Co-funded by the Erasmus+ Programme of the European Union

UPWOOD

EXELIA

O1-T4: Learning outcomes for construction sector WBL schemes report

UPWOOD
Up-skilling construction workers in wood construction methods for energy efficient buildings

EXELIA 8/5/20 2019-1-AT01-KA202-051488

Co-funded by the Erasmus+ Programme of the European Union

UPWOOD

EXELIA

Project details

Project acronym:	UPWOOD
Project name:	Up-skilling construction workers in wood construction methods for energy efficient buildings
Project code:	2019-1-AT01-KA202-051488

Document Information

Document ID name:	2020-05-11_UPWOOD_IO1_Report
Document title:	Definition of UPWOOD learning outcomes for construction sector WBL schemes
Output Type:	Intellectual Output 1
Date of Delivery:	11/05/2020
Activity type:	Report
Activity leader:	Holzcluster Steiermark GmbH
Dissemination level:	Public

Document History

Versions	Date	Changes	Type of change	Delivered by
Version 1.0	11/05/2020	Initial document	-	EXELIA
Version 1.1	29/05/2020	Updated version	Integration of feedback from HCS,UPV,LVT,WOODPOLIS	EXELIA
Version 1.2	01/06/2020	Fine-tuned	Final modifications of learning outcomes	EXELIA

Disclaimer

Contents

1. ACRONYMS AND ABBREVIATIONS

Acronyms and Abbreviations	
AF	Application form
UPWOOD	Up-skilling construction workers in wood construction methods for energy efficient buildings
HCS	Holzcluster Steiermark GmbH
UPV	Universitat Politecnica de Valencia
LVT	PIKC "Lipepajas Valsts tehnikums"
WBL	Work-Based-Learning
C-VET	Continuous Vocational Education and Training
ECVET	European Credit system for Vocational Education and Training
EQF	European Qualification Framework
EU	European Union
ECSCO	European Construction Sector Observatory
EIBI	Energy Efficient Buildings Initiative
I-VET	Initial Vocational Education and Training
KPI	Key Performance Indicator
M.Sc.	Master of Science
OER	Open Educational Resources
VET	Vocational Education and Training
CNC	Computerised numerical control
CLT	Cross-laminated timber

UPWOOD Consortium	
HCS	Holzcluster Steiermark GmbH
EXELIA	EXELIA E.E.
UPV	Universitat Politecnica de Valencia
LVT	PIKC "Lierpajas Valsts technikums"
WOODPOLIS	Kuhmon Kaupunki

2. INTRODUCTION

UPWOOD's first intellectual output, comprises tasks that lead to the definition of the work-based learning outcomes on environmentally-friendly and energy efficient innovative woodworking construction practices, setting the basis for the development of the UPWOOD WBL curriculum structure. In this light, relevant desk and field research has been carried out in line with the steps and instructions presented in the intellectual output's methodology report (O1-T1).

Specifically the completion of Intellectual Output 1 is based on the following four sub-tasks:

a. Tools and guidelines for mapping current and future innovative woodworking skill needs in the construction sector.

b. the field research focusing on the current and future workplace requirements on energy efficient applications of wood and woodworking methods. Interviews were an optional task for the collection of further evidence or in case the KPIs defined in the methodology were not attained.

c. the desk research focused on the existing relevant construction sector apprenticeships, aiming to identify trends in skill supply as regards innovative and energy efficient woodworking methods and applications.

d. definition of the UPWOOD learning outcomes for construction sector WBL schemes.

This report provides the analysis and results of the collected input and data, of the above stated research activities, aiming to identify the priorities and training requirements on energy efficient applications of wood and woodworking methods, thereby setting the foundations for the development of the training and assessment material and the UPWOOD course.

The report "Definition of UPWOOD learning outcomes for construction sector WBL schemes" is structured as follows:

Section 3: Field research

Section 4: Semi-structured interviews

Section 5: Desk research

Section 6: Definition of the learning outcomes for the UPWOOD apprenticeship programme on energy efficient construction with wood and woodworking methods and applications.

Section 7: Guidelines on how to prepare the UPWOOD learning units corresponding to the defined learning outcomes.

3. FIELD RESEARCH

3.1 Purpose and target groups

The structured questionnaire is one of the main instruments for gathering survey data and is often used to establish a structured, organised and well documented way to collect opinion-based evidence and personal views on woodworking skills requirements. A web-based approach (using EU Survey) was employed for reasons of practicality, and to facilitate the data collection process. The questionnaire was structured in a clear and simple manner to encourage participation and facilitate communication with target groups. The questionnaire comprises mostly closed-ended questions as they are easier and quicker for respondents to answer; offer better coding, analysis and comparison possibilities; and can clarify question meaning for respondents through response choices.

This questionnaire addresses the relevant stakeholders to capture their perceptions on skills requirements for construction sector WBL learners to perform energy efficient woodworking applications and methods. According to the objectives of the survey, the target respondents should include individuals with experience in innovative and energy efficient woodworking techniques. Thus, indicatively the main target population as identified in the methodology consists of construction industry executives, construction sector employees and senior executives, VET and training providers, academics/researchers, field experts and consultants. The questionnaire was open online for a period of two months between 20/12/2019 and 24/02/2020.

The questionnaire begins with a short introduction that includes the background and objectives of the UPWOOD project as well as the purpose of data collection on energy-efficient applications of wood and woodworking methods. Respondents had the option to answer the questionnaire in English or in any of the official partnership languages (DE, ES, LV, FI, EL). The English version of the online questionnaire can be found at the following link: https://ec.europa.eu/eusurvey/runner/UPWOODSurvey2019

3.2 Online questionnaire results

This section presents the data collected via the online questionnaire and summarises the outcomes of the field research data collected by the consortium in the partnership countries (i.e. Austria, Spain, Latvia, Finland and Greece) and beyond. The data has been analysed collectively in order to obtain aggregate results presented in graphical format, while taking into consideration all available contributions. The structure of this section follows that of the online questionnaire.

3.2.1 Sampling targets & participation statistics

The research methodology, set the target numbers of responses to be collected from the online questionnaire to be between 125 and 180 replies. The actual contributions reached are presented in Table 1 below.

Table 1: Responses vs. Target number of responses per consortium country and project partner

Partner	Country	Target number	Completed questionnaires
HCS	Austria	30-40	29
LVT	Latvia	25-35	26
UPV	Spain	30-40	23
WOODPOLIS	Finland	25-40	27
EXELIA	Greece	15-25	10
Other	Other (Sweden)	-	1
	TOTAL	**125-180**	**116**

Most partners did not achieve their targets on the first round of the email campaign. This challenge was overcome by extending the data collection period to ensure sufficient representation from each partnership country and emphasising the importance of reaching the set KPIs for the development of UPWOOD's training and assessment material.

Furthermore, the research methodology suggested that additional semi-structured interviews as an optional tool, that should made mandatory if the total numbers of replies to the online survey is below 125. All partners and particularly the ones that had not reached the desired KPI, with a significant database of relevant experts, were advised to contact their existing contacts and conduct interviews with WBL, VET providers and construction sector

knowledgeable experts. Thereby, partners overall collected sufficient data allowing for the smooth progress of the project to continue as foreseen. Table 2 summarises the partners' contribution with the organisation of semi-structured interviews.

Table 2: Number of Semi-Structured Interviews by country partner

Partner	Country	No. of Interviews conducted
HCS	Austria	12
LVT	Latvia	3
	TOTAL	**15**

Further analysis of questionnaire responses and semi-structured interviews will be given in the section 4.

3.2.2 Respondents' profile

The first required field of the survey was designed to determine the geographical location of the respondents. The responses collected where located in the UPWOOD consortium countries (Austria, Spain, Latvia, Finland and Greece), and 1 response was recorded from outside the consortium countries.

Table 3: Origin country of respondents and corresponding percentages

Country	Completed questionnaires	Percentage (%)
Austria	29	25.0
Latvia	26	22.4
Spain	23	19.8
Finland	27	23.3
Greece	10	8.6
Sweden	1	0.9
TOTAL	**116**	**100**

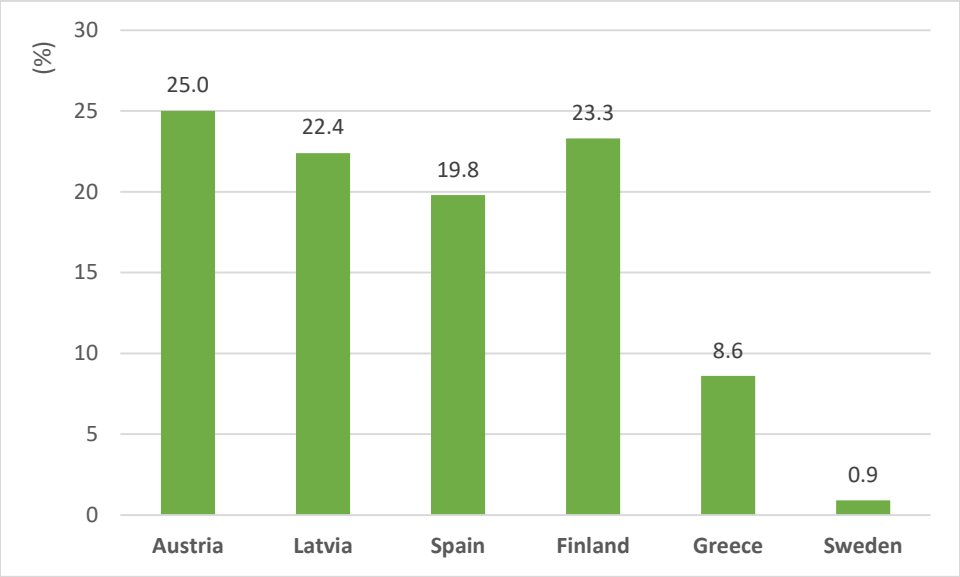

Figure 1: Origin country of respondents in percentage

3.2.2.1 Job functions of the respondents

This question aims to identify the respondents' profile, from within the categories defined in the methodology. The most represented group were the Academics/researchers with a total of approximately 34%, followed by construction sector employees with a respective percentage of approximately 20%. The remaining target groups i.e. executive in construction companies, field experts and VET providers/trainers were represented with a similar percentage shares between 13% and 16%, as indicated in figure 2.

Figure 2: Job function of respondents in percentage (%)

3.2.2.2 Specialised services provided by companies

The majority (40%) of respondents from the category "Executive in construction company" provided specialised construction engineering services. Façade construction and prefabricated house construction followed with contributions of approximately between 13% and 8% respectively. Sealing building was the least represented category.

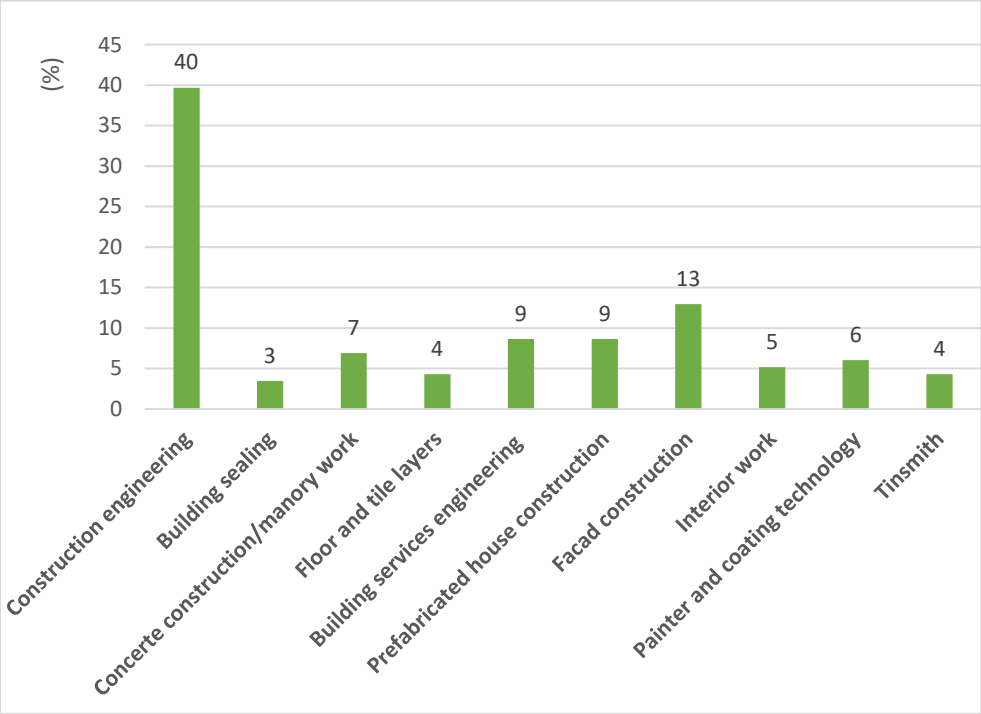

Figure 3: Specialised services provided by companies (%)

3.2.2.3 Experience

This question aimed to ascertain the respondents' level of experience. Overall, more than 80% of the respondents' claimed to have at least 4 years of experience, while more than 70% of the respondents' claimed to have more than 7 years of experience of working or VET provision the construction sector. This high rate, emphasises the valuable profile and opinion of the survey participants.

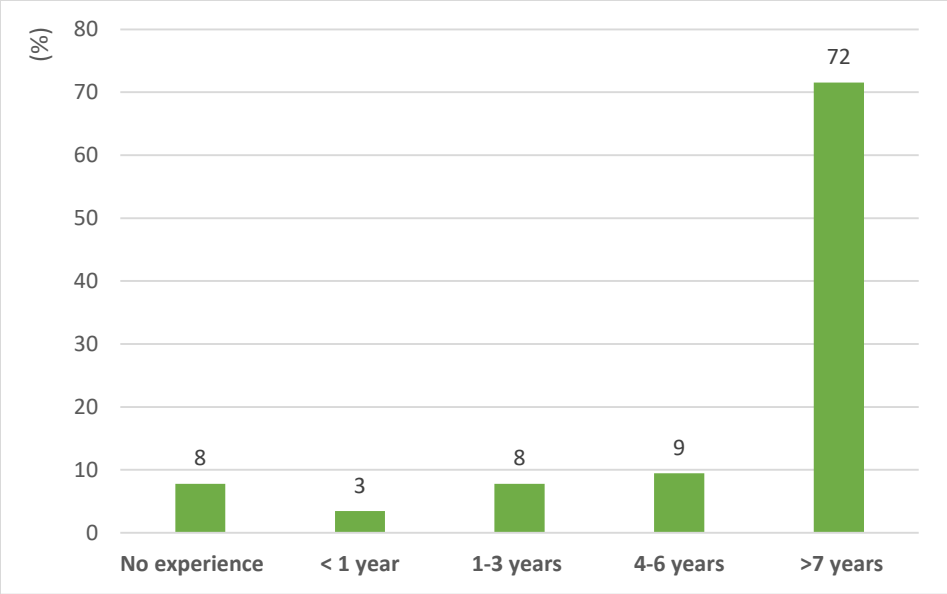

Figure 4: Years of experience working or training in the construction sector in percentage (%)

Table 4 presents the distribution of respondents per partner country according to the number of years of experience in absolute values, while table 5 presents the findings in percentage rates.

Table 4: Years of experience per partner country

Country	No experience	< 1 year	1-3 years	4-6 years	>7 years	Total
Austria	1	0	1	1	26	29
Latvia	1	0	2	3	20	26
Spain	2	3	2	2	14	23
Finland	3	1	4	4	15	27
Greece	2	0	0	1	7	10
Other	0	0	0	0	1	1
TOTAL	**9**	**4**	**9**	**11**	**83**	**116**

Country	Total	No experience	< 1 year	1-3 years	4-6 years	>7 years
Austria	**29**	3%	0%	3%	3%	91%
Latvia	**26**	4%	0%	7%	12%	77%
Spain	**23**	9%	13%	9%	9%	60%

Country	Total	No experience	< 1 year	1-3 years	4-6 years	>7 years
Finland	**27**	11%	4%	15%	15%	55%
Greece	**10**	20%	0%	0%	10%	70%
Other	**1**	0%	0%	0%	0%	100%
TOTAL	**116**	**9**	**4**	**9**	**11**	**83**

Table 5: Years of experience per partner country in percentage rates (%)

More specifically, from the 83 participants with more than 7 years of experience, 26 were from Austria, 20 from Latvia, 15 from Finland, 14 from Spain and 7 from Greece, representing the level of expertise in the partnership countries. The respective percentage distribution is presented in figure 5 below.

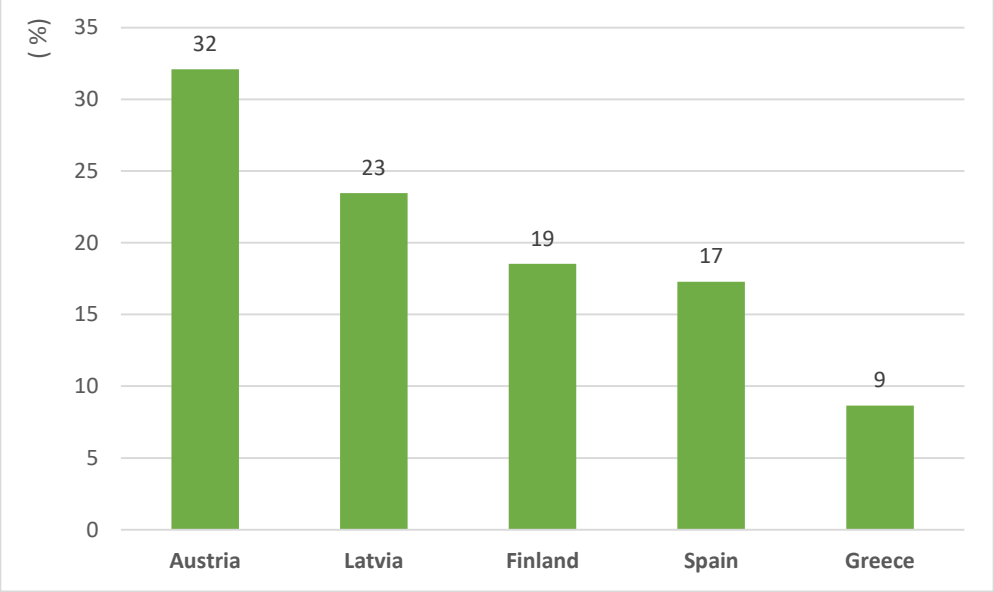

Figure 5: More than 7 years of experience in construction per partner country (%)

3.2.3 Questionnaire responses regarding knowledge & skill requirements

This section of the questionnaire urged respondents to evaluate the importance of necessary knowledge and skills required for construction workers to demonstrate when working with wood.

The section header is the following "in your experience, to what extent do construction workers need to have the following knowledge, skills and competences?" and for each topic/statement respondents selected of the following options on a Likert scale i. Very low ii. Low iii. Average iv. High v. Very high.

3.2.3.1 Types/species of wood

Regarding the question "to what extent do construction workers need to know the types/species of wood used in construction", 53% of the total respondents considered it to be of very high or high importance, while 42% only considered it to be of average importance. On the other hand only 5% of the total 116 considered it to be of low importance, while no replies were recorded under the category of "very low". Table 6 presents the absolute values of these results, according to the geographical distribution.

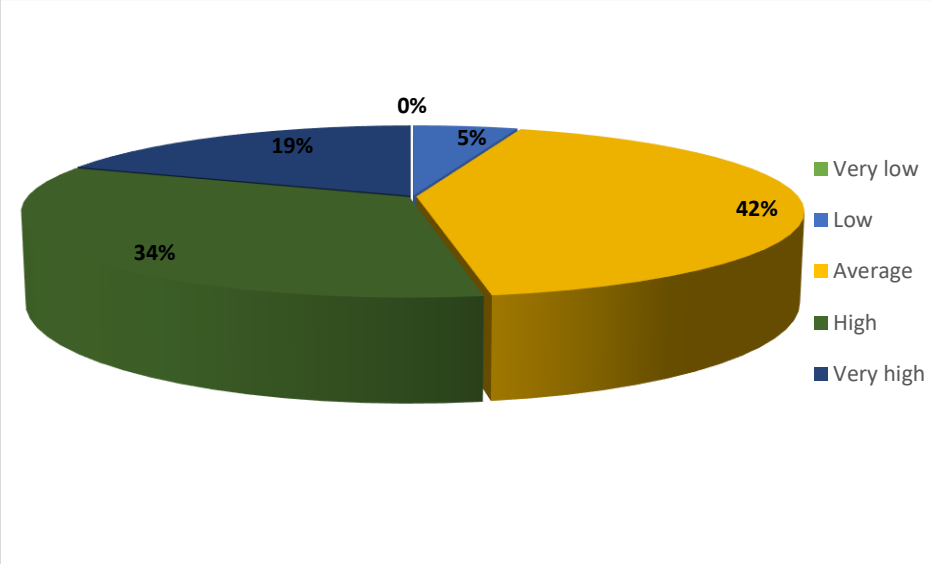

Figure 6: importance of knowledge regarding different types/species of wood used in construction (%)

Table 6: importance of knowledge regarding different types/species of wood used in construction

Country	Very Low	Low	Average	High	Very High	Total
Austria	0	3	11	8	7	**29**
Latvia	0	0	14	10	2	**26**
Spain	0	2	6	10	5	**23**
Finland	0	1	16	7	3	**27**
Greece	0	0	2	3	5	**10**
Other	0	0	0	1	0	**1**
TOTAL	**0**	**6**	**49**	**39**	**22**	**116**

3.2.3.2 Properties of wood

This question examines how important respondents considered construction workers to be familiar with the properties of wood such as thermal, acoustic, electrical, mechanical characteristics in order to be able to successfully use wood and apply energy-efficient woodworking methods and applications. The majority (58%) of the respondents consider this type of knowledge of very high or high importance, whereas only less than 10% considered it of limited significance, rating it under the categories of low or very low importance as indicated in figure 7. Table 7 demonstrates the corresponding geographical distribution of the responses.

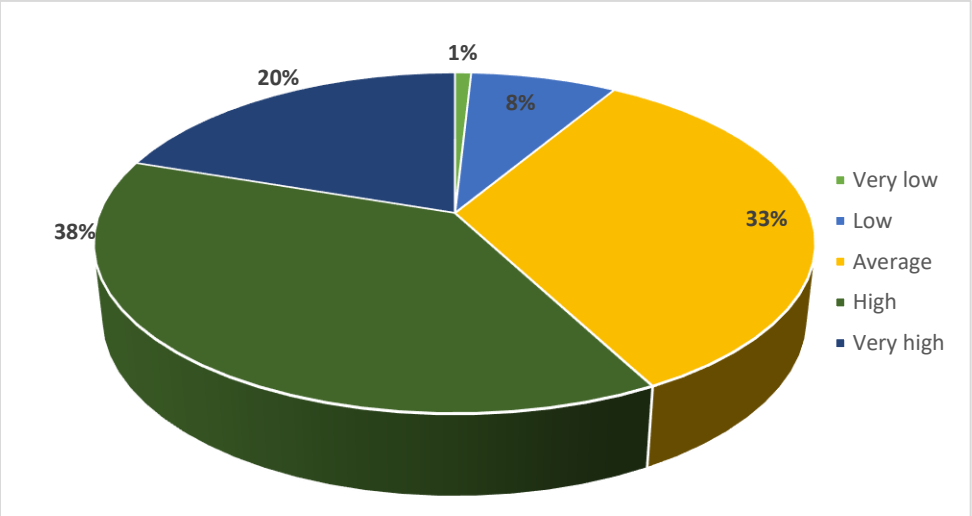

Figure 7: importance of knowledge regarding properties of wood (%)

Table 7: importance of knowledge regarding properties of wood

Country	Very Low	Low	Average	High	Very High	Total
Austria	0	2	10	10	7	**29**
Latvia	0	2	11	10	3	**26**
Spain	0	4	3	11	5	**23**
Finland	1	1	12	8	5	**27**
Greece	0	0	3	4	3	**10**
Other	0	0	0	1	0	**1**
TOTAL	**1**	**9**	**39**	**44**	**23**	**116**

3.2.3.3 Limitations of wood in construction

When examining the importance of knowledge related to the limitations that wood introduces in the construction process such as shrinking, swelling and biotic deterioration/degradation, overall only 9% of the total 166 respondents considered it to be of low importance. On the contrary, 35% considered it to be significant knowledge of very high importance and 44% of high importance respectively. This result, tends to demonstrate the increased need for construction workers to be able to understand and use wood as a construction material in realistic and practical ways. As table 8 presents the geographical distribution or responses in absolute values.

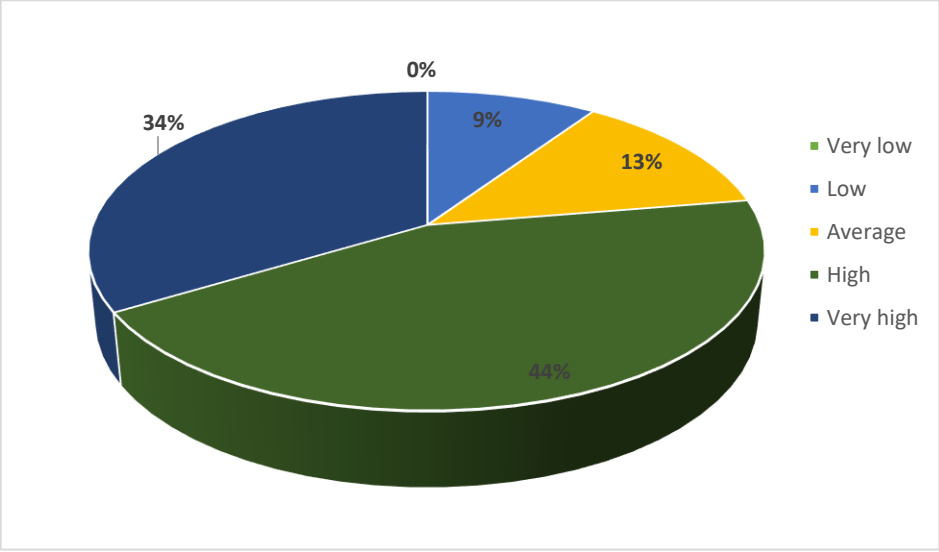

Figure 8: importance of understanding with the limitations of wood (%)

Table 8: importance of understanding with the limitations of wood

Country	Very Low	Low	Average	High	Very High	Total
Austria	0	3	2	11	13	**29**
Latvia	0	5	5	11	5	**26**
Spain	0	2	4	9	8	**23**
Finland	0	1	4	16	6	**27**
Greece	0	0	0	4	6	**10**
Other	0	0	0	0	1	**1**
TOTAL	**0**	**11**	**15**	**51**	**39**	**116**

3.2.3.4 Environmental effects & weather conditions

The statement "to what extent do construction workers need to be aware of how wood behave & react to particular weather conditions (such as moisture, rain, UV radiation etc.)", proved to be of very high importance for more than 40% of the total respondents. A further 39% of participants also considered this statement of high importance. A relatively small fraction of respondents considered this statement of average or low importance as figure 9 indicates.

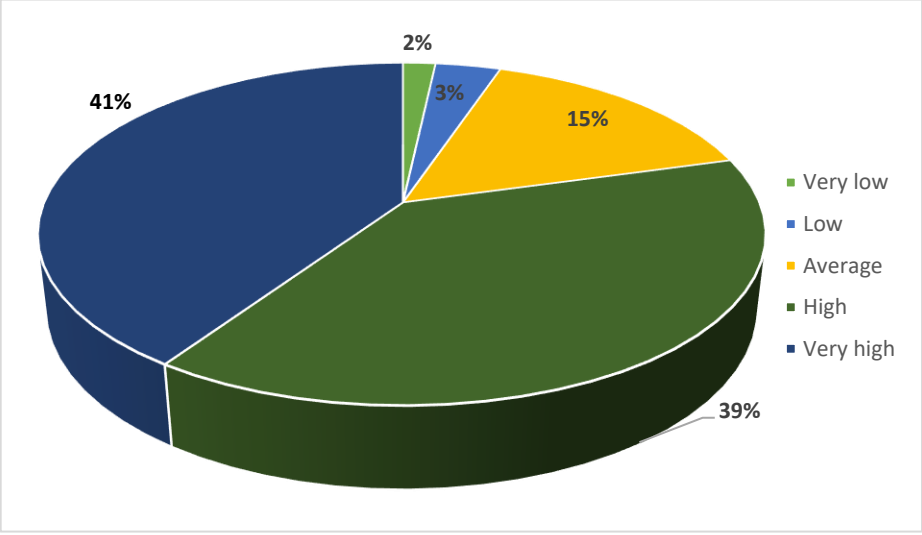

Figure 9: importance of knowledge on wood behaviour & effects of weather conditions (%)

Table 9, explains the geographical distribution of respondents and suggests that countries with differentiated climates consider the importance of understanding the effects of weather conditions remains of particular significance.

Table 9: importance of knowledge on wood behaviour & effects of weather conditions

Country	Very Low	Low	Average	High	Very High	Total
Austria	0	2	2	12	13	**29**
Latvia	1	0	5	12	8	**26**
Spain	1	2	7	7	6	**23**
Finland	0	0	3	12	12	**27**
Greece	0	0	1	2	7	**10**
Other	0	0	0	0	1	**1**
TOTAL	**2**	**4**	**18**	**45**	**47**	**116**

3.2.3.5 Benefits of wood as an environmentally friendly building material

With regards to the benefits of wood as an environmentally friendly building material, the responses collected varied. In fact 38% of the total respondents considered this statement to be of average or low importance, while the 58% rated it either as very high or high importance. A minority of 4% rated the statement as very low importance.

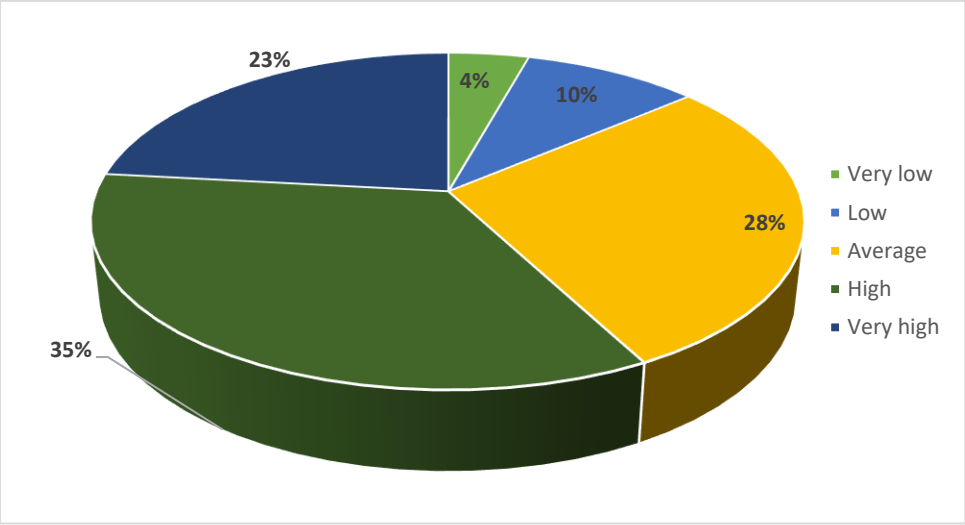

Figure 10: importance of knowledge about benefits of wood as an environmentally friendly building material (%)

3.2.3.6 Selection of appropriate wood type or wood product

The ability to select of the most appropriate wood type or wood product to work with within the context of a particular project, was found to be of particular significance among the respondents. More specifically 72% of the 116 responses in total rated this statement, as very high or high importance. This indicates the significance of being knowledgeable on the different wood types and their properties, so to be able to work with them efficiently and effectively. Only 7% considered it of low importance and no replies were recorded in the very low category.

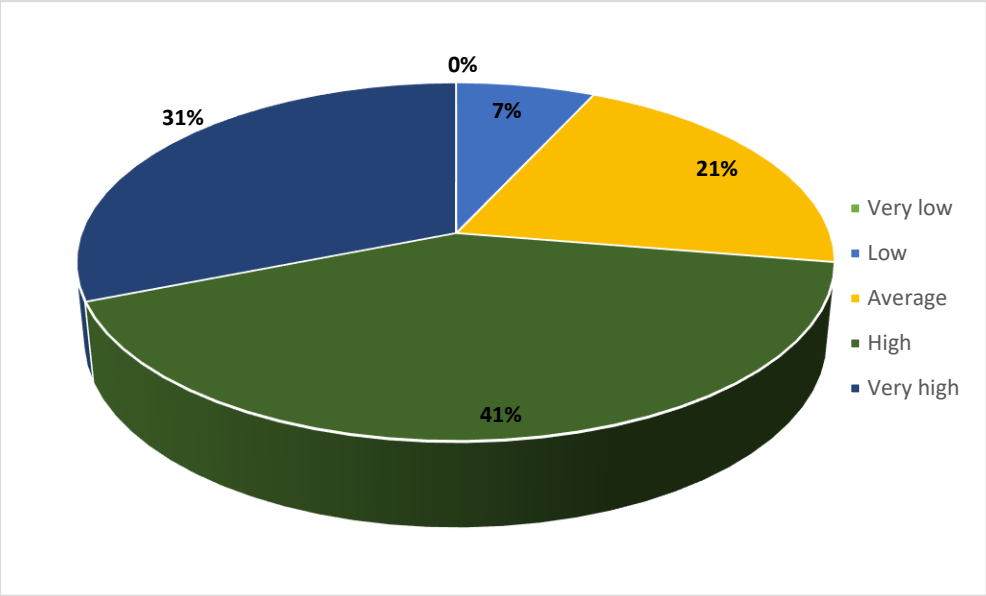

Figure 11: importance of ability to select the most appropriate type of wood/wood building product according to construction project requirements (%)

3.2.3.7 Cross-laminated timber (CLT)

The statement "to what extent do construction workers need to work with cross-laminated timber (CLT) and apply modern CLT technology for large-scale design" aimed to determine the role and importance of CLT in the wood construction of energy efficient buildings. In particular 56% of the total number of respondents considered this statement to be of very high or high importance (19% and 37% respectively). Just over 11% on the other hand, do not consider it to be of noteworthy significance.

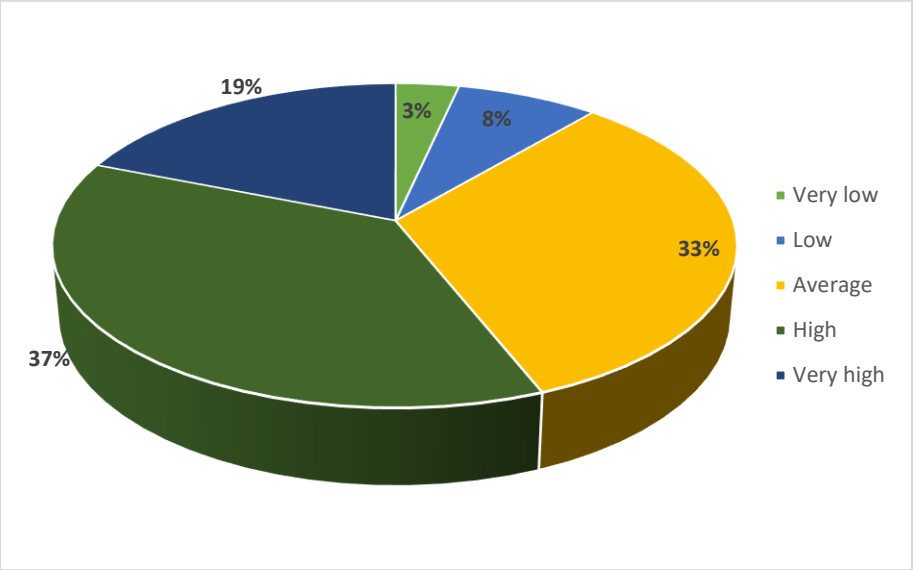

Figure 12: importance of familiarity with cross-laminated timber (CLT) and apply modern CLT technology for large-scale design (%)

The results confirm the increasing role that the use of CLT has developed within the wood construction industry according to recent trends. In this case as shown in table 10, the geographical distribution indicates that the countries with a more advanced wood construction sector and greater expertise for large-scale buildings such as Austria and Finland, consider the use of CLT of greater importance.

Table 10: importance of familiarity with CLT and related technology for large-scale design

Country	Very Low	Low	Average	High	Very High	Total
Austria	2	1	7	12	7	**29**
Latvia	1	1	13	8	3	**26**
Spain	1	5	7	8	2	**23**
Finland	0	2	9	9	7	**27**
Greece	0	0	2	5	3	**10**
Other	0	0	0	1	0	**1**
TOTAL	**4**	**9**	**38**	**43**	**22**	**116**

3.2.3.8 Select the appropriate wooden structure

Regarding the statement "to what extent is it important to know about different wooden structures" 70% of the total respondents, considered the ability to identify and select the appropriate structure for a specific project (e.g. solid wood construction vs. lightweight /timber frame as a vital skill.

More specifically, 46% stated it was of high importance and 24% of very high importance for construction workers. Only a small proportion of 8% replied that it was of relatively low importance skill to acquire for the workplace.

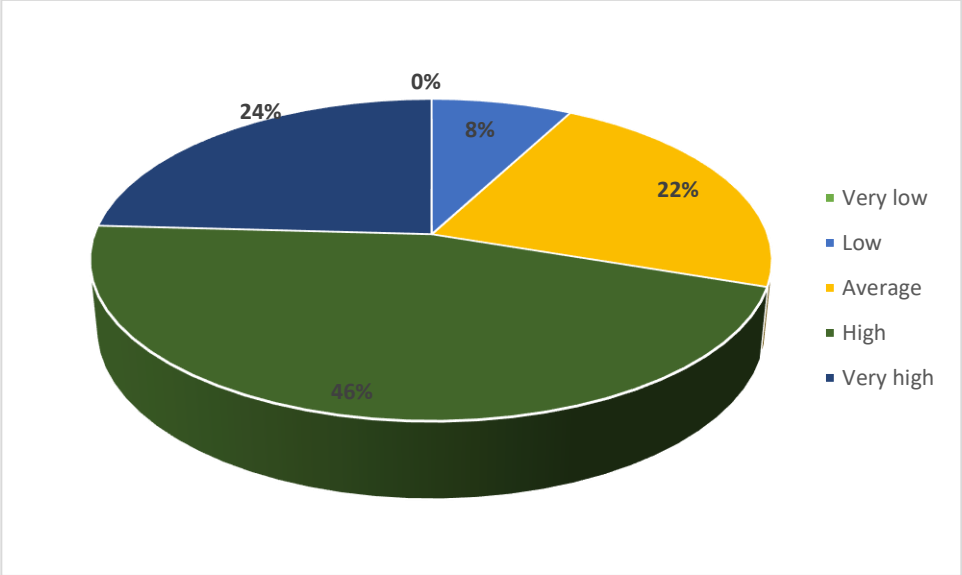

Figure 13: importance of familiarity with the different wooden structures (%)

3.2.3.9 Prefabricated wooden building elements

Analysing the responses to the statement "*to what extent do construction workers need to know about the use of prefabricated wooden building elements*", 50% of the respondents considered the ability to work with such structures of high importance, while 24% of very high importance. On the other hand 17% considered it of average importance and the remaining 9% of low significance. These results further support the conception that modern wood construction now in a dynamic phase of development is characterised by the use of

prefabricated elements.[1] Table 11 illustrates the geographical distribution of responses per partner country for each category.

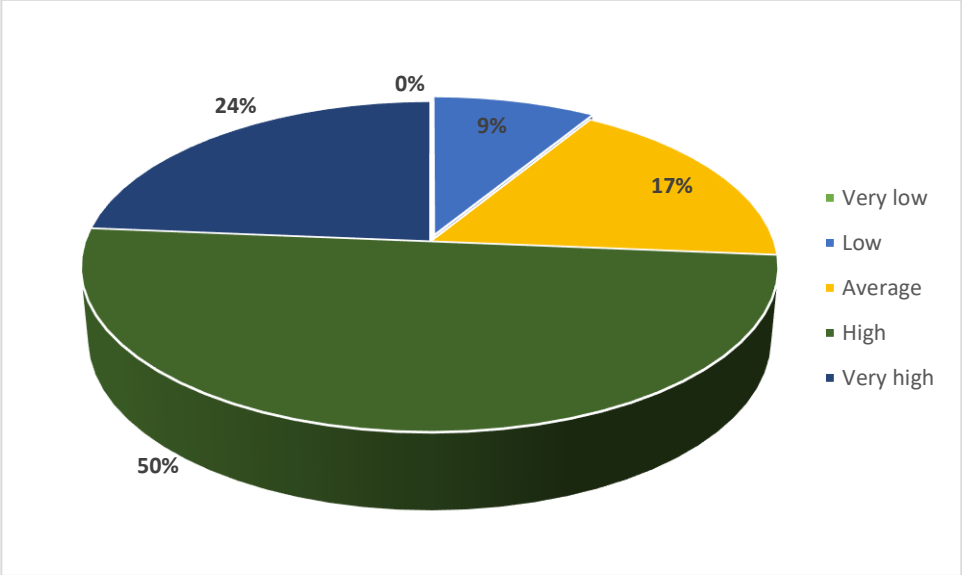

Figure 14: importance of familiarity with the use of prefabricated wooden building elements (%)

Table 11: importance of familiarity with the use of prefabricated wooden building elements

Country	Very Low	Low	Average	High	Very High	Total
Austria	1	2	6	12	8	**29**
Latvia	0	1	6	13	6	**26**
Spain	1	5	2	10	5	**23**
Finland	0	1	5	14	7	**27**
Greece	0	1	1	7	1	**10**
Other	0	0	0	1	0	**1**
TOTAL	**2**	**10**	**20**	**57**	**27**	**116**

[1] Swedish wood, 2020

3.2.3.10 Digital woodworking tools & methods

The use of digital woodworking tools and techniques is a relatively new concept and consequently a challenge for many workers who might have not be trained on how to apply them in the workplace. The importance of developing the necessary skills in order to be able to use them efficiently and effectively is of growing importance. However, when examining this statement the majority of respondents seemed to have varied responses of the importance of being familiar with digital woodworking methods and tools. More specifically, a total of 38% determined the statement to be of average importance, 40% of very high or high importance and 22% of low significance.

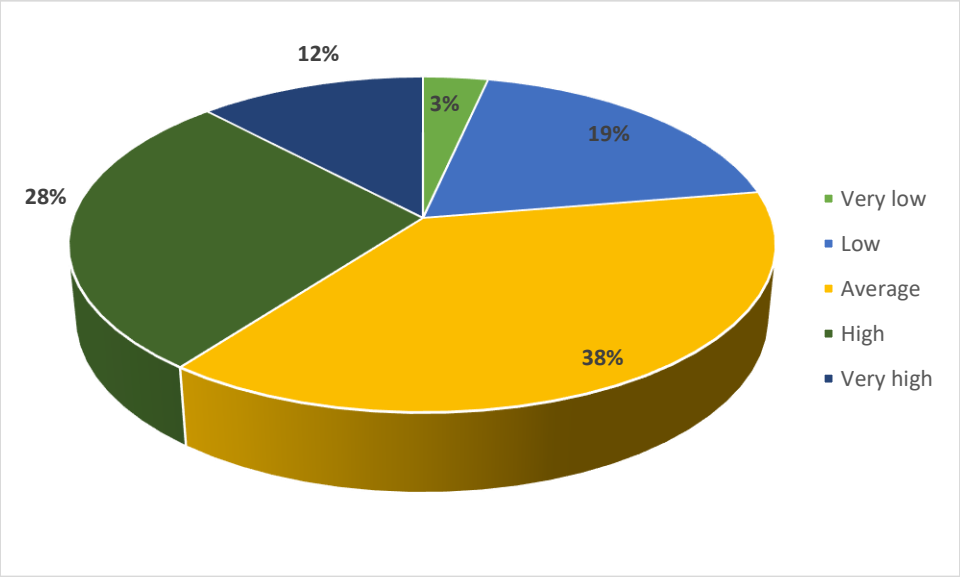

Figure 15: importance of familiarity with the use of digital woodworking methods & tools

3.2.3.11 Renovation, extension & deconstruction

When comparing the responses to the statement "to what extent do construction workers need to know the applications of wood for energy-efficient renovation/extension/deconstruction", the majority of respondents considered it to be of significant importance. In particular, 52% of respondents considered it to be of very high or high importance, 28% rated it as average and only 3% stated it was of very low importance.

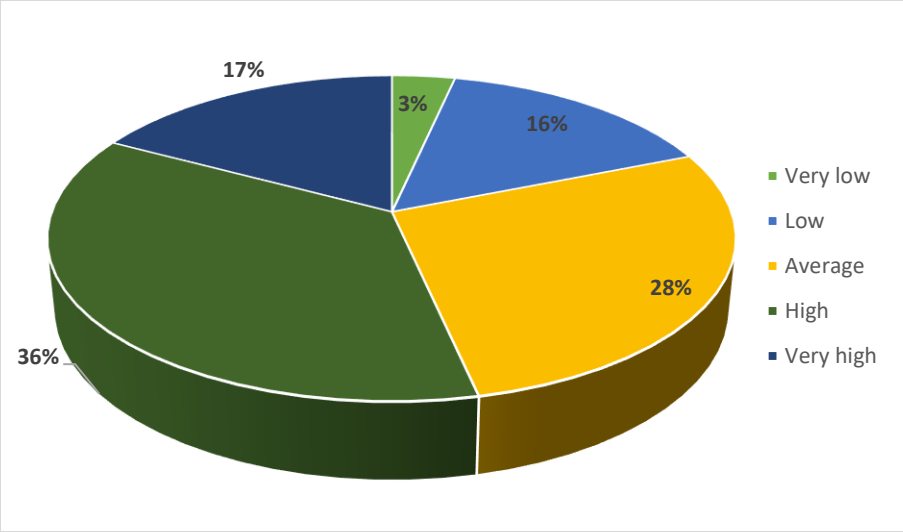

Figure 16: importance of familiarity with the applications of wood for energy-efficient renovation/extension/deconstruction

3.2.3.12 EU and national construction regulations & legislation

Another aspect that is interesting to consider when examining the skills required for construction workers working with energy efficient wood methods and applications, is their knowledge of the European as well as the national construction legislations and frameworks, given that it effects their working reality. Overall the vast majority of employees in this sector are not well informed on related issues in the European Union. Likewise, the majority of the respondents (35%), considered the question "to what extent do construction workers need to be familiar with EU & national construction regulations & legislation" of moderate importance, while 32% considered it to be of high importance and only 7% considered it to be of very high importance.

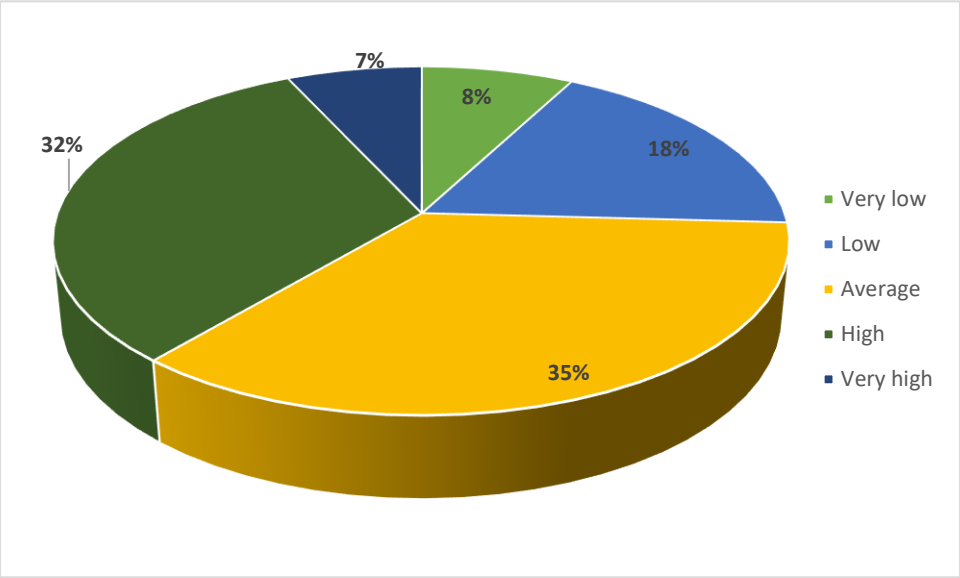

Figure 17: importance of familiarity with EU & national construction regulations & legislation

3.2.3.13 National fire safety regulations

According to the respondents, the concept of fire safety regulations proved to be of great concern for construction workers. 16% of the total respondents rated it as very high importance, while more than 40% considered it of consideration importance and rated it as high. Nevertheless, approximately 25% of the total respondents considered this statement of average importance. Moreover, understanding the effects of wooden surfaces as a heat stabilise was overall considered as important among the survey respondents.

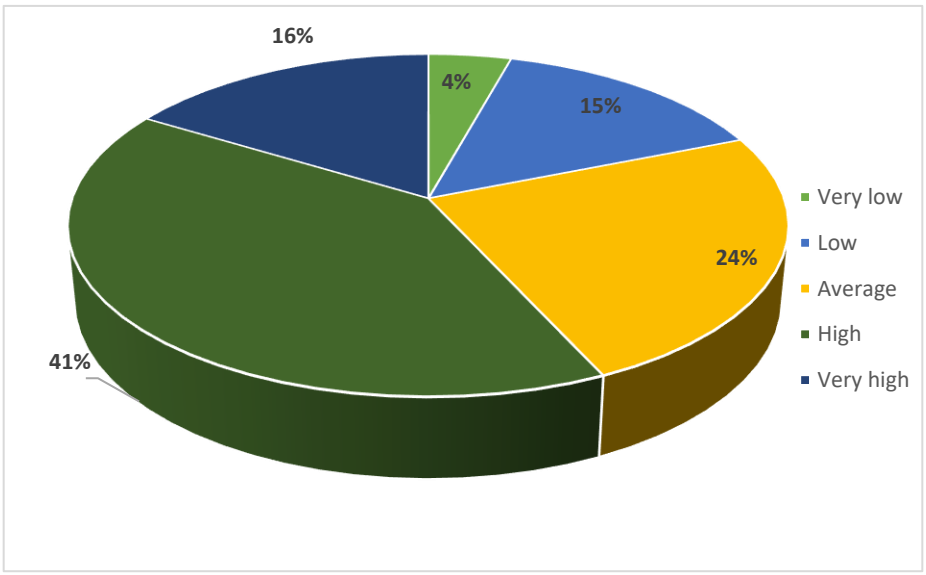

Figure 18: importance with familiarity with national fire safety regulations & restrictions/ communicate the effects of wooden surfaces as a heat stabilizer (%)

3.3 Main findings

According to the respondents, the five most important concepts that construction workers needed to be knowledgeable in & be familiar with when constructing with wood are the following in decreasing order of importance:

- behavior and effects of weather conditions on different types of wood such as moisture, rain, UV radiation (80%),
- limitations of wood, such as shrinkage and swelling, biotic degradation (78%),
- use of prefabricated wooden building elements (74%)
- selection of the most appropriate type of wood or wood building product according to construction project requirements (72%)
- different wooden structures (solid wood construction vs. lightweight/timber frame construction) (70%)

The statements that respondents considered as the least important knowledge and skills for construction workers in decreasing order of importance were the following a. the applications of wood for energy-efficient renovation/extension/ deconstruction (53%), b. different wooden structures such as solid wood construction vs. lightweight /timber frame construction (40%) and c. familiarity with EU & national construction regulations & legislation such as the Construction Products' Directive (39%).

Furthermore, when asked about the future trends of the industry the majority of respondents from all the partnership countries shared the view that wood construction will follow a high growth rate, particularly as far CLT multi-storey buildings are concerned. Greatly due its durability as a building material, environmentally friendly properties, high energy efficiency value and relative availability, wood construction seems to be the answer to the changing trends resulting from the fast-paced emergence of new markets (e.g. green buildings) and stringent policy measures. It was also suggested that digitalization in site practices including BIM and its´ various applications (AR/VR), robotics and work management will be in high demand in the coming years. Finally, a possible factor limiting the development of wood construction in future trends, according to the respondents seemed to be the high cost of the base materials.

4. SEMI-STRUCTURED INTERVIEWS

4.1 Principles and scope

Semi-structured interviews were conducted as an optional and complementary research method to get additional in-depth views and opinions on the skillset required on current and future workplace requirements on energy efficient of wood and woodworking methods for construction workers. The rationale is that interviews can help to collect in-depth qualitative information, providing increased flexibility and allowing for more detailed answers from respondents. The information was the documented using the template form provided in ANNEX D of the methodology report (O1-T1).

The target population for the interviewees was the same as for the online questionnaire:

i. Construction industry executives
   - Head of training departments or workplace trainers
   - Mentors of construction workers
   - Team-leaders – Senior (experienced) employees

ii. VET and WBL providers
   - Providers of training of construction apprenticeships/training programmes specialising in wood construction
   - Designers/coordinators of apprenticeship programmes and work-based learning in the construction sector
   - Providers of training programmes in the construction sector
   - Providers of apprenticeships and work-based learning in related sectors

iii. Field experts
   - Experienced in wood construction
   - Specialising in WBL
   - Specialising in the construction industry (knowledgeable in woodworking methods and applications)

iv. Other construction sectors employees
   - Architects
   - Carpenters

- Electricians
- Mechanical Engineers
- Wood machinists/technicians
- Roof tilers
- Painters

v. Other construction sector agencies and organisations, academics, researchers, as well as professional associations at the national and European level.

4.2 Main findings & conclusions

Given their expertise and wide networks, HCS and LVT collectively conducted a total of 15 interviews with national and regional stakeholders amongst which representatives from associations, research institutes, companies, WBL and VET providers from various sectors of the construction industry.

Specifically, interviewees included managing directors, lecturers, researchers, electrical engineers, construction engineers, production managers as well as construction workers such as roofers, plumbers, painter and electricians. Interviewers could indicatively follow the structure suggestion in the template form (ANNEX D of the methodology) or follow a different approach. The main findings were documented in the respective form.

When comparing the skill supply of the workforce and the training requirements in Austria and Latvia the situation seems to be different. Austria is a supplier of wooden construction components, and likewise the workforce seems to have easier access to specialised training courses and therefore be comparatively better prepared for the workplace.

On the other hand, the majority of Latvian wood elements manufacturers and construction organizations deliver their production and service to foreign customers (export), because construction with wood is not being lobbied well enough on national level. Lack of efficient marketing methods in Latvia the specific factor can be constructions habits and traditions of post-Soviet territory both of consumers and manufacturers, which anticipates building with concrete and bricks.

Still a common ground does seem to exist. Overall, current education does not seem to provide required quality and workers with demanded skills, and particular gap is noticed in

practical training, well balance with specialized in-depth knowledge and skills and the demand for energy efficient wood working skills (methods and applications) does seem to outpace supply in the labour market.

When questioned about the factors hindering the use of wood in modern construction, leading to an overall limit to its use in buildings, respondents emphasized the following points of "building physics", suggesting that frequent deficiencies with the vapour barrier and the resulting condensation on wooden components, which leads to the destruction of the wooden structure and the need for renovation.

Furthermore, most components are prefabricated meaning that only a short time span for the assembly at the construction site is required and thus fast construction time at a timber construction site. The planning of their work steps is adapted to a slowly growing manageable solid construction. In this sense an important point is the coordination of the trades among each other (construction site coordination), as well as the resource planning of each individual trade. Frequent deficiencies in the organisation and coordination of the construction site are factors that significantly delay the construction process. Important topics for training include construction management/workplace organisation, building physics, fire protection as well as the field of prefabricated house construction. Further specialised training is required for the trades of plumbing, drywall construction and sealing. Additionally there seems to be a gap in training painter of how to handle wood as a basic building material. Training for painting with wood. Finally, the interaction between the building materials (material mix) should also be considered more closely, given that there are new technologies with foams and adhesives that are not yet in existing training schemes.

5. DESK RESEARCH

5.1 Desk research aims and scope

Desk research was carried out to collect information on existing relevant construction sector apprenticeships, as a means to identify current trends in skill supply as regards innovative and energy woodworking methods and applications. Thereby the purpose was to help define the current level of woodworking, carpentry and joining skills within the construction labour market.

According to the methodological guidelines, each partner was asked to examine and contribute with evidence on relevant apprenticeships in their own territory, while LVT additionally studied the presence of such apprenticeships on a European (EU-28) level. A summary of the number of apprenticeships documents versus the required number is presented in Table 12.

Table 12: *No. of desk research results* vs. KPI per partner country

Partner	Country	KPI	Obtained
HCS	**Austria**	5 apprenticeships	32 apprenticeships
LVT	**Latvia**	5 apprenticeships from own country and 10 from EU-28	7 apprenticeships from own country and 11 from EU-28
UPV	**Spain**	5 apprenticeships	7 apprenticeships
WOODPOLIS	**Finland**	5 apprenticeships	15 apprenticeships
EXELIA	**Greece**	5 apprenticeships	7 apprenticeships
TOTAL	**UPWOOD Partnership**	**35 apprenticeships**	**79 apprenticeships**

5.2 Main findings

Looking at the existing I-VET and C-VET apprenticeships from the conducted research, it can be concluded that the central European and Nordic countries (Finland, Sweden Germany, Ireland and France) are currently more advanced in their training offerings as regards wood construction methods and applications.

A significant proportion of the available training constitute a limited part of a postgraduate degree or diploma. Consequently, not enough depth is given to the addressed topics and limited focus is given to the increasingly fast-changing trends and needs of the particular industry.

Additionally, it is important to note, that the majority of the courses are addressed to highly qualified experts (e.g. architects and engineers), that may not always be appropriate for a construction worker to follow.

The list below summarises the main topics identified across the training offerings:

- Properties of wood as a building material
- Design of CLT structures
- Advanced CAD-CAM Systems
- 3D studio computer-controlled manufacturing methods (laser cutting, 3D printing and CNC machining of bio-based materials)
- Innovative products marketing
- Production, Operations Management
- Structure and organisation of employeer organisation
- Innovative Wood Construction Techniques
- Air tightness of buildings, sealing and durability
- Wooden roof structures
- Fire and safety when building with wood
- Considerations of Natural hazards
- Industrial surface treatment of planed timber
- Frames and beams, laminated and microlaminated timber - modern machining line works within a real building project
- Traditional joints, pin type and glued joints

The complete documentation of apprenticeships is found in Annex A of the present document.

6. DEFINITION OF LEARNING OUTCOMES

Aligned with the provisions of the project Application Form and the O1-T1 deliverable, the definition of the UPWOOD learning outcomes is based on the European Qualification Framework (EQF) [1], as the latter acts as a translation device to make national qualifications more readable and comparable across Europe, aiming to promote workers' and learners' mobility between countries and facilitate their lifelong learning. The EQF relates different countries' national qualifications systems and frameworks together around a common European reference – its eight reference levels based on **"learning outcomes"** (defined in terms of knowledge, skills and competences). Learning outcomes do not describe the learning target or the learning path, but the result following the completion of a learning process.

According to the 2017 CEDEFOP handbook *Defining, writing and applying learning outcomes* [2], learning outcomes are "statements of what a learner knows, understands and is able to do on completion of a learning process, which are defined in terms of knowledge, skills and competences". We recall their definition, as mentioned in the O1-T1 deliverable:

- **Knowledge**: The outcome of the assimilation of information through learning. Knowledge is the body of facts, principles, theories and practices related to a field of work or study. According to the EQF, knowledge is described as theoretical and/or factual.
- **Skill**: The ability to apply knowledge and use know-how to complete tasks and solve problems. According to the EQF, skills are described as cognitive (involving the use of logical, intuitive and creative thinking) and practical skills (involving manual dexterity and the use of methods, material tools and instruments).
- **Competence:** The proven ability to use knowledge, skills and attitudes, in work in study situations and in professional and personal development. According to the EQF, competence is described in terms of responsibility and autonomy.

While learning outcomes promote overall transparency and help to clarify the intentions of learning processes, the CEDEFOP handbook [2] also points out some criticism to the learning outcomes approach. Among other imperfections, "it can be argued that learning outcomes can inhibit the learning process, for example when indicating (too) restricted a threshold level. Too much specificity and detail, it is argued, also makes it difficult to give room for innovation and exploit the unexpected present in any situation" ([2], page 39). Indeed, the learning outcomes approach is seen, by some constructivist schools of thought, as 'policy hype' and as a threat to high quality education, training and innovation. To try to improve these flaws,

([2] page 40) stress the importance of aligning learning outcomes statements to teaching and learning practices as well as to assessment tasks. Aligning learning outcomes to teaching and learning is about connecting the abstract idea of a learning outcome to what teachers actually do to help students learn, and the things that students do to learn.

In fact, learning-outcomes-based approaches have different origins and have been promoted by different schools of thought. While the behaviouristic tradition emphasises learning outcomes as result-oriented, full-ended, clearly observable and (objectively) measurable, the constructivist approach will emphasise the need for learning outcomes to be process-oriented and open-ended, limiting quantified measurability.

The CEDEFOP handbook [2] also emphasises *the writing and articulation of learning outcomes must be followed by implementation, through teaching, learning and assessment*. Learning outcomes statements form an important part of curricula. They guide teachers in the teaching process, for example supporting the choice of methods, and they inform learners about what they are expected to know/do and understand after a given learning activity.

The definitions and descriptions of learning outcomes as used in curricula are statements and expressions of intentions. They are not outcomes of learning, but desired targets. Achieved learning outcomes can only be identified following the learning process, through assessments and demonstration of achieved learning in real life, for example as the result of following the training.

6.1 Formulation of the UPWOOD learning outcomes

The research conducted in the above activities, to guarantee the collection of adequate evidence that will set the requirements and specifications for the development of UPWOOD learning outcomes. As a result of three types of research carried out by five country partners, the following work-based learning outcomes (LO) that should define the content of UPWOOD course.

Table 13: UPWOOD work-based learning outcomes

LO#	Description
LO1	Develop knowledge and understanding of the different types of wood and their properties
LO2	Give an account of the limitations that wood presents as a building material in a given situation
LO3	Understand the benefits of using wood in the active and passive design of a building in terms of energy efficiency
LO4	Evaluation of the climate influence in wooden buildings in order to reduce energy consumption
LO5	Autonomously select the most appropriate type of wood or wood building product (e.g. CLT) according to construction project requirements
LO6	Demonstrate the skills to work with prefabricated wooden building products
LO7	Autonomously select the appropriate wooden structure
LO8	Assess the use of wood in renovation, extension or deconstruction projects
LO9	Be able to organise/priortise tasks and collaborate with team members
LO10	Understand fire/sound protection and building physics in the construction process
LO11	Be able to integrate technical building components in timber construction

7. GUIDELINES ON HOW TO PREPARE CORRESPONDING LEARNING UNITS

The UPWOOD learning outcomes lay the ground for the formulation of UPWOOD learning units. The learning units should be specified in intellectual output 2, according to the project application form. As so, this section intends to provide guidelines on how to prepare the UPWOOD learning units. Table 14 presents a template and guidelines for the development of the UPWOOD apprenticeship programme and learning materials. A learning unit should include the following items: a title, the module of which the learning unit is part of, the list of topics of the learning unit content, prerequisites, learning materials, planned duration of the learning unit and references.

Training materials will be created and if suitable reused to support learning on the technical components and practical applications, such as lecture notes, slide presentations, case studies, FAQs, and audio-visual aids.

Assessment of learning outcomes means methods and processes used to establish the extent to which a learner has in fact attained particular knowledge, skills and competences. In order to determine whether the learner has acquired the proposed knowledge, skills and competences and to provide learners with the opportunity to evaluate the extent to which they have attained the desirable knowledge and skills, assessment materials for each learning unit will be developed.

Table 14: Template and example of specification of a learning unit

Learning unit title		
e.g. Knowledge of the qualities of wood & its various applications in construction		
Abstract		
EQF Level		
e.g. Level 4		
Learning Outcome X		
Knowledge <u>Knows/Aware of:</u>	**Skills** <u>Ability for:</u>	**Competences** <u>Ability to:</u>

Learning Outcome X		
Knowledge Knows/Aware of:	**Skills** Ability for:	**Competences** Ability to:
Topics / Content		
-		
Prerequisites / recommended background		
-		
Teaching and assessment materials/methods		
40 pages with lecture notes and theory 5-15 units of presentation slides Case studies: 15 FAQs: 20 -25 For this learning unit, situation case studies can be useful. The situation case requires an analysis of the information embodied in the case and asks students to delineate the significant relationships existing among the various items of information. The forum discussion is designed to develop an understanding of why things went wrong and how that could have been avoided. Assessment material: Multiple choice questions and quizzes, case studies and application scenarios analysis will comprise the bulk of assessment material. Multiple choice questions: 25-40 Case studies and application scenarios analysis: 1-2 All learning materials will be available in English and in the partnership languages (DE, ES, LV, FI, EL).		
Planned duration of the learning unit		
- Average duration for reading the lecture notes and slide presentations: 4h - Learner personal work: 10h		
References		

8. REFERENCES

[1] The European Qualifications Framework, https://ec.europa.eu/ploteus/search/site?f%5B0%5D=im_field_entity_type%3A97

and http://www.cedefop.europa.eu/en/events-and-projects/projects/european-qualifications-framework-eqf

[2] CEDEFOP (2017). Defining, writing and applying learning outcomes - A European handbook, Luxembourg: Publications Office of the European Union, http://www.cedefop.europa.eu/en/publications-and-resources/publications/4156

[3] The European e-Competence Framework (e-CF) - A common European framework for ICT Professionals in all industry sectors, http://www.ecompetences.eu/

9. ANNEX A: desk research on relevant construction sector apprenticeships

10. ANNEX B: COMPLETED INTERVIEW FORMS