTRUCT taxonomy uses a second pivot table named *Profile_Learning_Outcome_Rel* table, allowing the assignment of individual grading levels on a per profile basis.

Project phase	Short description	Detailed description of competencies	1	2	3	4	5
General	Understand smart grids in relation to energy performance	Has general knowledge and a holistic view on smart grids and buildings' energy profiles, understanding of its contribution to energy performance					
General	Information management of smart grids in NZEB design	Can provide the (smart) grid manager with basic information on buildings' energy profiles					
General	Holistic approach of smart grids in NZEB design	Can think in a holistic way concerning energy demand, energy supply, storage and is able to make trade-offs					
Preparation	Determine smart grid concepts	Can perform a feasibility study to determine the basic concept within the project, based on energy saving contribution, costs, restrictions, etc.					

Table 12: Grading of PROF/TRAC LOs

Table 12 on the other shows that the PROF/TRAC qualification scheme assigns an overall grading level for individual LOs. The INSTRUCT taxonomy allows to do this by providing a link to the **Grading Level** table directly at the level of the LO structuring table, i.e. the *Role_Learning_Outcome_Rel* table. It should be noted though, that the PROF/TRAC qualification scheme defines on top of that minimum grading levels for individual target groups (Table 13). As for the BIMEET qualification scheme shown earlier, these mappings can also be stored by using *Profile_Learning_Outcome_Rel* table.

TECHNOLOGY AND INTERDISCIPLINARY COMPETENCIES PER TARGET GROUP

	TARGET GROUP	Public Adminstration	Professionals	Professionals	Professionals	Professionals	Technicians	Technicians
	Reference professions	Legislators Civil servants	Architects	Civil Engineering (consultancy)	Electrical Engineer (consultancy)	Mechanical Engineer (consultancy)	Engineer (installer)	Installers (field)
EM	**ENERGY MANAGEMENT**							
EM1	Smart grid systems	1	2	1	5	3	3	3
EM2	Domotic systems	1	2	1	4	4	2	2
EM3	Building management systems	1	2	1	4	5	2	2
EP	**ENERGY PRODUCTION (on-site and nearby renewable energy production and off-site renewable energy)**							
EP1	Geothermal energy	1	2	2	3	4	3	3
EP2	Biomass	1	2	2	3	4	3	3
EP3	Biogass	1	2	2	3	4	3	3
EP4	District heating and cooling	1	2	2	3	4	2	2
EP5	Heatpumps	1	2	2	3	5	2	2
EP6	Solar power systems for electricity generation	1	3	3	5	4	2	2
EP7	Solar thermal systems for cooling generation	1	2	2	3	4	3	3
EP8	Solar thermal systems for domestic hot water and/or	1	2	2	3	5	2	2
EP9	Mini wind power	1	3	3	4	3	3	3
EP10	Combined Heat and Power (CHP)	1	2	2	4	4	2	2

Table 13:Minimum Levels for Target Groups (PROF/TRAC)

6.1.6 Training Module Pre-requisites and Outcomes

The INSTRUCT taxonomy allows defining for each individual **Training Module** two sets of LOs form the respective qualification scheme. The first set defines the **Pre-requisites** of the given module, listing the LOs or competencies the potential attendee needs to have acquired to qualify as eligible for attending said module. The second set defines the actual **Outcomes** of the given module, listing the LOs or competencies the attendee will have acquired upon successful completion of the module. The particularity of the Module **Pre-requisites** and **Outcomes** consists in their link to the **Maturity** table. This table defines maturity levels as defined by the *Dreyfus* scale, ranging from novice to expert in five stages. The rational for this expertise overlay stems from the thought that, even though a certain LO is associated with a given EQF level for a given profile, a basic or introductory training will only provide the attendee with a subset of the knowledge ascribed to the respective LO.

6.2 Data Collection Instrument

The training data collection relies on a form in a xls format that is submitted to the Instruct partners as well as to universities/schools/training institutions dedicated to AEC sector academic, vocational education and training.

The form targets to collect data about the training courses in EU and especially in the Instruct partners' countries (i.e. Poland, United Kingdom, Bulgaria, Italy, Finland, Luxembourg, and France).

The file that has to be filled in for each country is structured in 6 major sections:

1) Organiser
2) Host
3) Training data
4) Targeted public
5) Prerequisite and learning outcomes
6) Others

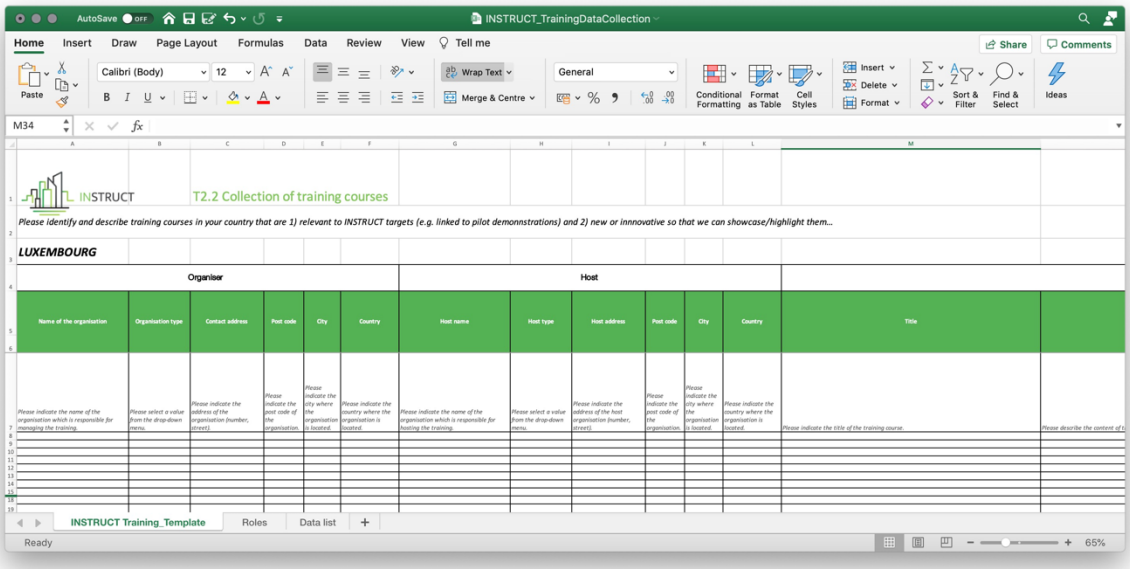


Figure 14 - Xls file for training data collection

The first section "Organiser" allows collecting data about the training organiser (i.e. Name, organisation type, address).

The second section "Host" allows collecting data about the training host (i.e. Name, organisation type, address).

The third section "Training data" allows describing the training and collecting the following information:

- Title of the training course
- Description of the content
- Language
- Module reference (if the training course is composed of several modules)
- Module name
- Tutor name
- Tutor organisation name
- Price (in euro)
- URL where we can find detailed information about the training course
- Duration (number of days, weeks, or years depending on the type of the training)
- Start date
- Available on demand (if the training course can be scheduled on demand)
- Exam (if a test is required at the end of the course, or to follow the next module of the training)
- Diploma name (if a diploma is delivered at the end of the course after a test or an exam)
- Delivery type (i.e. online (live or recorded), on site or both)
- EQF level (i.e level from the European Qualifications Framework for lifelong learning)

The fourth section allows collecting data about the targeted public. A list of 22 roles is predetermined and structured in 7 categories (i.e. Client & advisors, Architectural design roles, Structural design roles, Building services design roles, Construction work roles, Maintenance work roles, Material manufacturing work roles). The respondent has the possibility to add another category if required and a Nace code.

The fifth section addresses the "Prerequisites and learning outcomes". The corresponding cells allows to identify the learning outomes of the training, if a prior training is required before following this training, if a specific academic level is required to follow the training, and if the training course has been designed based on a known competence matrix (e.g. BIMEET matrix, BIM4VET matrix, etc.).

Finally, if "Resources" for this training are available online, the url can be added, and if a partnership exists for the training course, the partners can be indicated.

All collected data will be used to feed a training repository, and will be further analysed in order to identify:

1) The status of existing training schemes (in partners' countries and at EU-level),
2) The eventual gaps detected (especially in relation with INSTRUCT project demonstration pilots' applications (WP4)),
3) Opportunities, trends and expectations from the market.

7 Conclusion

This deliverable starts with an update on the status the challenges associated with Skills in construction, in the EU and with a focus on INSTRUCT consortium Member States.
It highlights the fact that numerous training and upskilling initiatives exist in Member States. In the last decades indeed, policies in relation with our built environment's Energy Efficiency, Digitalisation and Occupational Safety and Health have been implemented, with a required impact on skills. Public and private organisations tackled the challenge of skills, by developing training offers that in most cases are structured in so-called qualification frameworks, enabling for some of them certification and the accreditation of professionals and/or organisations.

However, even if helping in structuring the upskilling offer, these approaches lack a comprehensive management, homogeneity in the application and often create confusion for professionals who are not used to it. Moreover, as initiatives are often localised, the ability to compare training curriculums or even skills level is difficult.

The taxonomy provided in this deliverable aims to define the common ground for INSTRUCT partners to address the demonstration pilots, with a focus on training and skills requirements.
Besides, the meta-framework sets a methodology aiming at embracing a large set of training initiatives, and associated qualification frameworks, with a focus on digital skills and BIM. Besides informing T2.3, through a comprehensive integration of learning outcomes from other initiatives, including H2020 sister projects, the long-term vision is to integrate those various initiatives and reduce the complexity, while offering training providers with established sets of learning outcomes that would eventually facilitate the recognition of skills across the EU.

As part of INSTRUCT next tasks, training and qualification frameworks will be analysed to further improve the proposed method. The collection process itself will be split into two phases. A first phase will be limited in scope to the project partner countries (FR, LU, IT, UK, BG, PL, FI) and will use the Excel sheet presented in section **Błąd! Nie można odnaleźć źródła odwołania.**, aiming at setting up a representative sample of available trainings. This sample will supply insight for several questions related to the setup of a new catalogue, namely, which targets are being addressed by available training offer, to which extent are they linked to already existing qualification schemes, and last but least, which are those schemes.
This data, combined with key findings of earlier tasks, will influence the design and structure of the a Training Repository to be setup as a key instrument in INSTRUCT. The training repository will be a database hosted in the cloud. The data collected in phase one will be used for populating the repository.

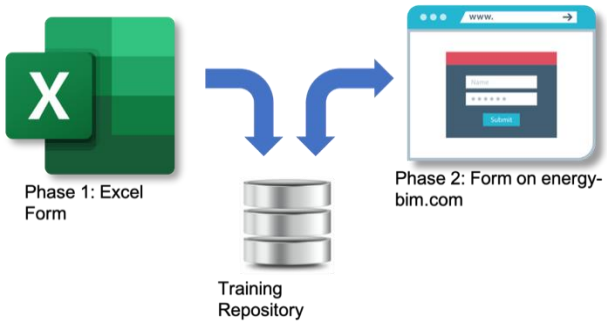


Figure 15: Two phase data collection process

In phase two, the collection scope will be widened, including stakeholders throughout the European Union by soliciting the INSTRUCT project stakeholder network. An online web form will be made available on the energy-bim.com portal to ease the collection process.

8 References

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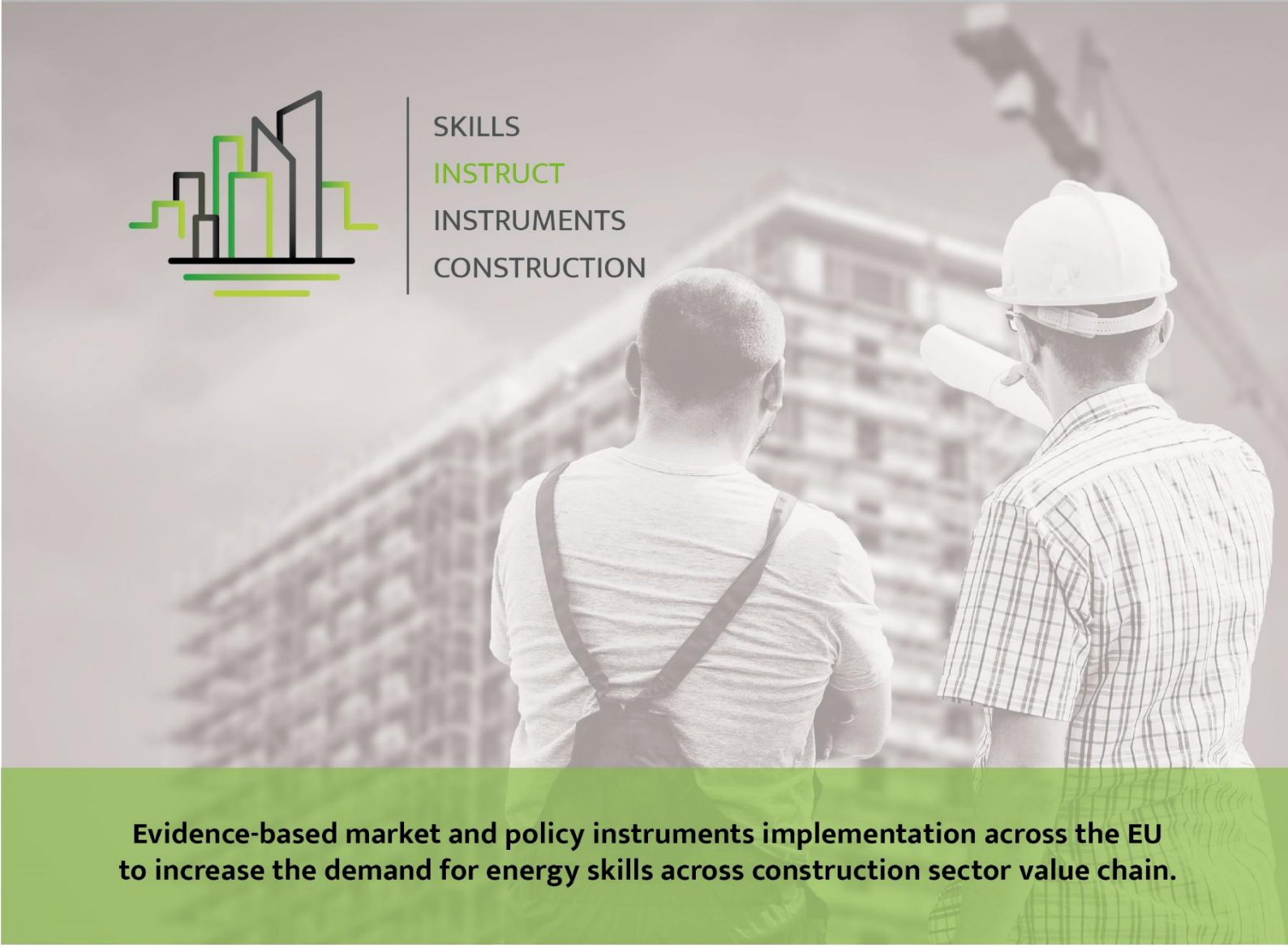
Glossary

Acronym	Full name
AEC	Architecture, Engineering and Construction
CA	Consortium Agreement
CEDEFOP	European Centre for the Development of Vocational Training
EC	European Commission
EASME	The Executive Agency for Small and Medium-sized Enterprises
EQF	European Qualifications Framework
ERD	Entity Relation Diagram
GA	Grant Agreement
PC	Project Coordinator
WP	Work Package
TL	Task Leader
DoA	Description of Action
PSC	Project Steering Committee
SQM	Scientific and Quality Manager
DEC	Dissemination and Exploitation Committee
KOM	Kick-off meeting
ASM	ASM – Market Research and Analysis Centre
VET	Vocational Education and Training
VTT	Technical Research Centre of Finland
LIST	Luxembourg Institute of Science and Technology
RIL	Finnish Association of Civil Engineers
CU	Cardiff University
R2M	Research to Market Solution France
DTTN	Distretto Tecnologico Trentino
ENEFFECT	Center for Energy Efficiency EnEffect
GER	General Exploitable Result
AB	Advisory Board
PM	Person month
M	Month
LO	Learning Outcome
NZEB	Near Zero Energy Building
ECSO	European Construction Sector Observatory

SKILLS
INSTRUCT
INSTRUMENTS
CONSTRUCTION



Evidence-based market and policy instruments implementation across the EU to increase the demand for energy skills across construction sector value chain.

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