SKILLS
INSTRUCT
INSTRUMENTS
CONSTRUCTION

Reduction of gap between designed and actual energy efficiency and initiatives for building owners

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 894756.

D4.6 Reduction of gap between designed and actual energy efficiency and initiatives for building owners

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Glossary:

Acronym	Full name
WP	Work Package
T	Task
DoA	Description of Action
D	Deliverable
LO	Learning Outcome
S-K-C	Skills, knowledge, competence
GER	General Exploitable Result
OER	Other Exploitable Results
Rakli	Association for Finnish Property Owners
UIPI	International Union for Property Owners
SuLVI	The HVAC Association of Finland
FISE	Qualification of Professionals in Building, HVAC and Real Estate Sector in Finland
LAB	University of Applied Sciences, Lahti and Lappeenranta
Metropolia	University of Applied Sciences, Helsinki region
HVAC	Heating, ventilation and air conditioning
MEP	Mechanical, Electrical, Plumping
BAS	Building automation
BMS	Building management system
BEMS	Building energy management system
RES	Reusable energy sources
ASM	ASM – Market Research and Analysis Centre, Poland
VTT	Technical Research Centre of Finland
LIST	Luxembourg Institute of Science and Technology
RIL	Finnish Association of Civil Engineers
CU	Cardiff University, UK
R2M	Research to Market Solution France
DTTN	Distretto Tecnologico Trentino, Italy
ENEFFECT	Center for Energy Efficiency EnEffect, Bulgaria

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Executive summary

In the EU, there is a failure in producing expected energy efficiency in the construction value chain, due to the dynamic nature of the construction building processes (planning, designing, procuring, building, maintaining). Demo 6 of the INSTRUCT project focuses on Energy gap reduction and initiatives for building owners looking for answers to the questions:

Q1: What are the reasons behind the reduction of the gap between designed and actual energy efficiency, and what role do the skills play here?

Q2: What are the established and new initiatives to manage targeted energy performance of buildings?

Q3: What are the methods, especially for building owners, regarding the skills verifying methods in the tendering phase?

Several activities were conducted, in order to understand the reasons for EE gap in building projects and to collect evidence based material on methods around how to avoid the EE gap by demanding better skills:

- Studying the methods to overcome the challenge with real case examples of skills verifying methods.
- Three seminars were organised around the challenge for awareness raising and enabling key stakeholders to share their insights.
- Reasons for EE gap was discussed in expert workshop and studied with help of case building projects and in connection to clients strategies.
- Mini-interviews with clients, training providers and with competence qualifications and accreditation bodies resulted valuable understanding about the nature of the national challenge.
- Based on the seminars, dialogue with stakeholders and informative content development, the basic idea of INSTRUCT method for skills verifying was developed. The method takes advantage of the use of any LO framework and its LO sentences or any Skills/ Knowledge/ Competence-requirements for disciplines executing the tasks in the building process. Further 3 analysing methods were tested: (1) Analysing the reasons for energy gap, (2) Identifying the emerging skills and respective roles, (3) Cross checking the emerging skills with LO frameworks.

Result 1: A set of skills verification methods collected and grouped skills verification methods, in tendering or in collaborative phase of projects.

Result 2: INSTRUCT approach for competence verification in the procurement phase of building project, in dialogue with clients and project managers. The INSTRUCT approach for competence verification during the procurement phase of building project is based on target definition by the client and self-assessment by the service provider.

Result 3: Further understanding of the reasons for the EE gap.

Result 4: Based on analysing the reasons for the EE gap, recognition of new needed competences (skills and competence gaps).

Result 5: Based on skills & competence gap analyse and identifying new roles and needed related LO's, few critical roles were identified:

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From Demo 6 results, two **tangible outcomes emerge and can be further defined and exploited**:

1. Information package and competence verification methods, in form of a set of skills verification methods was identified with detailed examples from projects (different types).
2. INSTRUCT method for defining LO's for existing or new roles based on the EE gaps analyse with competence gaps

Exploitation and valorisation activities on national level will focus on:

- Introducing the learning outcome (LO) framework as an underlying matrix for skills definitions for the requirement of skills of the needed experts during public building procurements, as well as for training courses and programmes.
- Guidance to building owners to support the sustainable change towards better energy efficiency.

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1. Demo 6 objective

Construction is a key component of the EU strategy and, faces huge pressure from EU and national regulations. Buildings represent 40% of primary energy consumption in the EU and between 30 and 40% of CO2 emissions depending on national energy mixes. Improving the EE of European buildings is a key step in achieving the 2030 and 2050 EU energy and CO2 emission targets. ([1]EC Factsheet 15/12/2021).

Energy performance is the result of an entire process from briefing to decommissioning involving all the supply chains concurring in the delivery and operation of a building. In fact, the energy performance gap can be attributed to a complex combination of, and interaction between, three factors: (a) intrinsic quality of the building, (b) "in use" conditions and user behaviour, and (c) energy control and actuation strategy . These factors are These factors are rooted in the Pre-design; Design; Construction; and Occupancy and Operations phases of a project (INSTRUCT DoA).

Challenge

In the EU, there is a failure in producing expected energy efficiency in the construction value chain, due to the dynamic nature of the construction building processes (planning, designing, procuring, building, maintaining). Demo 4.6 of the INSTRUCT project focuses on Energy gap reduction and initiatives for building owners and is looking for answers to the questions:

(1) What are the reasons for the energy performance gap?

(2) What type of skills are needed during the process to reduce this gap?

(3) How we could demand these skills from the expert and workers?

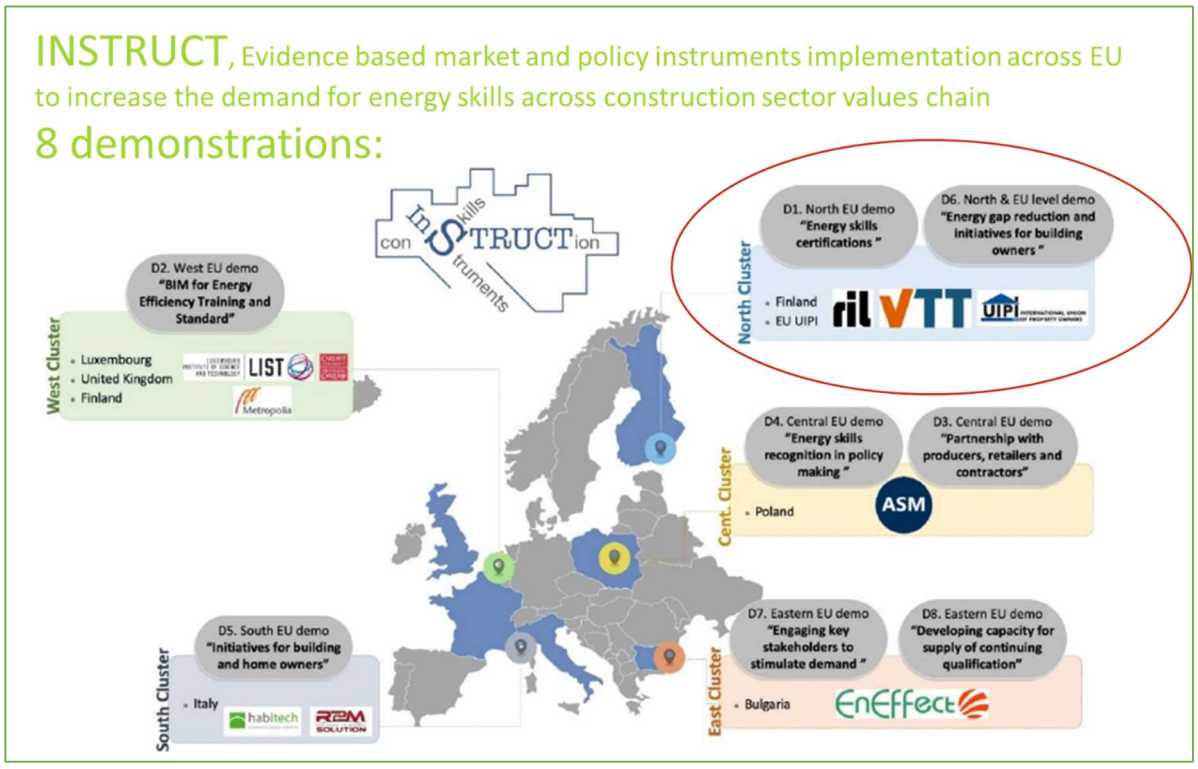

Figure 1: INSTRUCT project demonstrations and the North Cluster's Demo 1 and Demo 6.

[1] Factsheet - Energy Perfromance of Buildings
https://ec.europa.eu/commission/presscorner/detail/en/fs_21_6691

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1.1 Introduction

This deliverable (D4.6) reports the results of INSTRUCT project task 4.6: **Energy gap reduction and initiatives for building owner**s (North Cluster and European level). D4.6 focuses on the reduction of the gap between designed and actual energy efficiency, and initiatives for building owners. The report concludes:
- improvements done to reduce the gap between designed and actual energy efficiency. Improvements happen in procurement and process steering level and are based on demanding better skills.
- additional initiatives and their success rates, based on the management and up-dating needed skills,
- concepts for building owners to adapt relevant skills verifying methods to building procurement process.

The report concludes the work done in the task 4.6 and gives concrete examples of the reduction of the gap between designed and actual energy performance through better energy skills (from DoA).

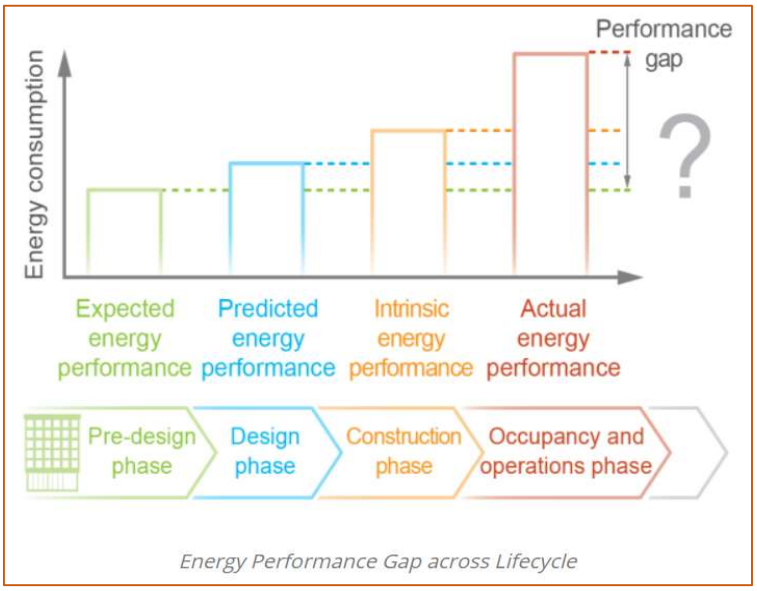
Aim and targets

The aim is to understand the reasons for EE gap in building projects and collect evidence based material on methods around how to avoid the gap by demanding better skills by:

- Organising several events around the challenge, with different stakeholders, in order to support development and dialogue on defining the needed skills, demanding the skills and building up a certification system of the skills.
- Introducing the learning outcome (LO) framework as an underlying matrix for skills definitions for the requirement of skills of the needed experts during public building procurements, as well as for training courses and programmes.
- Studying the methods to overcome the challenge (examples of skills verifying methods), and define an analysing methodology for emerging skills.

Further, in the valorisation and exploitation phase the targets cover:

- The real case examples which are demonstrated and concrete steps for adaptation of the results will introduced to European wide network for building owners, via Rakli and UIPI.
- Guidance to building owners to support the sustainable change towards better energy efficiency.



Energy Performance Gap across Lifecycle

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Figure 2: Energy perfromance gap from expected energy perfromance to actual energy performance.

1.2 Terminology

Results: Findings from the RDI-working process of INSTRUCT project, focused on the specific results of Demo 6.
Outcome: Exploitable results or potentially exploitable results based on Demo 6 results. For the INSTRUCT project's level key outcomes an exploitation strategy has been defined.
Demo/ Demonstration: Searching for evidence based on deep understanding of the usage potential of INSTRUCT instruments. Demo 6 is focusing on the instrument: "Legislative changes and public procurement".
Exploitation: The utilisation of results – up to four years after the project finished:

- in further research activities other than those covered by the action concerned, or
- in developing, creating and marketing a product or process, or
- in creating and providing a service, or in standardisation activities.

Valorisation: Creating more value based on learning from the initial results implementation, demonstration during INSTRUCT project time.

1.2 Challenges as questions

Based on the aim and targets of Demo 6, three more specific questions were formulated to focus on the challenge areas:
Q1: What are the reasons behind the reduction of the gap between designed and actual energy efficiency, and what role do the skills play here?
Q2: What are the established and new initiatives to manage targeted energy performance of buildings?
Q3: What are the methods, especially for building owners, regarding the skills verifying methods in the tendering phase?

1.2.1 Q1 Reasons for the EE gap

Q1 was studied in workshops held during mini-seminars, and in one-to-one interviews with project managers. The starting point was a list of reasons for the EE gap elaborated from a one deep case study.

Q1: What are the reasons between reduction of the gap between designed and actual energy efficiency, and what role does the skills play here? Some observations stemming from the analysis are:

- Several reasons were noticed, and they vary from projects to project
- Reasons can be translated to gaps in skills, knowledge or competences (S-K-C)
- S-K-C can be identified to be part of the work task responsibilities of one discipline or many disciplines, in the building process.

1.2.2 Q2: Management of the EE target in general

Q2 was studied with help of case studies of buildings and their lessons learned, and best practices.

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The case buildings were shortly analysed from 4 perspectives: process, target (business value), technology, and people.

Q2: What are the established and new initiatives to manage better skills, in the area of energy performance. Some observations stemming from the analysis are:

- Clear goals
- Resources
- Procurement of experts
- Processes and tools
- Qualified experts, certification systems, requirements for skills (top down/ voluntary
- Training and competence building
- Connection to a labelling system like: net zero buildings, Passive House, RTS 3 stars etc

1.2.3 Q3: Method for verifying skills

Q3 was studied with help of literature and development of evidence based examples. Several examples of the skills verifying methods were collected from real case projects, mainly project of transport infrastructure.

Q3: What are the methods, especially for building owners, regarding the skills verifying methods in the tendering phase? Some observations stemming from the analysis of the collected examples are:

- Examples collected cover individual, team and organisational level.
- Examples od skills verifying methods can be groupped to (1) general methods, (2) methods connected to procurement type nas (3) methods conneted to project specific factors.

Further development needs in exploitation phase is clearly foreseen. These methods will be valorised in exploitation phase in Finland and Nordic: City of Helsinki (building owner), Metropolia (building user), Energy Authority, Ministry of Environment and the International Union of Property Owners.

2. Connection to other tasks

Activities and sub-tasks of this demo are related to

- WP2, task 2.3: Skills and Learning outcomes matrix
- WP3, task 3.3: New legislative frameworks

Demo 4.6 contributes to WP6, to the task 6.2: Exploitation roadmaps and task 6.4: Exploitation workshops and “business plans”.

These relations were identified early in the planning phase, and are presented in Figure 3.

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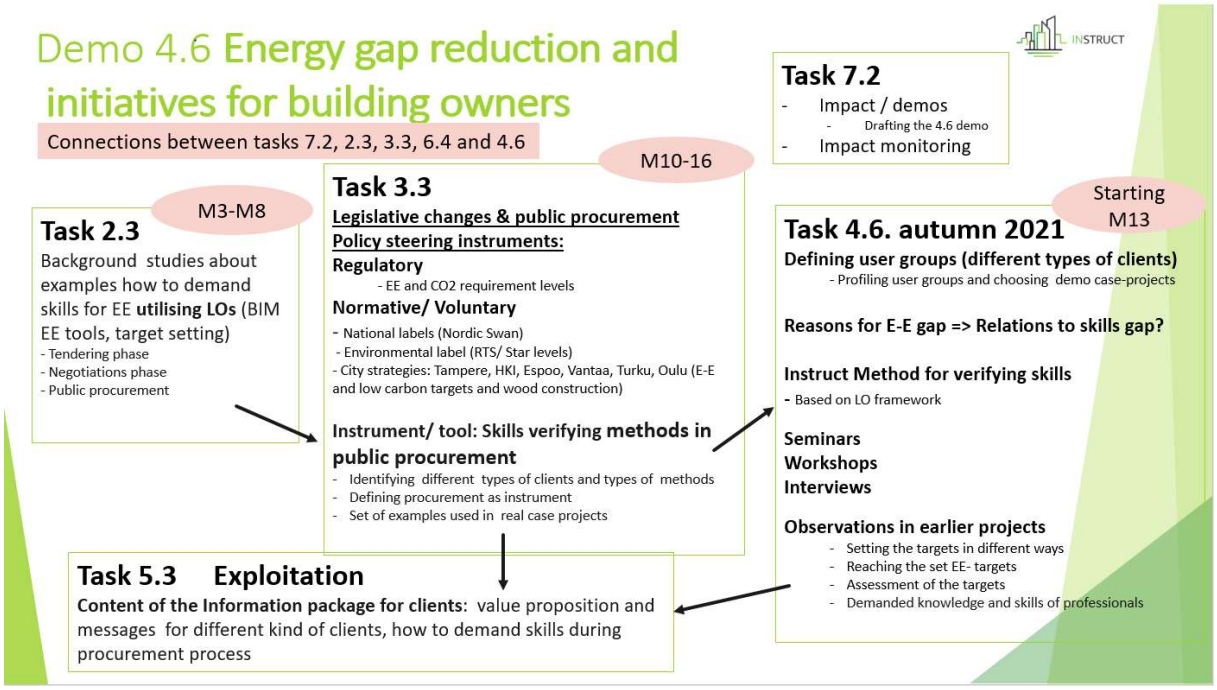

Figure 3: Connection between demo 6 (task 4.6) and other tasks.

3. Methodologies used

During the demonstration process, the following methodologies were used: Seminars and workshops, Literature studies, Lessons learned case descriptions, Interviews, Analyses, Networking.

3.1 Seminars and workshops

Several seminars and workshops were used as backbone of the development process flow of Demo 6.

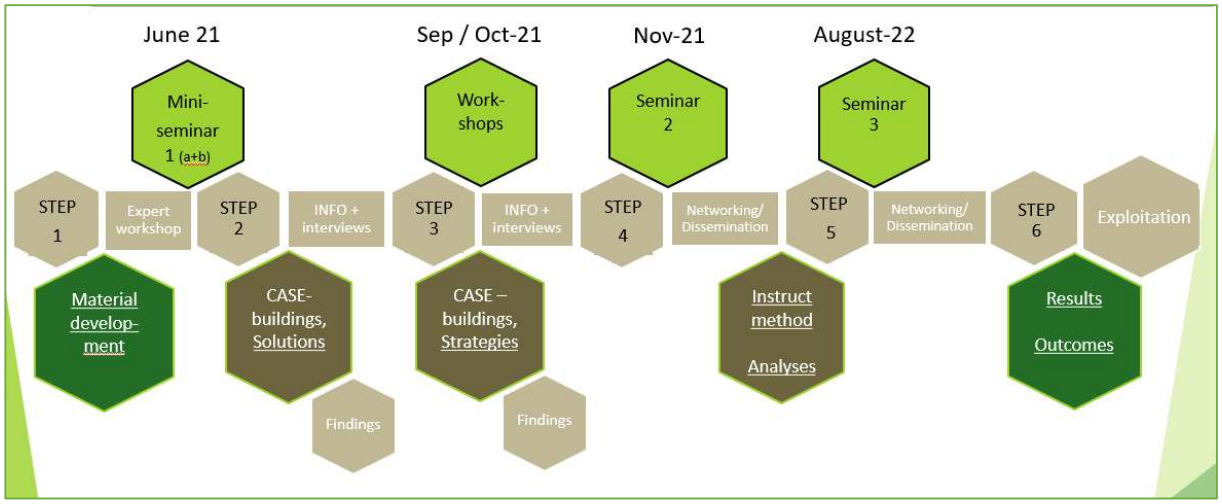

Figure 4: Process flow for the demo 6

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3.1.1. Presentation material content development

All presenters in the seminars were briefed and guidance given in order to fine-tune the presentation material content, and enrich the focus areas of INSTRCUCT Demo 6.
Seminars and workshops produced 27 different presentation materials and 6 workshop or panel facilitation materials.

3.2 Literature studies

A desk review (literature search of scientific articles) for sustainable procurement and skills verifying methods was conducted.

3.3. Lessons learned case descriptions

In order to understand the reasons for the EE gap, a few real case buildings, with clear EE targets, were studied.

3.4 Analyses

For some of the results of Demo 6 further analyses were conducted: grouping, characterising, matching with earlier results from other tasks, and asking for reflections.

3.5 Interviews

In connection to the planning of the seminars, semi-structured short expert interviews were conducted around the research questions of Demo 6. In different phases of the demo working process, nine interviews collected insights clarifying the perspective of

- cities and owners (City of Espoo, City of Kouvola, Väylä),
- associations (SuLVI),
- accreditation body (FISE),
- development ecosystems (bSF),
- education and training organisations (Metropolia, LAB)
- and Ministry of Environment.

3.6 Networking

General development nationally and internationally is active around skills management. Nationally in Finland the new Building Act and Degrees consists of strong demand for low carbon (and energy efficient) buildings and use of digital information (building information modelling) in the lifetime of facilities ([2])

[2] Government's legislative proposals to Parliament aim to reduce emissions from building and promote digitalisation, Finnish Goverment press release 15/09/ 2022. https://valtioneuvosto.fi/en/-/1410903/government-s-legislative-proposals-to-parliament-aim-to-reduce-emissions-from-building-and-promote-digitalisation

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The aim for policy level steering is to support the adaptation/ adaptation/ implementing the twin transition to the process steering and management of the built environment.

Networking activites:

- National network bodies contacted are the following: FISE, RT, RIL, SulVi, Motiva, Ministry of Environment, buildingSMART Finland.
- International network bodies contacted are: bSI and professional certification system, bS Italy, bS Norwegian, bS Audtria, CEN/TC 442 and working Group 8 (competence), BIM Alliance.
- Research projects contacted are: BIM ICE, Benedict, EU project SPARKS.

4. Process/Tasks/Events

The process connected desktop research and studies to events and seminars organised together with relevant industry stakeholders. The seminars aimed to support an active dialogue on common questions.

4.1 Material development

As part of task 2.3 and 3.3 presentation material was developed to clarify the potential of using more advanced skills verifying method as common pre-established references and formal qualification (organisation and personal level). The informative material package is based on case examples from earlier research projects focusing on procurement method development, and mainly transport infrastructure project cases.

4.2 Organising Mini-seminars

Two similar mini-seminars were organised in June 2021, with key stakeholders, focusing on project managers. The seminar days were organised together with Demo 1 and with RIL.

Title: **Building managers and the challenge of reaching energy-efficiency target**.
Dates: 1st June and 2nd June, 2021 with same agenda, but for different audience.
Target of the seminar: Increasing the need and impact of EE skills, supporting dialogue with stakeholders.
Location: on-line
Programme: see annexes
Participants: 40 participants, mainly senior building manages and clients.

Results: Know-how from project managers and clients about steering of the processes of EE buildings. Please see section 5.1.

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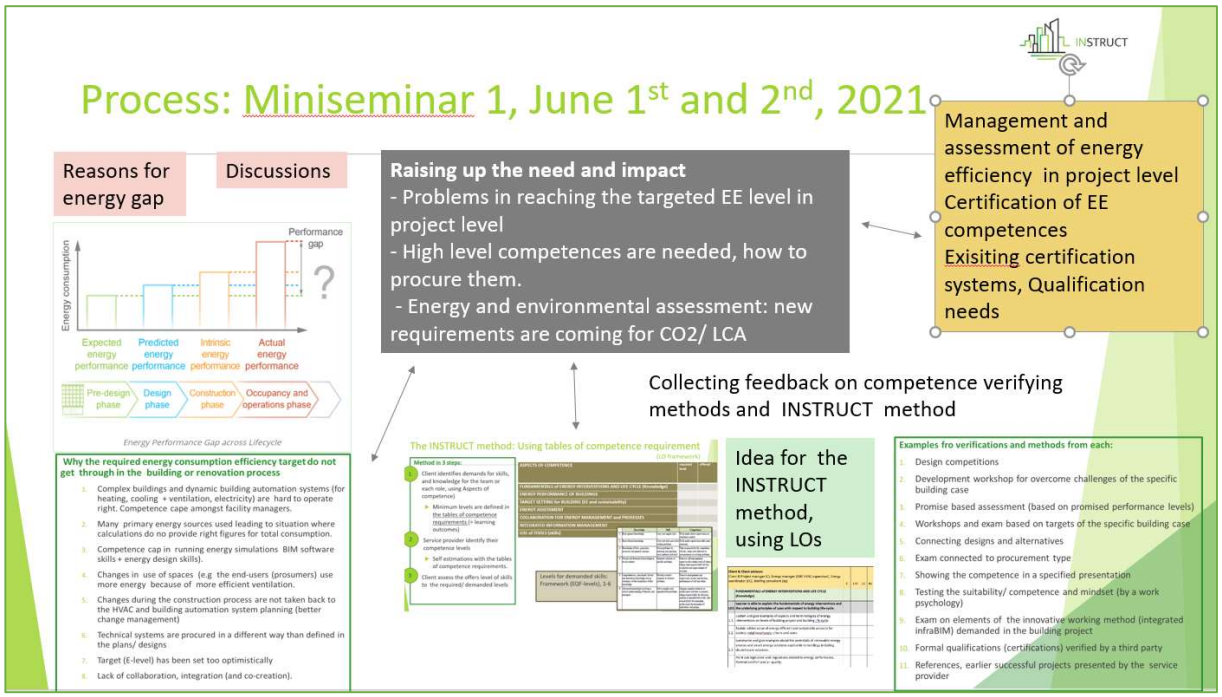

Figure 5: Mini-seminars' targets and content.

The list of potential reasons for Energy performance gap was introduced and discussed, for the following question:

Why does the required energy consumption efficiency target not get through in the building or renovation process?

Potential reasons ([3]):

1. *Complex buildings and dynamic building automation systems (for heating, cooling + ventilation, electricity) are hard to operate right. Competence gaps amongst the facility managers and operators.*
2. *Many primary energy sources used are leading to situation where calculations do no provide right figures for total consumption.*
3. *Competence gap in running energy simulations BIM software skills + energy design skills).*
4. *Changes in use of spaces (e.g the end-users (prosumers) use more energy because of more efficient ventilation.*
5. *Changes during the construction process are not taken back to the HVAC and building automation system planning (better change management)*
6. *Technical systems are procured in a different way than defined in the plans/ designs*
7. *Target (E-level) has been set too optimistically*
8. *Lack of collaboration, integration (and co-creation).*

[3] The list is based on a study made by Sofia Al-Khatib: Key findings of the energy performance gap in a Finnish office building. Thesis 2017, Aalto University

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4.3 INSTRUCT methods development

Based on the mini-seminars and dialogue with stakeholder and material development, the basic idea of INSTRUCT method for skills verifying was developed. Method took advantage of the use of the LO framework (see INSTRUCT D2.3) and its LO sentences as skills/knowledge/competence requirements for disciplines executing the tasks in the building process.
Further 3 analysing methods were tested

- Analysing the reasons for energy gap
- Identifying the emerging skills and respective roles
- Cross checking the emerging skills with LO frameworks

4.4 CASE-buildings and owners' strategies

As the adaptation of new processes and technologies for EE and low carbon buildings is related to the clients' demand and ambiguous level on the target values for EE and CO2, a closer look was taken to owners'/ clients' strategies. Two municipalities, with building cases, were studied.

4.4.1 CASE Kouvola

Early negotiation sessions organised by the Client/the project manager of a new wooden school project with a potential stakeholder

- Dates: 28th September, 2021 and 7th October, 2021
- Target of the workshops: Early market negotiation sessions about the content of tender for a wooden school, Kuusankoski School. The project must full fill the sustainability goals of Kouvola City strategy.
- Location: on-line
- Programme: see annex
- Participants: 60 participants, potential project manager, main contractor, material produces for structural concept, designers and experts (value chain) for a wooden school building.
- Content: Targeted EE and CO2 discussed with relevant procurement process and organisation models. Introduction of skills verifying method to stakeholders, support for client in setting targets for EE and CO2. Supporting managers and clients about steering of the processes of EE and low carbon, modular wooden building. Both the client and the different service providers got a better understanding of how the coming building process could be organised and how the performance targets should be demanded. To verify the need for skills on team level was an interesting approach to the client.
- Tangible results: The process and workshop programmes to organise an early market negotiation session with stakeholders and clients.

4.4.2 CASE Espoo, new schools

One of the case example is Monikko School campus, where the total energy consumption has been two times bigger compared to the designed EPC class. This has happened in a couple of other school buildings as well. One highly possible reason is that the BAS and BEM systems have been too

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complicated to manage. Energy management plan combines several systems and primary energy sources: geothermal for heating and cooling, solar energy for electricity, district heating and district electricity networks.

As a client in building project building manager of Espoo City prefers to fulfil the building programme and the predicted and designed EE target levels promised. The projects are introduced to the authorities and to city governments (politicians) for financial estimates and specific performance targets are promised to be reached when project is finished. Cities have estimated energy consumption reductions and carbon footprint reduction, where the levels of EE and low carbon of building project play a central part.

Espoo city has used a program approach based on public private partnership. They have procured a set of 7 new school buildings, where YIT is the main partner for the Espoo City([4]).

Cases from 2017-2022 shows that EE targets have been achieved in the new school building project in the Espoo City (table.) Annex C1 include the technical solutions per project.

Table 1: Building project of Espoo City (2017-23), EPC class and energy consuption levels

Name of the school (koulu) or kindergarden (päiväkoti) or building project	Finishing time month/year	EPC class Energy consumption kWh/m2/a	Labelling with RTS (1-2-3-4 stars)	Other info
Karhusuon koulu, part 1	10/2017	B	-	
Karhusuon koulu, parts 2-3	5/2020	86	-	
Leppävaaran koulu Monikko	5/2021	57	3 stars	
Matinkylä swimming hall	1/2022	C, 166		
Joutsenkaaren koulu	4/2022	64		
Kalajärven koulu and youth house	2022-23	79	3 stars	
Matinkylä highschool and sport hall	12/2023	71	3 stars	
Tiisilän koulu and kindergarden	6/ 2023	66	3 stars	
7 school project 2022- 2023 as grouped PPP- procurement		targets: EPC lower than 80 and RTS-level 3 stars		
Perkkaan koulu	2/ 2022	66	4 stars	certified
Pohjois Tapiolan koulu	6/ 2022	65	4 stars	certified
Nauriskasken koulu	6/ 2022	62	4 stars	certified
Nöykkiöniityn päiväkoti	6/ 2022	66	4 stars	certified
Kilon koulu ja päiväkoti	12/ 2023			certified
Kuitinmäen alakoulu	6/2023			certified
Perkaan päiväkoti	12/ 2023			certified

[4] Source: Interview with building manager of Espoo City and presentation in seminar 3

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4.4 Organising seminar with key stakeholders, focusing on international experts and authorities

An international seminar was held together with bSF, Buidling SMART Finland, Competence building and change management Room.

- Date: 4th November, 2021
- Targets of the seminar:
    - The networking seminar presented and discussed possible development paths to certified skills in the domain of BIM in some countries.
    - The second discussion topic is whether there is a need for Education Room (in BSI) to coordinate development efforts in and accelerating the full implementation of systemic change with needed new skills in place.
    - Thirdly (in the Finnish part) we discussed what kind of strategies are needed for digital skills and BIM competence for development nationally, including layers of qualification and certification system(s).
    - Opening the discussion in Finland on Learning Outcome (LO)- based BIM competence development, competence requirements, qualification levels and certification systems. INSTRUCT project findings presented.
- Location: on-line
- Programme: see annex
- Participants: 95 participants
- Content: BIM training: competence development, qualifications and certification
    - International and national viewpoints: BSI, Australia, Italy, Norwegian, Austria, Finland
    - Strategies needed for digital skills and BIM competence development nationally.

Tangible results: Seminar report (in Finnish language) for further use under building SMART Finland working group of Competence development and Change management.

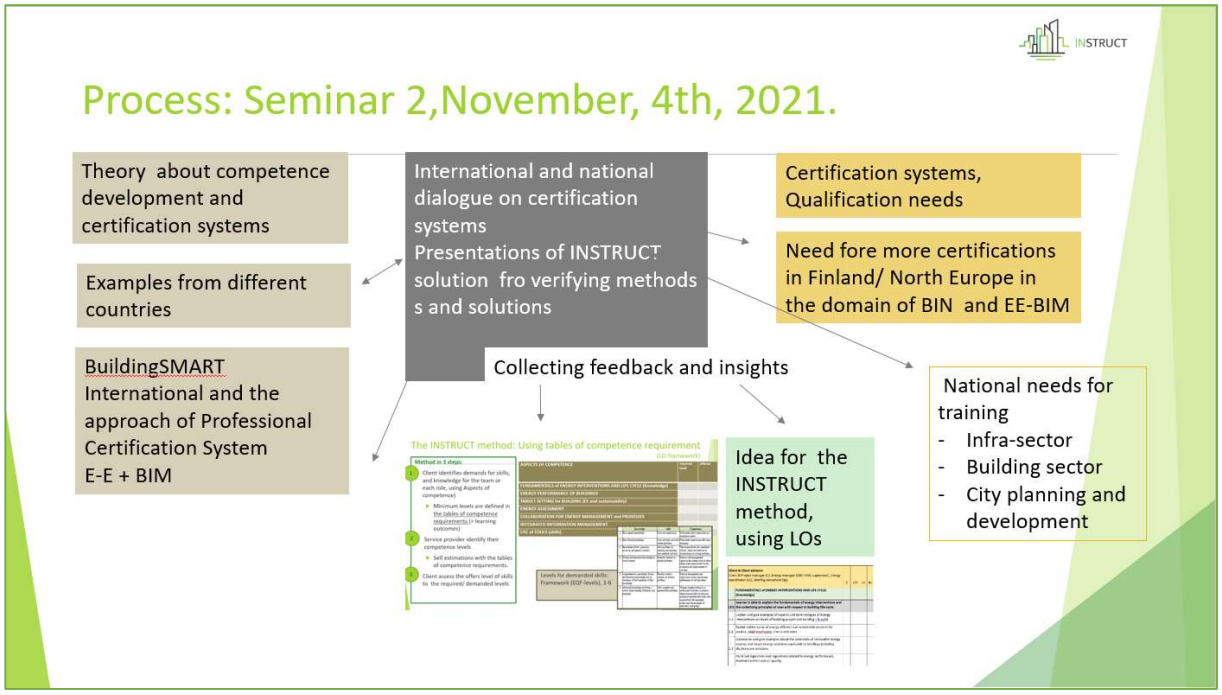

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Figure 6: buildingSMART seminar targets and content

4.5 Lessons learned EE case buildings

Discussion with senior building managers and clients in the mini-seminars and in one-on-one meetings gave a strong signal that the EE gap exists in normal building cases. It seems to be such a normal phenomena that experts are getting used to it and take it as given. They rely on new energy (heating, cooling, electricity) and ventilation systems' adjustments and BMS expertise to adjust the building's service technology (systems and equipment) within 2-year time after finishing the building project.
Studies of 3 high-quality buildings with ambitious EE targets show that the energy performance gap can be avoided (see Appendix C) The challenge here is to execute the same level of management, steering, design know-how and quality workmanship and assembly in all building projects.
Below, three cases are shortly introduced. They are analysed from four perspectives: process, target (business value), technology, people, some similarities can be seen:

- Strong focus on process management
- The use of technology (both HVAC and MEP and BAU systems and equipment) and analysing/ simulation technologies to optimise the solutions. Setting right adjustments for Building management system (BMS) and Building energy management system (BEMS) as there might be many primary energy sources and RES for a single building is challenging expert level task.
- Clear business vision, ambitions target setting of EE and other performances.
- Procuring key experts to the team

4.5.1 Case Metropolia campus

Metropolia Campus- project finished in 2 phases in 2019-20, is a large service facility for University of Applied Sciences. Building service technologies installed to be part of the education programmes and the spaces can be used for studying purposes.
Based on insight from the facility manager (excursion on 7th October 2022) there are positive and negative factors around running a smart building; challenges can often be traced to occupancy levels and behaviours. Also, BAS and BEM systems took time to get in to balance, and influenced high level consumption of district heating. The facility used the low energy guidelines for low energy office buildings made by City of Helsinki
Result: Targeted energy consumption levels were lower than planned after finishing the project, because of limitations (COVID -19).

4.5.2 Onnelanpolku-case

Onnelanpolku -project is a well documented nearly zero energy building. The senior building is situated in Lahti. The team working in with this building was selected carefully as it was the first pilot project for nZEB in Finland.
Result: Targeted energy consumption levels were reached quite soon after finishing the project.

4.5.3 Biomedicum

Biomedicum Helsinki is a research and training center, on the Meilahti hospital area.
High level steering expertise in HVAC and BAS and BEM design, procurement and installations with in an innovative atmosphere and collaborative ways of working resulted as successful project. Specific

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guidance matrix with all HVAC, MEP and BAS and BEM service systems, components and equipment helped that also detailed level decisions were done at the right time.
Results: No gap in estimated and real energy consumptions.

4.6 Interviews

Nine one-to-one discussion /mini-interviews inclucing briefing of the presenters before the seminar days, were conducted. Expert interviews focused on the key question of the demo and collected first thoughts and insights to the INSTRUCT approach, instruments and methods, including LO matrix and taxonomy.

4.7 Organising seminar August 2022

The third seminar was organised together with Demo 1 and Demo 6. The national programme for adaption to the twin transition in the construction and real estate sectors in Finland (KIRA growth programme) is starting and is in-line with the goals of the New Building Act, in demanding more sustainable lifecycle management (EE, nZEB, and low carbon buildings) with model based (BIM) and machine-readable information management. Here the goals of authorities and industry matches well.

Date: 24the August 2022
Location: House of Estates, Helsinki and on-line
Target: Awareness raising on different aspects of INSTRUCT projects. Contacting the right parties for further development and exploitation of the demo 4 and demo 1 results.
Content: Third seminar programme showed with real-life building cases the many possible ways to reach high level energy performance targets. Further updates were given on the fields of education and training, and accreditation and qualification evaluation process. Current standards on climate survey and the relation to energy efficiency survey (EPC) and KIRA Growth programme were introduced.
Participants: 85
Tangible result: wide content of topical presentations, which can be used as part of continuing education courses, and questionnaire results (Menti).

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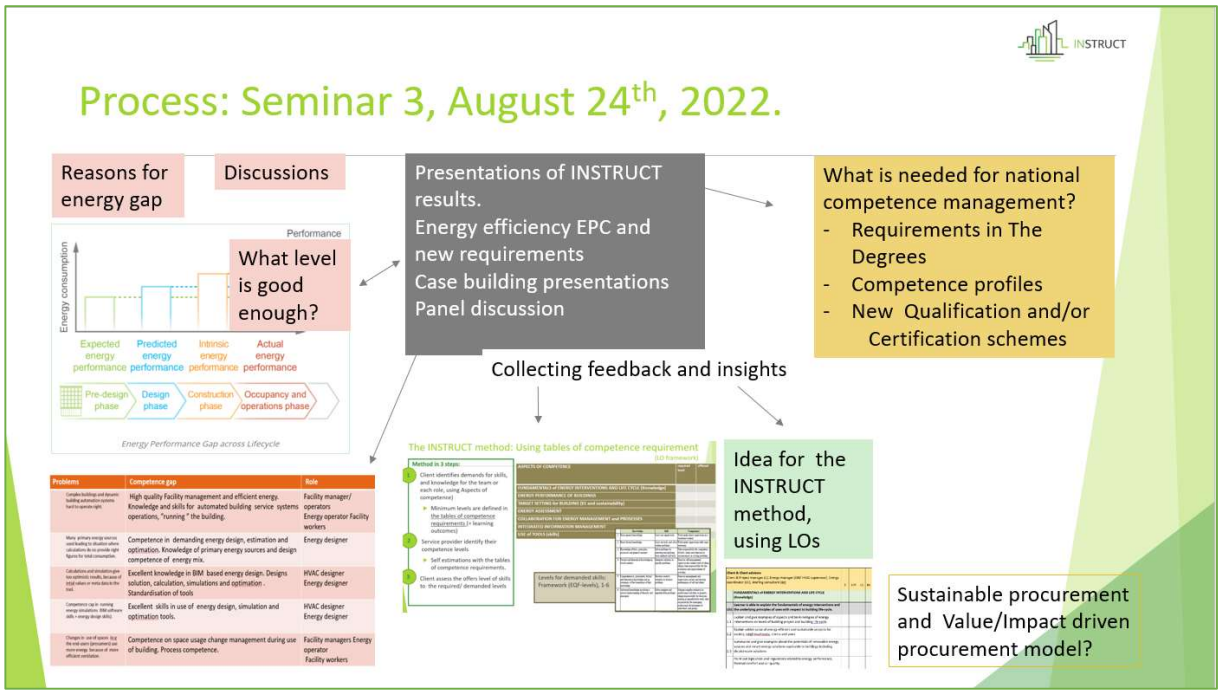

Figure 7: INSTRUCT seminar targets and content

5. Results and Outcomes

The organised workshops and seminars produced good presentation materials as one result.
The up to date information is seen as one tangible results, and can be used further in the exploitation and valorisation phase of INSTRUCT project. Figure 8 shows basic information on energy -efficiency in Finland. Efficiency as a formula:

$$\text{Efficiency} = \frac{\text{Quality of life}}{\text{Environmental pressure} \times \text{Use of Resources} \times \text{Costs}}$$

Statistics graphs in the figure 8 show :

- The biggest sources of CO2 in Finland indicates 13 companies and the Contraction Activities in the capital region (Helsinki, Vantaa, Espoo).
- Embodied CO2, Carbon peak Scenario on the development of requirement levels (building code and nZEB target values) and the levels in the building stock in modernization projects and in existing buildings in general ([5]).
  The energy consumption during the use of buildings produce 76% of the total CO2 emissions of the built environment. Metric: one year total CO2 emissions ([6])

[5] Säynäjoki, Heinonen, Junnila (2012). A scenario analyses of the lifecycle greenhouse gas emission of a residential area. Enviromental Research Letters / (3), 034037
[6] Rakennetun ympäristön hiilielinkaaren nykytila www.rakennusteollisuus.fi/tiekartta

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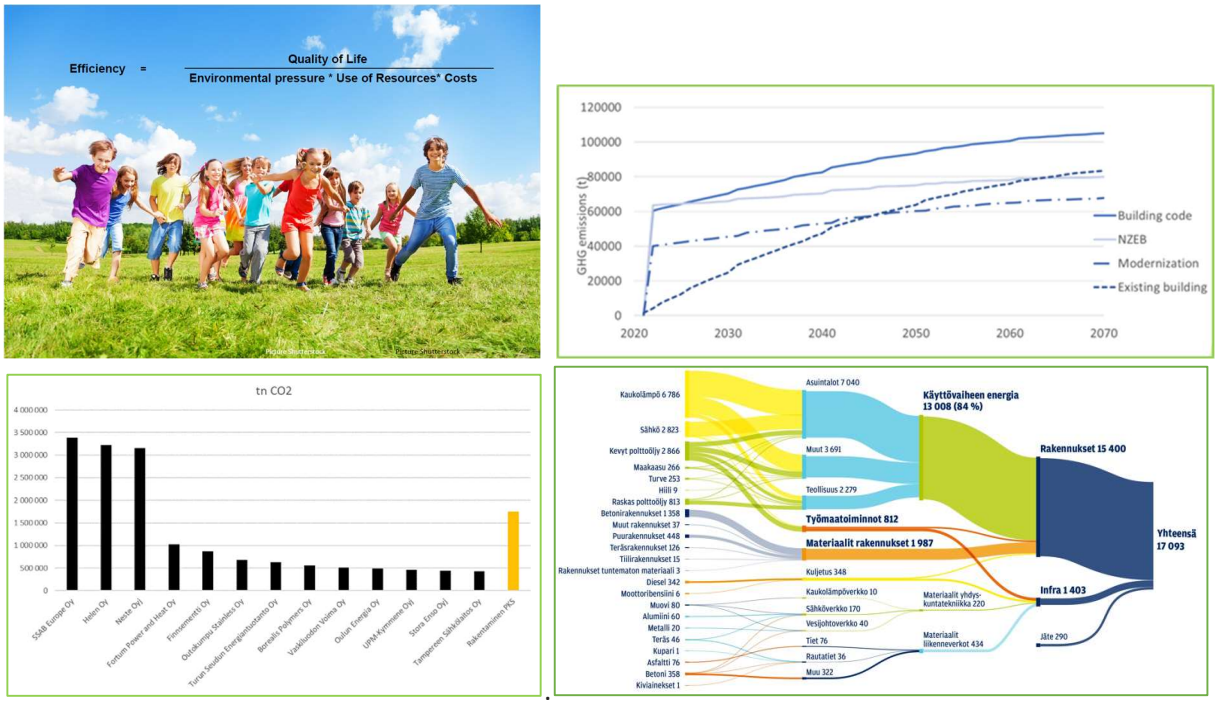

Figure 8: Seminar presentation materials from the mini-seminars

5.1 Knowledge base for energy gap reduction

5.1.1 Material development

For the first mini seminars a comprehensive knowledge base material was developed. Altogether 14 different types of skills verification methods were identified in earlier pilot & research projects connected to procurement model studies.

Defining the skills verification methods with CASE examples from each:

1. Design competitions
    - *Expressing the level of know-how of the professional/ teams in form of planning and designing the concepts and the solutions. Used as part of procurement process; architectural competitions, competitions for bridges, in partnership city planning and competitions on building sites.*
2. Development workshop for overcoming challenges of the specific building case.
    - *Used in Alliancing procurement method for finding solutions to the building case challenges in collaboration of client. Third party (the alliancing consultant) observing the team working skills.*
3. Promise based assessment (based on promised performance levels)
    - *Used in defining the promised performance levels in tenders for maintenance contracts of roads, street construction contracts, also in ESCO services (ESCO, Energy Service Company)*
4. Workshops and exam based on targets of the specific building case
    - *The offering parties participating an exam assessing the needed skills and knowledge of novel process competence requirements.*
5. *Connecting general designs and alternatives of service providers*

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- *Further development of the clients' preliminary design solutions as part of the competition for the selection the contractor. (Total contracting model incl. the development phase)*

6. *Exam connected to procurement type*
   - *Exam as part of procurement model, where a certain level of skills and competences are promised, though without naming the expert or participating any exam (Maintenance contracts for roads).*
7. *Design-built competitions*
   - *Design solution from the offering parties (contractors) is included in the offer (procurement models: DB-models, Product and service contract models, lifecycle models, ESCO services)*
8. *Specific development phase*
   - *Final construction deal connected to Performance capacity of the offering party, Capacity level presented with development of an economically sustainable solution tackling the case specific challenges. (Alliancing, Design and Built model incl. the development phase)*
9. *Showing the competence in a specified presentation*
   - *Presentation of skills and knowledge by the offering parties. Assessment by expert panel using a assessment matrix, and comparison the results to the overall selection requirements of the case. (Railroad stations area in Jorvas, verifying BIM competences)*
10. *Testing the suitability/ competence and mindset (by a work psychologist)*
    - *Personal testing of the key experts executed by a work psychologist. (Building cases: Heath centre of Järvenpää city, Key alliancing projects of Senate Properties, Maintenance contracts for roads of Finnish Transport infrastructure Agency)*
11. *Exam on the elements of the innovative working method (integrated infraBIM) demanded in the building project*
    - *Mandatory exam for all offering parties testing new skill and knowledge as required. (Building case: PISARA, the underground railroad in Helsinki. BIM coordinators, 300 designers participates the exam in tendering phase).*
12. *Formal qualifications (certifications) verified by a third party*
    - *Qualifications based on Building Act and Degrees, certified often by FISE.*
13. *References, earlier successful projects presented by the service provider*
    - *Presented by the offering party on general level.*
14. *References for individual professionals*
    - *References like roles in earlier successful projects, personal certifications and education, other merits.*

Grouping of the Skills verification methods in two ways formed a structure to view the examples (table2):

1. Methods for individual professionals, teams or company
2. General methods, procuremet type method and project specific methods

   2a. Four general methods:

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- Design competitions, Company references, Formal qualifications, Professional references.

2b. Three procurement type methods:

- Design-Built competitions, Specific development phase, Exam connected to procurement type.

2c. Seven project specific methods:

- Development workshop for overcome challenges of the specific building case, Promise based assessment (based on promised performance levels), Workshops and exam based on targets of the specific building case, Connecting general designs and alternatives of service providers, Specific development phase, Showing the competence in a specified presentation, Testing the suitability/ competence and mindset (a work psychologist used), Exam on elements of the innovative working method demanded in the building project.

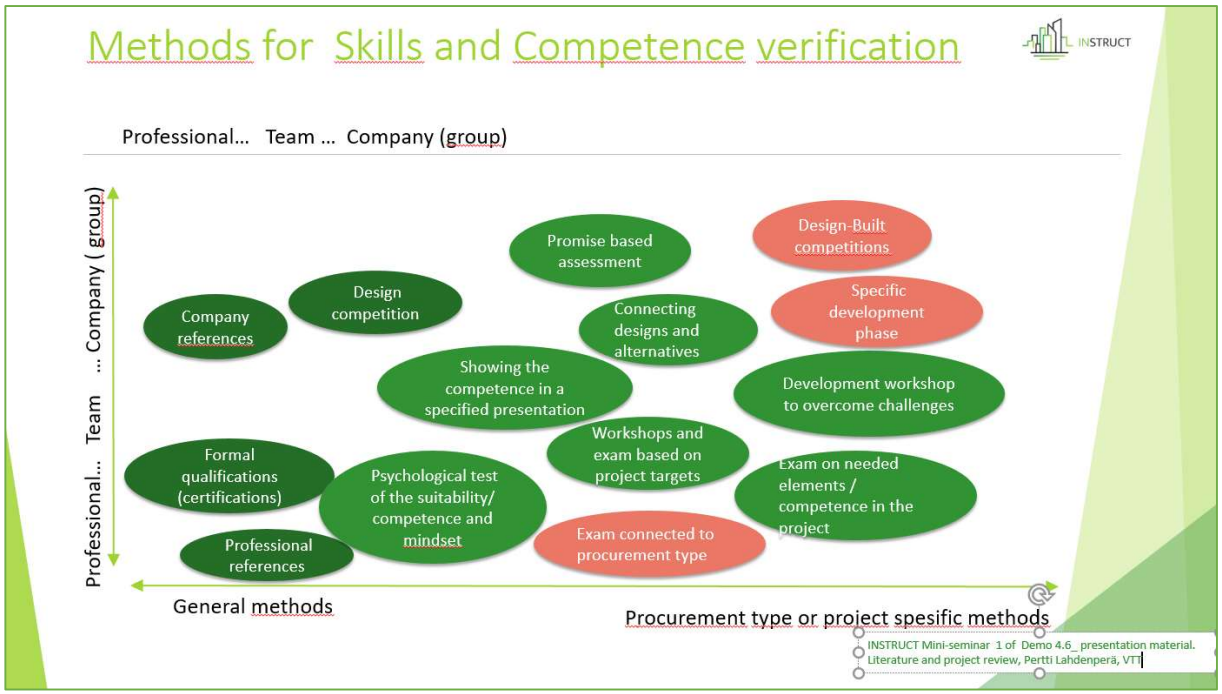

Figure 9: Identified and grouped skills' verifying methods

Table 2: Grouppig of the skills verifying methods by types.

Method	general methods	connected to procurement type	conneted to project specific factors
1. Design competitions			
2. Development workshop to overcome challenges of the specific building case			

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3. Promise based assessment (based on promised performance levels)			
4. Workshops and exam based on targets of the specific building case			
5. Connecting general designs and alternatives of service providers			
6. Exam connected to procurement type			
7. Design-built competitions			
8. Specific development phase			
9. Showing the competence in a specified presentation			
10. Testing the suitability/ competence and mindset (a work psychologist used)			
11. Exam on elements of the innovative working method (here integrated infraBIM) demanded in the building project			
12. Formal qualifications (certifications) verified by a third party			
13. References, earlier successful projects presented by the service provider			
14. References, professional			

5.1.2 Analysing the reasons for energy gap

Evaluation of the reasons for the energy gap and discussion during mini-seminars highlighted especially two reasons for energy gap that are present in almost every single building project:

1. Complex buildings and dynamic building automation systems (for heating, cooling + ventilation, electricity) are hard to operate right
2. Not enough time to balance the systems before handover of the building

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Why the required energy consumption efficiency target do not get through in the building or renovation process	Competence gap/ role
Complex buildings and dynamic building automation systems (for heating, cooling + ventilation, electricity) are hard to operate right	
Many primary energy sources used leading to situation where calculations do no provide right figures for total consumption.	
Calculations and simulation give too optimistic results, because of intial values or meta data in the tool.	
Competence cap in running energy simulations BIM software skills + energy design skills).	
Changes in use of spaces (e.g the end-users (prosumers) use more energy because of more efficient ventilation.	
Changes during the construction process are not taken back to the HVAC and building automation system planning (better change management).	
Technical systems are procured in a different way than defined in the plans/ designs.	
Target (E-level) has been set too optimistically.	
Lack of collaboration, integration (and co-creation).	

Based on expert discussions (Evidence based) and Sofia Al-Khatib: Key findings of the energy performance gap in a Finnish office building. Thesis 2017, Aalto yliopisto

Figure 10: Problems faced in reaching energy efficiency. Source: Based on expert discussions (Evidence based) and Sofia Al-Khatib: Key findings of the energy performance gap in a Finnish office building. Thesis 2017, Aalto yliopisto

5 more reasons for the EE gap were identified:

- Lack of collaboration, integration (and co-creation).
- Initial data for design phase is not complete
- Products technical performance is promised to be different(better or worse) than actual performance
- Not enough time to balance the systems before handover of the building
- The client has not defined the EE targets or procured the needed technologies

Table 3: Reasons for EE gap and respective comments and insights

Why the required energy consumption efficiency target do not get through in the building or renovation process	Comments from workshop (experts discussion during mini-seminars
Complex buildings and dynamic building automation systems (for heating, cooling + ventilation, electricity) are hard to operate right	There is a lack of skills and know-how in handover and taken use of the building tech. service systems and equipment
Many primary energy sources used are leading to situations where calculations do no provide right figures for total consumption.	
Calculations and simulation give too optimistic results, because of initial values or meta data in the tool.	
Competence gap in running energy simulations (BIM software skills + energy design skills).	Tools are in every important role for providing information to decision making

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Changes in use of spaces (e.g., the end-users (prosumers) use more energy because of more efficient ventilation.	The user has major influence to energy consumption with their behaviour
Changes during the construction process are not taken back to the HVAC and building automation system planning (better change management).	
Technical systems are procured in a different way than defined in the plans/ designs.	
Product's technical performance is promised to be different(better or worse) than actual performance	
Target (E-level) has been set too optimistically.	Targets and complexity varies because of the type of buildings (office, housing, retail, schools…)
Lack of collaboration, integration (and co-creation).	Right type of persons in the team. The team has to be tested.
Initial data for design phase is not complete	
Not enough time to balance the systems before handover of the building	Use of financial incentives could support the process change
The client has not defined the EE targets or procured the needed technologies.	

As the energy systems are complex, high level of competence is needed. Also, there is need for continuous up-dating of the know-how.
Current practice is that the building service systems are in balance with BAS and BEM within two years from finishing. The EE gap is very common and even experts feel that is hard to be avoided.
Further analyses with CASE buildings indicate that if the needed skills and a good management and collaboration processes are used in projects, the EE gap can also be avoided (see chapter 4.5).

5.1.3 Identifying the emerging skills

Based on the reasons for the EE gap, the related skills and knowledge gaps could be identified. Figure 10 shows reasons to competence gaps. The roles who are in responsible for the tasks where competences are lacking are several (Figure 11). Using the INSTRUCT LO- tables (see INSTRUCT D2.3) for each role in building process, the identification of needed new LOs, or detailing an existing LO, is possible.

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Problems	Competence gap	Role
Complex buildings and dynamic building automation systems hard to operate right.	High quality Facility management and efficient energy. Knowledge and skills for automated building service systems operations, "running " the building.	Facility manager/ operators Energy operator Facility workers
Many primary energy sources used leading to situation where calculations do no provide right figures for total consumption.	Competence in demanding energy design, estimation and optimation. Knowledge of primary energy sources and design competence of energy mix.	Energy designer
Calculations and simulation give too optimistic results, because of intial values or meta data in the tool.	Excellent knowledge in BIM based energy design. Designs solution, calculation, simulations and optimation . Standardisation of tools	HVAC designer Energy designer
Competence cap in running energy simulations BIM software skills + energy design skills).	Excellent skills in use of energy design, simulation and optimation tools.	HVAC designer Energy designer
Changes in use of spaces (e.g the end-users (prosumers) use more energy because of more efficient ventilation.	Competence on space usage change management during use of building. Process competence.	Facility managers Energy operator Facility workers
Problems	**Competence gap**	**Role**
Changes during the construction process are not taken back to the HVAC and building automation system planning (better change management)	Competence on change management of the targets of user groups or project partners, during design phase. Process competence.	Project manager Design steering Contraction steering
Technical systems are procured in a different way than defined in the plans/ designs	Change management during the procurement and assemply of HVAC and energy systems. Process competence.	Project manger Construction manager, Site manager
Target (E-level) has been set too optimistically	Target setting competence, competence on feasibility study to get realistic energy target values. Competence of steering estimated energy efficiency target	Client Briefing consultant Energy manager
Lack of collaboration, integration (and co-creation).	Collaboration, co-working and co-creation in integrated processes. Competence in steering of collaboration Skills and competence in virtual collaboration.	All disciplines

Figure 11: Problems faced in reaching energy efficiency - The Skills & Competence gap analyse

5.1.4 Cross-checking the emerging skills with LO framework

Cross-checking the needed skills and knowledge with the INSTRUCT LO framework will most probably result new LO's, clarifications for sub-LO and new roles. The short desk-top exercise used the learning outcome framework of the INSTRUCT project.

Some findings from the analyses(See appendix D):

- The evaluator need to be familiar with the topology of LO framework.
- Cross checking on the topic level is based on interpretations as the as the phrasing of LO sentences differs from the competence gap definitions.
- Cross-checking of desired competence levels of one LO/ role is more challenging.

The study can also use the Skills- Knowledge- Competence- framework (S-K-C), which is on work task level and follows the construction project's lifecycle process. S-K-C framework consists concrete definition of the skillset, and can be more usable framework for tools of verifying skills in procurement process. The topology recognises (2) skills as the technical skills to use of tools), (b) knowledge as theory and practical know-how and (3) competence as ability to execute the work in the responsible tasks for a role).

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5.2 Initiatives for building owners

5.2.1 Energy skills verification methods

Several methods of skills verification, with adaptation examples, were identified from earlier project cases. The methods have been used in tendering and/or collaboration phases mostly in transport infrastructure projects, but are scalable to other building projects. Annex B shows three examples of the studied method.

5.1.2 INSTRUCT method for skills verification

Using competence requirement tables as the assessment matrix, a new skills verification method was drafted. The INSTRUCT method follows a straightforward process (figure 12):

1. STEP: Client identifies demands for skills and knowledge for the team or each role, using the Aspects of Competence, which can rely on Learning- outcome frameworks or need skills in work process flow (Skills- Knowledge- Competence frameworks).
    - Minimum levels are defined by using the tables of the chosen framework based on competence requirements (= learning outcomes)/ role of the project case in question.

2. STEP: Service provider identify the experts allocates to the project in question and estimate competence levels
    - Method: Self estimations with the tables of competence requirements.

3. STEP: Client assesses the promised levels of skills toward the t required/ demanded levels
    - Method: Levels for demanded skills from 1-6 (EGF-level)

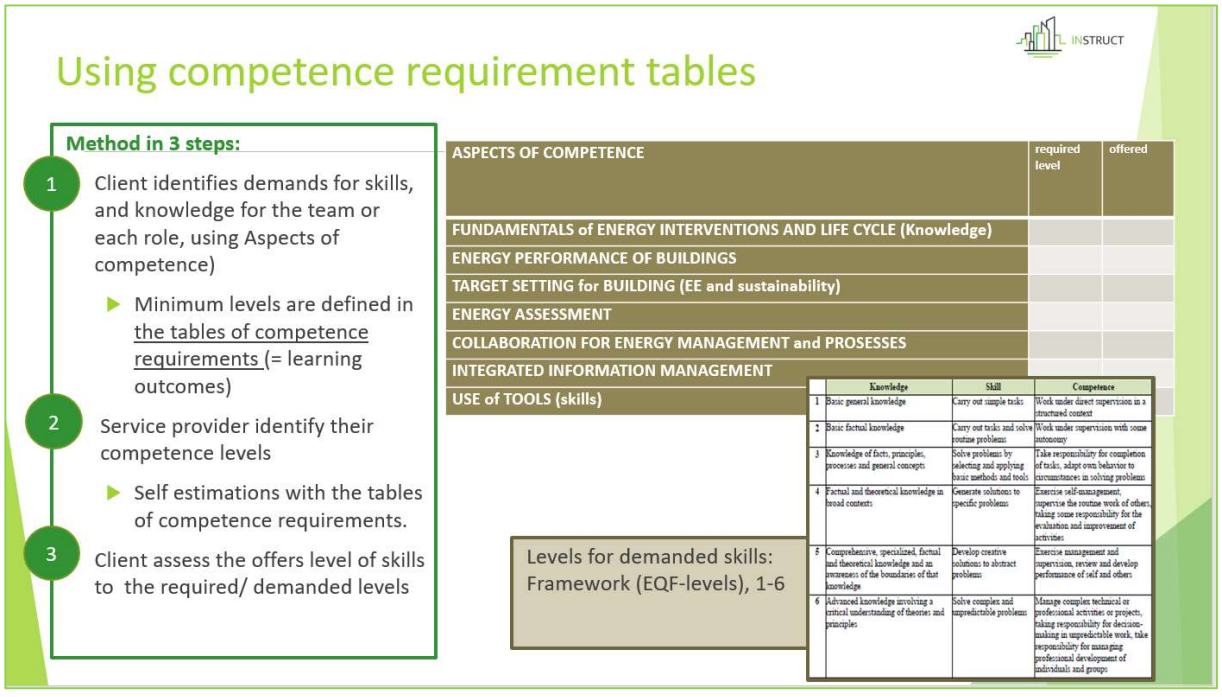

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Figure 12: INSTRUCT method for skills verification

The INSTRCUT skills verification method find three possible places in the landscape of the skills verifying methods (figure 13). Possible usage situations for the INSTRUCT method identified as following:

1. Procuring the key professionals for the project.
2. Procuring professional with the high level expertise. Method enables to assess needed skills towards the project challenge levels.
3. Procuring the partnering designers and other experts for several year contact with client.

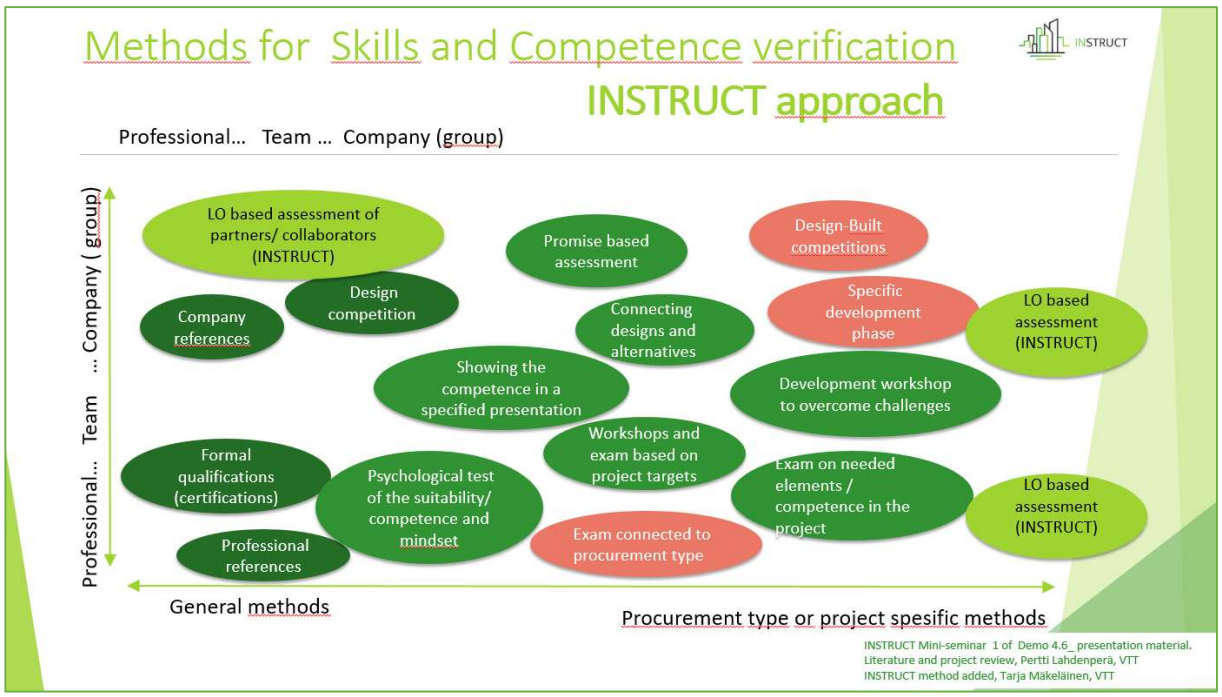

***Figure 13**: INSTRUCT method for skills verifying in the landskape of other verifying methods*

5.3. Outcomes

From Demo 6 results, two tangible outcomes emerge and can be further defined and exploited:

1. Information package and competence verification methods.
2. INSTRUCT method for defining LO's for existing or new roles based on the EE gaps analyse with competence gaps

5.3.1 Outcome 1: Information package and competence verification methods.

A set of skills verification methods was identified with detailed examples from projects (different types).

Outcome 1 is based on the result 1 and 2:
Result 1: A set of skills verification methods collected and grouped skills verification methods, in tendering or in collaborative phase of projects.

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Result 2: INSTRUCT skills verifying approach (see chapter 5.1.2) for competence verification in the procurement phase of building project, in dialogue with clients and project managers.

5.3.2 Outcome 2: INSTRUCT method for defining LO's for existing or new roles based on the EE gaps analyse with competence gaps.

The INSTRUCT approach for competence verification during the procurement phase of building project is based on target definition by the client and self-assessment by the service provider.

Outcome 2 is based on results 3, 4 and 5.
Result 3: Further understanding of the reasons for the EE gap
Result 4: Based on analysing the reasons for the EE gap and recognition of new needed competences (skills and competence gaps).
Result 5: Based on skills & competence gap, analyses for identifying new roles with their related LO's.
Following critical roles were identified:

- Project manager
- Chief designer
- EPC consultant
- Energy and environmental assessment consultant/ designer
- LCA consultant
- Building automation operator

6. Contributions to other tasks

Demonstration 6, contributes to other tasks in INSTRUCT:

- T2.3 LO's and roles identified
- T3.3 Legislative frameworks
- T4.9 Summary report on the demonstrations
- T6.4 Exploitation workshops and business plans

7. Further development

The action in demo 6 were fruitful and resulted insights and deeper understanding the reasons for EE gap, and how management of better skills links to this challenge.

Further development is needed firstly in form exploitation and valorisation the results of demonstration. Secondly deployment (adaptation, adaptation and implementing) of the instruments with key stakeholder in the areas of

(1) Exploitation and valorisation for the concept of LOs,
(2) EE certifications and their development,
(3) Testing the INSTRUCT skills verifying method. Defining the method in more detailed way ,
(4) Identifying the emerging skills and respective roles, based on the reasons for energy gap, and cross checking the emerging skills with S-K-C framework.

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Both national and international networks are involved in the processes of deployment and in building a community of practise.

7.1 Exploitation and valorisation for the concept of LOs

Stakeholders in Finland are no familiar with the concept of learning outcomes as a structuring framework. In training and education curricula and in the continuing education courses and programmes, the concept of learning objective a is widely used. Learning objective is a freely listed targets guiding mostly the planning of the agendas of a training course or programme. LO frameworks are more comprehensive and more specified matrixes for disciplines in the building process (with EGF levels). The frameworks consists of LO topologies which are composed based on (1) framework usage related principles and (2) theories of competence management science, like Blooms taxonomy for phrasing the LO sentences.
More awareness raising and valorisation need to be conducted on the usage of LO matrix as the basis of the instrument demanding better EE skills. This is a challenge to be tackled in the Task 6.4. The task defines messages with value propositions specifically tailored to stakeholder groups. The tasks and demonstrations of INSTRUCT project have collected much good evidence-based cases, which can be used as part of this valorisation.

7.1.1 Study of Cross-checking the emerging skills with S-K-C framework

This study is relevant in the exploitation phase as part of Finnish business plan and using the S-K-C framework from BIMEET project. Skills, Knowledge, Competence framework follows the process stages of a building project and is therefore a more relevant framework for verifying skill in the real building procurement process.

7.1.2 EE certification based on LOs

Boosting the LO based approach in programme develomenet amongst different levels of education organisations and trainings providers is needed. Only few organisations in Finland are using LO based approach or similar concept - despite of teh vocationla level eduction progeammes. Also national qualification commitees and certification and accreditation bodies are part of the ecosystem of EE competence development.

7.1.3 National level collaboration in deployment

The following are national level networking parties in Finland and their respective roles:

- Motiva - general awareness raising
- FISE - qualification commitees and certification
- Ministry of Enviroment - Building Act and Degrees
- Ministry of Education - LO based education
- universities baseig education and continuing edeucation
- Role of vocational education organisations

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- RATEKO
- Role of training organisation providing countinuing education courses - LO based cources
  - FCG, Aalto Pro, Kiinko, RIL
- Role of proffessional assosiations
  - RAKLI, RIL, RT, ATL, SulVI

7.1.4. EU level networkig

European level networking parties and their respective roles:

- CINIA and earlier Build up skills
- UIPI
- CEN/TC 442 WG8

7.2 Building a community of practice

7.2.1 Sharing of lessons learned and best practices

Demonstration activites showed strong interest for collecting more lessons learned on designed and actual performance levels from differnt types of case buildings, targeted to EE and low carbon performances. Also more collaboration and sharing the best practices in procuring skilled professionals is underlined by clients and project managers.

7.2.2 Community of paractice for innovative solutions

Only a few organisation in Finland are using LO based approach or similar concepts. Establishing a Community of Practise is one possible way to manage and organise all further development topics. The Community of Practise could strengten the national networks focusing towards common goals, as identified in INSTRUCT roadmaps. Further national comuntity of Practise can collaborate around INSTRUCT portal as one-stop shop for EE competence development.

8. Impact

Demonstrated reduction in the gap between designed and actual energy performance through improved quality of construction is estimated as results of the INSTRUCT project value chain consisting of 5 phases (figure 14) and eight different demonstrations.

The planned estimated impact triggered in Demo 6 was defined in DoA:
What are the KPIs to be reached that the demo is successful in (e.g., how many stakeholders need to be reached etc.)?

- Primary energy savings target for Demo 4.6: **143.5 GWh/year**, based on 300 professionals reached (direct reach).
- Altogether 290 experts were reached in seminars, workshops and interviews, where INSTRUCT Demo's 6 challenge/ solution/ insights were introduced and discussed. Primary energy savings for is 138,7 GWh/year.

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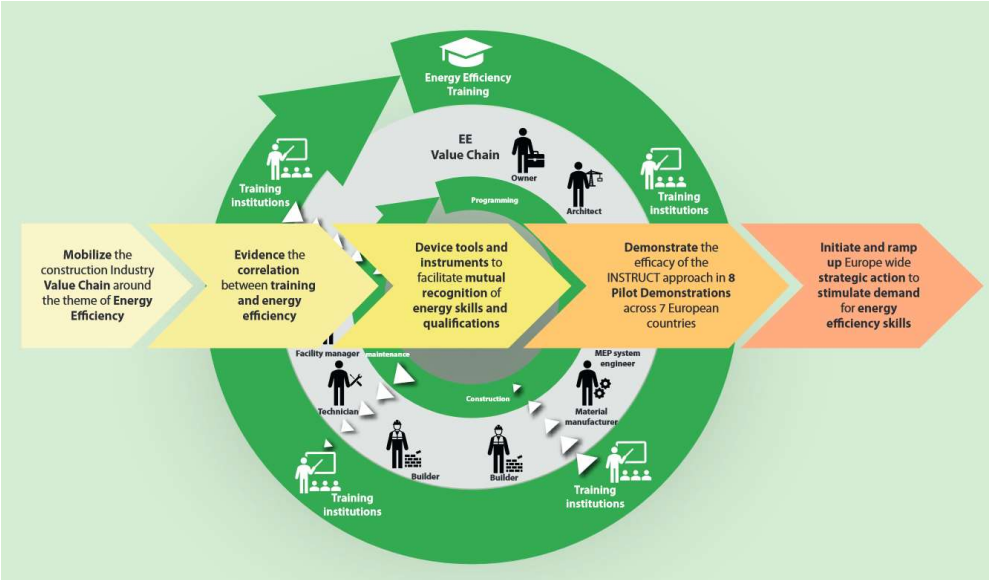

Figure 14: INSTRUCT project value chain

8.1 Primary energy savings

Demo 6: Professionals reached during the demonstration activities total: 290 experts.
The Seminars and workshop and expert discussions/ mini-interviews during the demo 6 process:
Seminar 1 (mini-seminars): **Building managers and the challenge of reaching energy-efficiency targets**

- 40 reached
- Seminars held on 1st June and 2nd June, 2021

- Seminar 2 (international seminar): **BIM training: competence development, qualifications and certification. Strategies needed for digital skills and BIM competence development nationally**
  - International and national viewpoints
  - 95 reached
  - Seminar on 4th November, 2021
- Workshops: **Early negotiation meetings (client and service providers) during sustainable procurement process with Kouvola city**
  - 60 reached
  - Workshops on 28th September, 2021 and 7th October, 2021.
- Expert discussions and mini-interviews:
  - Expert interviews and collection of insights for the INSTRUCT approach and method, including LO taxonomy
  - with 9 experts
- Seminar 3: ***Management of energy-efficiency and up-skilled professionals in the path towards carbon neutrality targets 2035***
  - 85 reached
  - Seminar on August 24th, 2022

Altogether 290 experts were reached in seminars, workshops and interviews, where INSTRUCT Demo's 6 challenge/ solution/ insights were introduced and discussed. Primary energy savings for is 138,7 GWh/year.

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8.2 Improved mutual recognition of sustainable energy skills

Target: Improved mutual recognition of sustainable energy skills between Member States and neighbouring countries.
North cluster (lead Finland): working with Nordic BuildUp skills via MOTIVA and with Nordic Ministries of Environment via Ministry of Environment.
Demo 6: Networking introduces a part of process flow of the demo (in section 3.6).

8.3 Improved collaboration

Target: Improved collaboration and understanding across different trades and professional groups.
Demo 6. Arranged meetings and 2 workshops and 4 seminar days with building owners and municipalities. Altogether, the reach is 290 professionals.
Stakeholder groups: Authorities, policy makers, international experts, designers, main constructors, clients, and owners, budging managers, training provider, teachers, researchers, experts from associations and ecosystem developers.
The main focus group has been building owners and building managers.

8.4 Increased market acceptance of sustainable energy skills

Target: Increased market acceptance of sustainable energy skills.

- The building's owners are included in training courses and workshops. The estimated reach of the potential stakeholders is 60-70% and 40-60% of the projects are estimated to increase sustainability in the energy choses.

Demo 6 Collected and developed a set of skills verification methods to be tested and used in procurement processes and the methods were largely presents for the key target groups.

8.5 Legislative changes

Target: Legislative changes stimulating the demand for energy skilled construction workers/professionals
Demo 6: Awareness raising and development of methods to manage energy related skills as part of policy steering instruments

- Regulatory steering via defining skills/ knowledge/ competence requirements in Building Act and Degrees (Ministry of Environment, Finland)
- Voluntary steering
    - via introducing a more detailed and well-structured methodology (LO -framework) for competence accreditation models (FISE and SulVI).
    - Method development for skills verification on public procurement process for the client and building owners.

9. Conclutions

All the events (workshops, meetings, seminars) organised in demo 6 were successful with may discussions, sharing insights and creating shared understanding. Demo 4 resulted tangible methods

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and useful content. In general, stakeholders in Finland value highly the well organised professional and collegial discussions, and take part in arguments on emerging topics. However, some reflections during the demo 6 show that the State of Practice in demanding of skilled experts with useful methods does have gaps, compared to the State of the Art.

Method development for verifying skills in the building process is one part of a more comprehensive updating of the national practices in accreditation of skilled professionals. The current way of qualifying or accrediting experts still satisfies the industry players. Only few clients and owners have raised **the need to be able to assess the level of skills, knowledge or competences** amongst the experts of energy performance or low carbon design or information modelling. Only when these topics are set as the central goals in the building project, the expertise levels will raise into the focus of procurement and verifying skills.

Common methodology could be based on a comprehensive, **national level standardised competence requirements matrix.** Clarification of the benefit, which the methodology is bringing in procuring the right experts to building processes, is central part of deployment.
Here the methods of defining skill, knowledge and competence (with their EQF levels), could be adapted. Outcomes from the BIMEET and INSTRUCT projects, as well as their sister projects, shows that Learning outcomes frameworks can be used for defining matrixes- and vice versa (BIMEET D3.2, INSTRUCT D2.2, D2.3). Reflections from stakeholders involved indicate that more awareness raising activities and valorisation are need about the key principles INSTRUCT method is using.
The key principle which the most of INSTRUCT instruments and methods share, is the use of either the Learning Outcome (LO) framework or the Skills-Knowledge-Competence (S-K-C) taxonomy. They are used as a structuring tool for defining the EE skills in competence development & training, for training management services; and verifying needed EE skills, enabling sustainable building procurement and processes to happen.
Based on the insight and reflection during the demo 6, one of the key target in exploitation and valorisation activities in short term, as highlighted in the INSTRUCT Exploitation Roadmap number 3 (INSTRUCT D6.2: Exploitation Roadmaps), need to be **building up the community of practice on national level.**

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Rakennetun ympäristön hiilielinkaaren nykytila, www.rakennusteollisuus.fi/tiekartta

INSTRUCT DoA

Grant Agreement number: 894756 — Evidence-based market and policy instruments Implementation across EU to increase the demand for eNergy Skills across conSTRUCTion sector value chain (INSTRUCT). AMENDMENT Reference No AMD-894756-1

INSTRUCT Deliverables (Drafts) https://instructproject.eu/library/results/

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

D2.3: Skills and Learning outcome matrix

D3.3: New Legistlative Frameworks

D6.2: Exploitation Roadmaps

BIMEET Deliverables https://projectsites.vtt.fi/bimeet

D3.2 (long version): Definition of Learning Outcomes

Information pages

- Ministry of Environment
  - https://ym.fi/en/land-use-and-building-act
  - https://ym.fi/en/the-national-building-code-of-finland
  - https://ym.fi/en/ecodesign-directive-and-the-energy-labelling-directive
  - https://ym.fi/en/the-eu-and-international-cooperation
- KIRA Growth programme
  - https://kirafoorumi.fi/wp-content/uploads/2022/02/KIRAfoorumi_Kasvuraportti_2022_EN.pdf
- Motiva
  - https://www.motiva.fi/en/sustainable_development
  - https://www.motiva.fi/en/solutions
  - https://www.motiva.fi/en/solutions/policy_instruments
  - https://www.motiva.fi/en/solutions/policy_instruments/energy_efficiency_agreements
- The Ministry of Economic Affairs and Employment
  - https://tem.fi/en/energy
- FISE
  - https://fise.fi/en/
- bSI buildingSMART International, Professional Certification Programme
  - https://education.buildingsmart.org/
- bSF, buildingSMART Finland
  - https://www.buildingsmart.fi/en_GB

Annexes

A. Seminar programmes

B. Example cases for the set of methods for verifying skills

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 894756.

C. Lessons learned- E-E case buildings

D. Cross-checking of LO frameworks and EE skills needed, based on EE gaps identified

A.1 Seminars 1a and b

A.2 Seminar 2

Seminar of buildingSMART Finland_ Education Group

Seminar in Finnish: BIM koulutus ja osaamisen kehittäminen, pätevyydet ja sertifiointi - kansainvälinen tilanne.

BIM competence development, qualifications and certification

Time: 4 of November, 2021, 11.00-15.15 (CET), 12.00-16.15 (EET)

Place: Virtual meeting (Teams)

Organiser: buildingSMART Finland, Education Group

Technical Moderator: VTT Technical Research Centre of Finland

Targets:

- The networking seminar will present and discuss development baths to certified skills in the domain of BIM in some countries.
- The second discussion topic is whether there is a need for Education Room (in BSI) to coordinate development efforts in and accelerating the full implementation of systemic change with needed new skills in place.

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- Thirdly (in the Finnish part) we discuss on what kind of strategies needed for digital skills and BIM competence development nationally, including layers of qualification and certification system(s).
- Opening the discussion in Finland on Learning Outcome (LO)- based BIM competence development, competence requirements, qualification levels and certification systems. INSTRUCT project.

Program:

(Note: The times in the program are EET)

12:00 - 14:30 (EET)	**Session 1: BIM training: competence development, qualifications and certification - International and national viewpoints** (in English)	
12:00 - 12:05	**Opening of the seminar** • Welcome • Goals for the seminar *Annina Lehikoinen, Rakennustietomalli Oy/ BS Finland* *Timo Lehtoviita, bSF Education Room*	
12:05 - 12:10	**Program of the day and speakers** *Tarja Mäkeläinen, VTT/ Moderator*	
12:10 - 12:20	**BIM and infraBIM Education in Finland** *Sunil Suwal, Metropolia*	
12:20 - 12:40 (19:20 in Australia)	**Competence modelling, profiling and assessment** • **theories and practice** *Bilal Succar, ChangeAgents AEC, Australia*	
12:40 - 13:00	**Competence development, BIMcert** • **case: Austria** • **implementing BIMcert to Switzerland and Germany** *Alfred Waschl, buildingSMART Austria*	
10 min	**SMALL BREAK**	
13:10 - 13:30	**BSI Professional Certification Program - latest news** • **Professional Certification – Foundation** • **Professional Certification – Practitioner** • **Development path and goals** *Richard Petrie, buildingSMART International, UK* *Mark Baldwin, BSI Certification Program*	 
13:30 - 13:50	**Competence development strategy** • **Norwegian experiences** *Eilif Hjelseth, NTNU Oslo, Norway*	

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13:50 - 14:10	**BSI and certificated BIM Energy Performance development** • **Which information is exchanged, why, when, and among which actor** *Anna Moreno, buildingSMART Italy*	
	MINI-WORKSHOP in English	
14:10 - 14:40 (30 min)	Q&A Discussion topic: need for Education Room (in BSI) to coordinate development efforts in and accelerating the full implementation of systemic change with needed new skills in place. What would the topics be? Who should be involved? What concreate outcomes would the Education Room provide? How could the Education Room be linked to the national level BIM competence development strategies?	
14:40 - 15:00 (20 min)	**COFFEE BREAK**	Websites of on-going development projects: **INSTRUCT, BIM-ICE, BENEDICT**
15:00-16:15 (EET)	**Session 2: Strategies needed for digital skills and BIM competence development nationally** (in Finnish)	
15:00 - 15:20	**Alustus: Uusi KRL ja pätevyysvaatimukset?** • **Mikä muuttuu?** • **LO- listojen käyttökelpoisuus?** *Pekka Virkamäki, Ympäristöministeriö*	
15:20 - 15:40	**Alustus: Suomen tilanne osaamisen sertifioinnissa** • **lakiin perustuvat pätevyydet** • **alan ylläpitämät pätevyydet** • **sertifioidut pätevyydet** • **LO- listojen käyttökelpoisuus?** *Timo Korhonen, FISE*	
	KOMMENTTIPUHEENVUOROT alustuksiin	
15:40 - 16:10 (30 min)	**Onko meillä tarvetta kansalliselle digiosaamisen kehittämiselle ja henkilösertifioinneille ja/tai osaamisen ja pätevyyden tasomäärittelyille?** **Näkökulmia mallintamisen osaamisen kehittämiseen:** - tilaajan tarve - kaupunkikehittäminen ja kaupunkimallinnus tarve *Marion Schenkwein, Väylä* *Jarmo Suomisto, HKI*	 ... 

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	Miten voisimme kehittää suomalaisen osaamisen vientiä? - *Anna-Riitta Kallinen, ARKCON* **LO (learning outcome)- osaamisen kuvausjärjestelmä ja sen käyttökelpoisuus** *- Tarja Mäkeläinen, VTT*	 
16:10 - 16:15	**Loppusanat** Onko osaamisen sertifioinnin tarve lisääntymässä? - vuonna 2022? entä vuonna 2025? Miten osaamista ja muutosjohtamista kehitetään? - osa bSF KIRADigiBase ohjelmaa *Timo Lehtoviita, LAB, bSF koulutuksen toimialaryhmä*	

Audience:

- **Members of buildingSMART Finland**
- **Invited experts from on-going development projects**

  - **INSTRUCT**, Evidence based market and policy instruments Implementation across EU to increase the demand for eNergy skills across conSTRUCTion value chain. https://instructproject.eu/
  - **BIM ICE**, BIM Integration in Higher and Continuing Education. https://bim-ice.com/?page_id=13&lang=en
  - **BENEDICT**, BIM- enabled Learning Environment for Digital Construction. https://benedictproject.eu/

Background materials:

ICIS- International BIM education Report, Global up-date 2021

https://www.icis.org/wp-content/uploads/2021/05/BIM-Education-Global-2021-Update-Report-V8.0.pdf

Mr. Hjelseth

- https://www.researchgate.net/profile/EilifHjelseth/publication/319134261_Building_Information_Modeling_BIM_in_Higher_Education_Based_on_Pedagogical_Concepts_and_Standardised_Methods/links/5b50b0560f7e9b240ff05d65/Building-Information-Modeling-BIM-in-Higher-Education-Based-on-Pedagogical-Concepts-and-Standardised-Methods.pdf
- https://intranet.be.uw.edu/news/bim-related-studies-at-norwegian-university-of-science-and-technology/

Mr. Succar

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 894756.

- https://www.academia.edu/3550824/An_integrated_approach_to_BIM_competency_assessment_acquisition_and_application
- https://www.academia.edu/25288122/Model_Uses_Foundations_for_a_Modular_Requirements_Clarification_Language
- https://www.academia.edu/1487618/Measuring_BIM_performance_Five_metrics?email_work_card=abstract-read-more

Mr. Waschl

- BIM cert **http://www.buildingsmart.co.at/wp-content/uploads/2021/06/BIMcert-ZT-Appendix-2021a.pdf**

Mrs. Moreno

- https://cordis.europa.eu/article/id/411698-increasing-energy-efficiency-with-building-information-modelling

Mr. Petrie

- https://education.buildingsmart.org/wp-content/uploads/2018/07/bSI_IndiQual_Doc4.1-OverviewSpon-LowRes.pdf
- esitys KiraHubissa 2020: https://kirahub.org/wp-content/uploads/2020/02/10.15-buildingSMART-intro-Richard.pdf

YM and FISE

- Environmental Ministry of Finland (YM)
- Qualification of Professionals in Building, HVAC and Real Estate Sector in Finland (FISE)

Learning Outcome (LO)- based BIM competence development, competence requirements, qualification levels and certification systems.

- Learning outcomes (LO) - The use of LO-tables for structuring competence requirements for competence requirements, qualification levels and certification systems.
- Tables developed in EU project BIMEET and INSTRUCT (on-going). https://projectsites.vtt.fi/sites/bimeet/files/D3_2%20BIMEET%20Definition%20of%20LOs%20in%20the%20EU%20level.pdf

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A.3 Seminar 3


SKILLS
INSTRUCT
INSTRUMENTS
CONSTRUCTION
Management of energy-efficiency and up-skilled professionals in the path towards carbon neutrality targets 2035
- Seminar on August 24th 2022
Project INSTRUCT aims to develop training courses and cooperation schemes for the construction industry in the field of energy-efficient buildings and to initiate legislative changes in this area.
https://instructproject.eu
ASM Market Research and Analysis Centre
R2M SOLUTION
ril
VTT
CARDIFF UNIVERSITY
habitech
EnEffect
LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY
LIST
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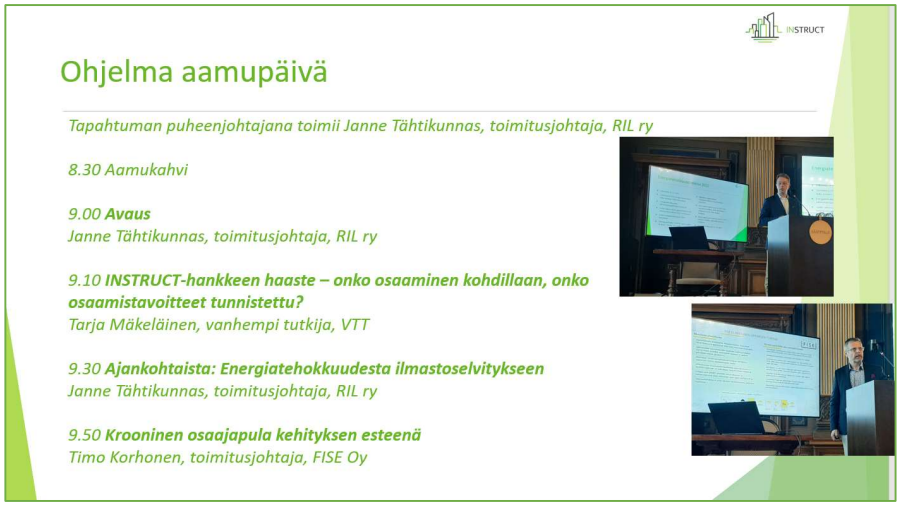
Ohjelma aamupäivä
Tapahtuman puheenjohtajana toimii Janne Tähtikunnas, toimitusjohtaja, RIL ry
8.30 Aamukahvi
9.00 Avaus
Janne Tähtikunnas, toimitusjohtaja, RIL ry
9.10 INSTRUCT-hankkeen haaste – onko osaaminen kohdillaan, onko osaamistavoitteet tunnistettu?
Tarja Mäkeläinen, vanhempi tutkija, VTT
9.30 Ajankohtaista: Energiatehokkuudesta ilmastoselvitykseen
Janne Tähtikunnas, toimitusjohtaja, RIL ry
9.50 Krooninen osaajapula kehityksen esteenä
Timo Korhonen, toimitusjohtaja, FISE Oy


Ohjelma iltapäivällä
11.10–12.00 LOUNAS
12.00-13.15 Projektiesittelyt
Uudet kouluhankkeet Kouvolassa
Katja Ahola, toimialajohtaja, Kouvolan kaupunki
Pilottikokemuksia Energiapositiivista ja vähähiilisistä alueista
• SPARCS - Smart Cities and Communities Lighthouse EU-project
Mari Hukkalainen, vanhempi tutkija, VTT
• SPARCS demo site: Lippulaiva Espoonlahdessa - hiilineutraalia energiaa
Elina Ekelund, vastuullisuuspäällikkö, Citycon
Espoon uudishankkeet ja hiilineutraalisuus
Kimmo Martinsen, suunnittelupäällikkö, Espoon kaupunki
Energiakatselmoinnit

B Example cases for the set of methods for verifying skills

The whole collection of cases consists of 14 verification methods in different context. Three methods introduced to clarify the wide range of possible skills verifying methods. The whole set will be used in the OER, national guideline (Finland).

B.1 Practical exam for the interests service providers

Case: Choosing the contractor for a maintenance project. Procurement model: Total contract with collaborative development/planning phase

The exam consists of 5 tasks, also a tasks which assess the service attitude in a face-to-face meeting with end-users. The exam is organised as part of collaborative development/planning workshop of the project case. The result of the exam is calculated as 25 weight% of the qualitative requirements in the selection of the contractor (Selection rates: Qualitative requirements 20%, Offered price 80%).

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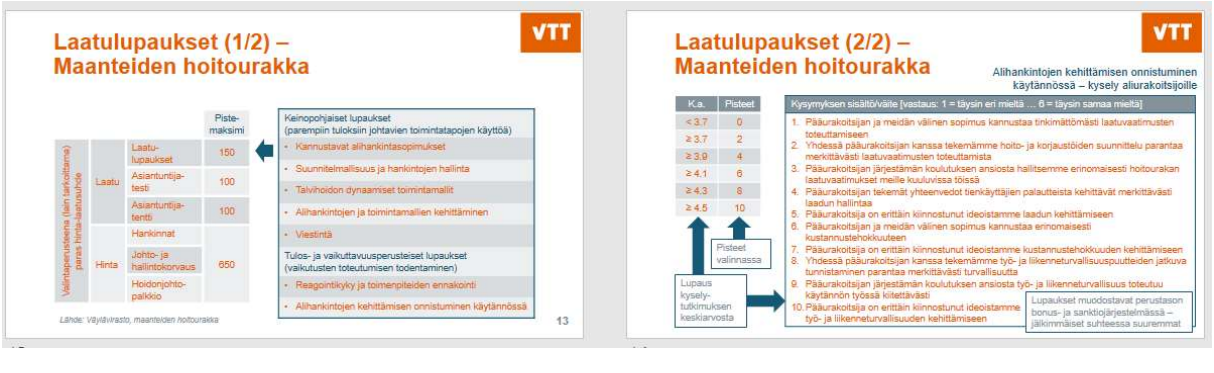
B.2 Qualitative promise based contract incl. promised skills

Case: A several years long maintenance contract of roads.
As part of the promised qualitative actions and approaches to keep up with the needed quality levels and improve execution, also training and innovativeness was promised.



B.3 Promises to quality standard and practical presentation

Case: Railroad station renovation. Procurement model: Pilot, InfraBIM enabled project.
Client was piloting Project information modelling, and the most innovative and effective ways of working was expected. The evaluation between 4 tenders was done with help of assessment templates. Templates includes 4 levels of definitions in 9 categories, also a category for skills and maturity level. The whole practical presentations showed well the competence of the team.

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C. Lessons learned- E-E case buildings

Examples of case buildings with ambitious targets for energy efficiency.
These case examples were studies from the perspective of reaching targeted energy consumption levels.

Metropolia campus - the campus for the builders of well-being

Finished: 1 phase 2019, 2 phase 2020

Client: City of Helsinki
Project manager: Koy Myllypuron kampus
Contractor: YIT
https://www.yit.fi/en/projects/metropolia-university-of-applied-sciences
Structural Designer: WSP
HVAC, MEP and BAS contractor: Quattro Mikenti Group
28milj€ contract under project management procurement model

Metropolia Campus- project finished in 2 phases in 2019-20, is a large service facility for University of Applied Sciences. Building service technologies installed to be part of the education programmes and the spaces can be used for studying purposes.
Based on insight from the facility manager (excursion on 7th October 2022) there are positive and negative factors around running a smart building; challenges can often be traced to occupancy levels and behaviours. Also, BAS and BEM systems took time to get in to balance, and influenced high level consumption of district heating. The facility used the low energy guidelines for low energy office buildings made by City of Helsinki
Result: Targeted energy consumption levels were lower than planned after finishing the project, because of limitations (COVID -19).

Onnelanpolku-case

Built: 2011-2014
Client: The Lahti Foundation for Housing for the Elderly (Lahden vanhusten asuntosäätiö)
Usage: nearly zero energy retirement home, 160 apartments

Onnelanpolku -project is a well documented nearly zero energy building. The senior building is situated in Lahti. One of the main objectives of the new building was to go beyond building regulations' requirements for energy efficiency and reach the nearly zero energy building level. Considering the scale of the project, it was unique in Finland. The energy solution in the building is based on the diverse use of district heat, high level of energy efficiency and the reuse of waste energy
Onnelanpolku project were published in three reports in Finnish:

- Instructions for developers on the procurement of nearly zero energy buildings (Hankintamenettelyohje rakennuttajalle, ARAn raportteja 3/2013),
- Planning guide for a nearly zero-energy building (Lähes nollaenergiatalon suunnitteluohjeet, ARAn raportteja 2/2013) and
- Analysis of the demolition of a retirement home from the 70's (70- luvun vanhusten asuintalon purkuanalyysi, ARAn raportteja 1/2013)

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The team working with this building was selected carefully as it was the first pilot project for nZEB in Finland. The execution of nZEB building demands extra know-how and collaborative design and construction from client, designers and contractors side.
The programing and briefing phase a specific procurement workshops were organised by Rakli. Facility owners, representatives from the Lahti city, contractors, service providers and designers took part. The participants developed general solution and requirements for the tender. Contactors got a clear picture about the targets of the project and procurement model.

Result: Targeted energy consumption levels were reached quite soon after finishing the project.

Biomedicum 1

Finished: 2001
Client: HYKS, Helsinki University Hospital
Architect: Timo Vormala
Engineering and building service design: Magnus Malmberg, Olof Granlund.
Procurement type. Project management
Main contractor: SRV.
Volume of the building: 200 000km3

The building and the whole project team were awarded for "innovative architectural and structural design and versatile use of concrete". Biomedicum's premises are flexible and adaptable for many types of usages.
Biomedicum Helsinki is a research and training center, situated in the Meilahti hospital area. The Biomedicum Helsinki building houses the following units of the Faculty of Medicine:
Medicum (Departments of Anatomy, Biochemistry, Clinical and medical genetics, Clinical Chemistry and Haematology, Clinical Pharmacology, Developmental biology, Pharmacology, Physiology) and Clinicum. The research laboratories of Department of Oral and Maxillofacial Diseases are also located in the Biomedicum building. The teaching and conference facilities on the ground floor, which are normally used in the teaching of first and second-year medical and dental students, may be rented for various types of seminars, symposia and conferences.

High level steering expertise in HVAC and BAU and BEM design, procurement and installations with in an innovative atmosphere and collaborative ways of working resulted as successful project. Specific **guidance matrix with all HVAC, MEP and BMS and BEMS systems, components and equipment** helped that also detailed level decisions were done at the right time.
Results: No gap in estimated and real energy consumptions.

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C1. Case of Espoo city

- **Karhusuon koulu vaihe 1**, valmistunut 10/2017:
    - Moduulikoulu tilaelementeistä n. 3100brm2 (KVR), n. 325 oppilasta
    - E-luku 104kwh/m2/a (B)
    - Maalämpö- ja maaviilennys kattosäteilijöillä, sähkökattila, (aurinkosähkö 12kWp) viilennyksen primääritavoite on siirtää lämpöenergiaa takaisin lämpökaivoihin ja viilennys on sivutuote
- **Karhusuon koulu vaihe 2-3**, valmistunut 5/2020
    - n. 7100 brm2 (KVR), n. 700 oppilasta vaihe 1 mukaan lukien
    - E-luku 86 kWh/m2/a
    - Maalämpö- ja maaviilennys kattosäteilijöillä, sähkökattila, aurinkosähkö 22kWp, viilennyksen primääritavoite on siirtää lämpöenergiaa takaisin lämpökaivoihin ja viilennys on sivutuote
- **Leppävaaran koulukeskus Monikko**, valmistunut 5/2021
    - n. 15100 brm2 (yht.toim.PJU), n. 1060 oppilasta ja 252 varhaiskasvatuspaikkaa
    - E-luku 57 kWh/m2/a, RTS tavoitetaso 3 tähteä, ei sertifioitu
    - Maalämpö- ja maaviilennys kattosäteilijöillä, kaukolämpö, aurinkosähkö 120kWp, viilennyksen primääritavoite on siirtää lämpöenergiaa takaisin lämpökaivoihin ja viilennys on sivutuote, lisäksi varsin kattava olosuhdeanturointi
- **Matinkylän uimahalli**, valmistunut 1/2022:
    - Uimahalli n. 7800 brm2 (jaettu urakka)
    - E-luku 166 kWh/m2/a (lk C) – oletus 400 000 kävijää vuodessa
    - Maalämpö- ja maaviilennys, aurinkosähkö, kaukolämpö, viherkatto
- **Jousenkaaren koulu**, valmistunut 4/2022
    - n. 5950 brm2 (yht.toim. KVR), n. 480 oppilasta
    - E-luku 64 kWh/m2/a, RTS tavoite 3 tähteä ei sertifioitu
    - Maalämpö- ja IV:n maaviilennys, kaukolämpö, aurinkosähkö 25,6kWp, viilennyksen primääritavoite on siirtää lämpöenergiaa takaisin lämpökaivoihin ja viilennys on sivutuote
- **Kalajärven koulu, päiväkoti ja nuorisotila**, rakenteilla – valmistuminen vaiheittain
    - n. 12600 brm2 (kok.U), n. 600 oppilasta ja 252 varhaiskasvatuspaikkaa
    - E-luku 79 kWh/m2/a, RTS tavoite 3 tähteä ei sertifioitu

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    - Kustannuspaineiden takia uusiutuvat energialähteet karsiutuivat (toistaiseksi) toteutuksesta
- **Matinkylän lukio ja liikuntahalli**, rakenteilla – tavoite 12/2023
    - n. 10900 brm2 (yht.toim.PJU),, n. 900 oppilasta
    - E-luku 71kWh/m2/a, RTS tavoite 3 tähteä ei sertifioitu
    - Maalämpö- ja maaviilennys, kaukolämpö, aurinkosähkö tulossa n. 80kWp, viilennyksen primääritavoite on siirtää lämpöenergiaa takaisin lämpökaivoihin ja viilennys on sivutuote
- **Tiistilän koulu ja päiväkoti**, rakenteilla - tavoite 6/2024
    - n. 13 000 brm2 (yht.toim.PJU), n. 990 oppilasta ja 168 varhaiskasvatuspaikkaa
    - E-luku 66kWh/m2/a, RTS tavoite 3 tähteä ei sertifioitu
    - Maalämpö- ja maaviilennys, kaukolämpö, aurinkosähkövaraus (36kWp), viilennyksen primääritavoite on siirtää lämpöenergiaa takaisin lämpökaivoihin ja viilennys on sivutuote, puukoulu

Espoon PPP – hankkeen koulut ja päiväkodit

- **Perkkaan koulu – 6/2022 (E=66)**
- **Pohjois-Tapiolan uusi koulu – 6/2022 (E=65)**
- **Nauriskasken koulu – 6/2022 (E=62)**
- **Nöykkiönniityn päiväkoti – 6/ 2022 (E=66)**
- **Kilon koulu ja päiväkoti – 12/2023**
- **Kuitinmäen alakoulu – 6/2023**
- **Perkkaan päiväkoti – 12/2023**
    - Hiilineutraalisuus ja energiatehokkuustavoitteet kuten edellisissä hankkeissa
    - Yhteensä n. 3300 Oppilasta ja 590 varhaiskasvatuspaikkaa ja yhteensä n. 48 000brm2
    - E-luku < 80kWh/m2/a, RTS tavoite 3 tähteä – toteutunee RTS 4 tähteä ja sertifioituna
    - Maalämpö- ja maaviilennys, kaukolämpö, aurinkosähkövaraus, viilennyksen primääritavoite
- Toteuttajana Kumppanuuskoulut Oy ja YIT kumppaneineen – tarkemmin tietoa hankkeista linkistä: Espoon kumppanuuskoulut | YIT.fi

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D. Cross-checking of LO frameworks and EE skills needed, based on EE gaps identified

Number of gap	Problems faced in reaching energy efficiency	Competence gap	Role
1	Complex buildings and dynamic building automation systems hard to operate right.	High quality Facility management and efficient energy. Knowledge and skills for automated building service systems operations, "running" the building.	Facility manager/ operators Energy operator Facility workers
2	Many primary energy sources used leading to situation where calculations do no provide right figures for total consumption.	Competence in demanding energy design, estimation and optimation. Knowledge of primary energy sources and design competence of energy mix.	Energy designer
3	Calculations and simulation give too optimistic results, because of intial values or meta data in the tool.	Excellent knowledge in BIM based energy design. Designs solution, calculation, simulations and optimation. Standardisation of tools	HVAC designer Energy designer
4	Competence cap in running energy simulations BIM software skills + energy design skills).	Excellent skills in use of energy design, simulation and optimation tools.	HVAC designer Energy designer
5	Changes in use of spaces (e.g the end-users (prosumers) use more energy because of more efficient ventilation.	Competence on space usage change management during use of building. Process competence.	Facility managers Energy operator Facility workers
6	Changes during the construction process are not taken back to the HVAC and building automation system planning (better change management)	Competence on change management of the targets of user groups or project partners, during design phase. Process competence.	Project manager Design steering Contraction steering
7	Technical systems are procured in a different way than defined in the plans/ designs	Change management during the procurement and assemply of HVAC and energy systems. Process competence.	Project manger Construction manager, Site manager
8	Target (E-level) has been set too optimistically	Target setting competence, competence on feasibility study to get realistic energy target values. Competence of steering estimated energy efficiency target	Client Briefing consultant Energy manager
9	Lack of collaboration, integration (and co-creation).	Collaboration, co-working and co-creation in integrated processes. Competence in steering of collaboration Skills and competence in virtual collaboration.	All disciplines

Relevant LOs in the INSTRUCT framework:

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Gap number 1: High quality Facility management and efficient energy. Knowledge and skills for **automated building service systems** operations (BAS), ”running ” the building.

- Relevant LOs:

LO6: Learner is able to explain, **implement and supervise quality compliant energy management procedures** in building project to achieve set targets.

MISSING: exact reference to BAS

Gap number 2: Competence in **demanding** energy design, estimation and optimation. Knowledge of primary energy sources and design competence of energy mix.

- Relevant LOs:

LO6 Learner is able to explain, implement and supervise quality compliant energy management procedures in building project to achieve set targets.

Gap number 3: Excellent knowledge in **BIM based energy design**. Designs solution, calculation, simulations and optimation. Standardisation of tools

- Relevant LOs:

LO6 Learner is able to explain, implement and supervise quality compliant energy management procedures in building project to achieve set targets.

6.1 Identify the services, methodologies (BIM) and people to constitute an operational team

4.1 Apply the set performance targets related to building design into BIM-based design process.

Gap number 4: Excellent skills in use of **energy design, simulation and optimation tools**

- Relevant LOs:

6.1 Learner is able to use tools such as energy management software.

LO7 Learner is able to use different relevant energy software and interfaces between relevant software

Gap number 5: Competence on **space usage change management during use of building**. Process competence.

- Relevant LOs:

LO1: Learner is able to explain the fundamentals of energy interventions and the underlying principles of uses with respect to building life-cycle.

3. Explain relations between life-cycle costs, energy performance and building performance.

MISSING: exact reference to change management

Gap number 6: Competence on **change management of the targets of user groups or project partners, during design phase.** Process competence.

- Relevant LOs:

4.2 Iterate the design solutions to meet the set targets of building performance and energy efficiency.

4.3 Consider options of renewable energy and optimize its potentials.

Design solutions upgradable to meet coming EE systems requirements (options for future EE improvements)

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4.4 Create different energy efficient design concepts renewable energy systems.

Gap number 7: <u>Change management</u> during the procurement and assemply of HVAC and energy systems. Process competence.

- Relevant LOs:

5.9 Prepare models to fulfil quality and information requirements for quality control and assurance processes in construction.

5.10 Prepare models based on data and information requirements of sustainable care and maintenance processes.

5.11 Prepare information for As-Built Models and Maintenance model for utilization of client and building management.

Gap number 8: Target setting competence, competence on feasibility study **to get realistic energy target values. Competence of steering** estimated energy efficiency target.

- Relevant LOs:

LO3 Learner is able to prepare energy efficiency execution plan and explain essential aspects in setting strategic and project based energy targets.

3.1 Learner is able to use relevant energy target-setting tools.

7.1 Master the technical principles (insulation, thermal bridges, airtightness, heat recovery) within the relevant software.

4.5 Perform energy analyses including dynamic simulations.

Gap number 9: Collaboration, co-working and co-creation in integrated processes.
Competence in **steering of collaboration**
Skills and competence in virtual collaboration.

- Relevant LOs:

LO5 Learner is able to explain and use energy based collaboration methods for energy management and processes.

5.4 Support the process resulting in the publication of the merged model (As-Designed) together with all needed information.

6.4 Prepare relevant visualization models to enable information sharing, decision making and opinion formation.

6.6 Collaborate with the help of communication platforms and processes.

Learning outcomes are defined in specific order forming eight groups:

- Group 1 (LO1) Basic general knowledge of sustainable energy interventions and principlesand their application across lifecycle and supply-chains
- Group 2 (LO2) Basic factual knowledge of sustainable and energy-efficient buildings and building performance.
- Group 3 (LO3) Knowledge of facts, principles, processes and general concepts on building energy efficiency
- Group 4 (LO4) Factual and theoretical knowledge on energy efficiency, sustainability and building performance

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- Group 5 (LO5) Comprehensive, specialised, factual and theoretical knowledge on energy efficiency, sustainability and building performance
- Group 6 (LO6) Advanced knowledge in energy efficiency, involving a critical understanding of theories and principles
- Group 7 (LO7) Highly specialised knowledge in energy efficiency.
- Group 8 (LO8) Knowledge at the most advanced frontier of energy efficiency and at the interface between related disciplines

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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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