Funded by the
Erasmus+ Programme
of the European Union

HybridTim

Design and Construction of Environmental High Performance Hybrid Engineered Timber Buildings (HybridTim)

Project number: KA203-2020-004

Project code: 2020-1-DK01-KA203-075045

COMPETENCY FRAMEWORK

Report

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2023

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INTRODUCTION

The HybridTim project is a three-year project that aims to fulfil the future demands in higher education of students in design and construction of high environmental performance hybrid engineered timber buildings by trans-disciplinary innovative student-centered learning approaches.

The specific objectives of the project are:

1) To develop and deliver new trans-disciplinary module on design and construction of engineered hybrid timber buildings, which meets the needs of the HEIs and labour market representatives.

2) To improve competencies of students and teachers in problem solving and team work, innovative thinking, motivation, awareness of cross-professional project input and project management by using project based learning, learning by doing and blended learning approaches.

3) To educate all participants (students, teachers, entrepreneurs) in the field of the engineered hybrid timber construction.

4) To ensure open awareness of the project results to local, national, EU level and international target groups.

The project is implemented by five higher education institutions from Denmark, Lithuania, Spain, Latvia and Austria, Study and Consulting Center and Spanish association Gremi Fusta i Moble.

The *Competency framework* helps to answer the question “what competencies of students have to be developed in the education of the design and construction of hybrid engineered timber buildings?”. The report consists of four chapters. In Chapter 1, the results of the survey of business companies from Denmark, Austria, Spain, Latvia, and Lithuania are summarized. Chapter 2 provides information on available education in timber design and construction at participating universities. Chapter 3 analyses available best practices and modules at the international level. In Chapter 4, the mapping of competencies across participating higher education institutions and in accordance to labour market needs is provided. The most important competencies to be developed in the new course are distinguished.

The Competency framework is dedicated to higher education institutions, in particular, teachers.

The content of this report is related to the HybridTim project and reflects only the author's view. The National Agency and the Commission are not responsible for any use that may be made of the information it contains.

1. SURVEY ON LABOR MARKET NEEDS

The aim of the survey was to determine what competencies of graduates are necessary in the timber construction industry.

1.1. Survey participants

In total 133 business companies participated in the survey.

The survey covered five countries: Austria (23%), Denmark (10%), Latvia (24%), Lithuania (23%), Spain (23%) and Germany (2%) (see Figure 1.1).

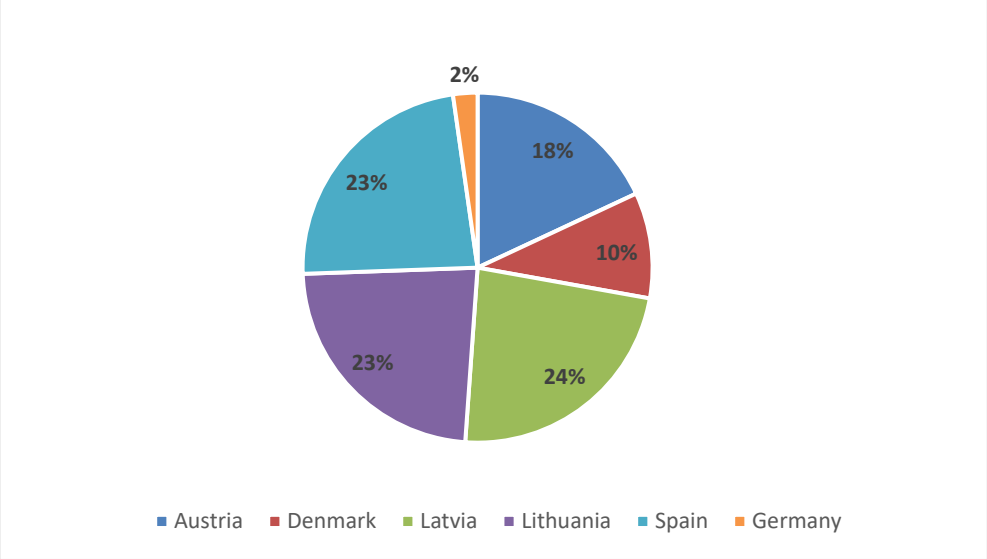

Figure 1.1. Survey participants by the country

Most of the respondents were from micro enterprises (39%) and small enterprises (39%). 13% of respondents were from large enterprises and 9% from medium (see Figure 1.2).

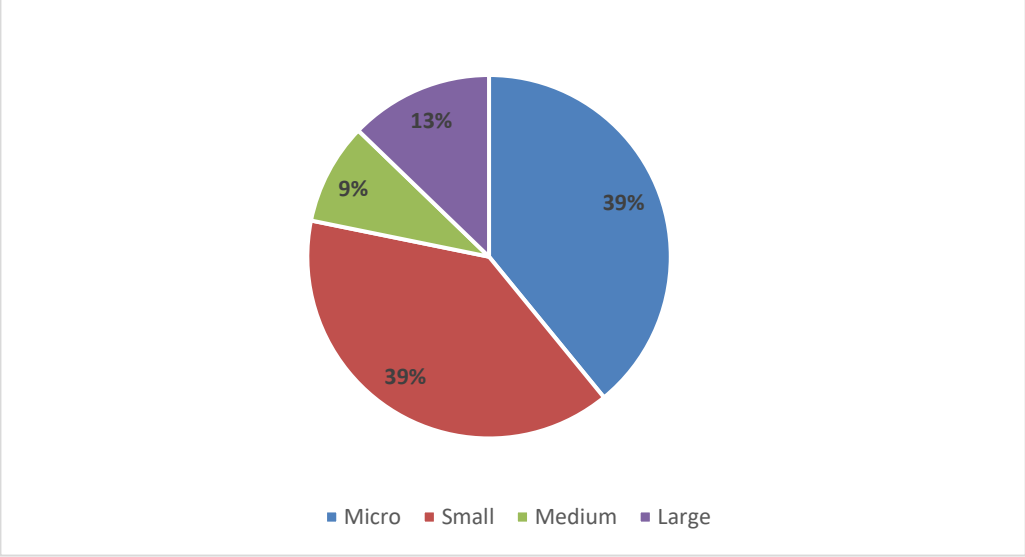

Figure 1.2. Survey participants by the company size

Most of the respondents were from limited liability companies (44%), joint stock companies (22%) and private enterprises (14%) (see Figure 1.3).

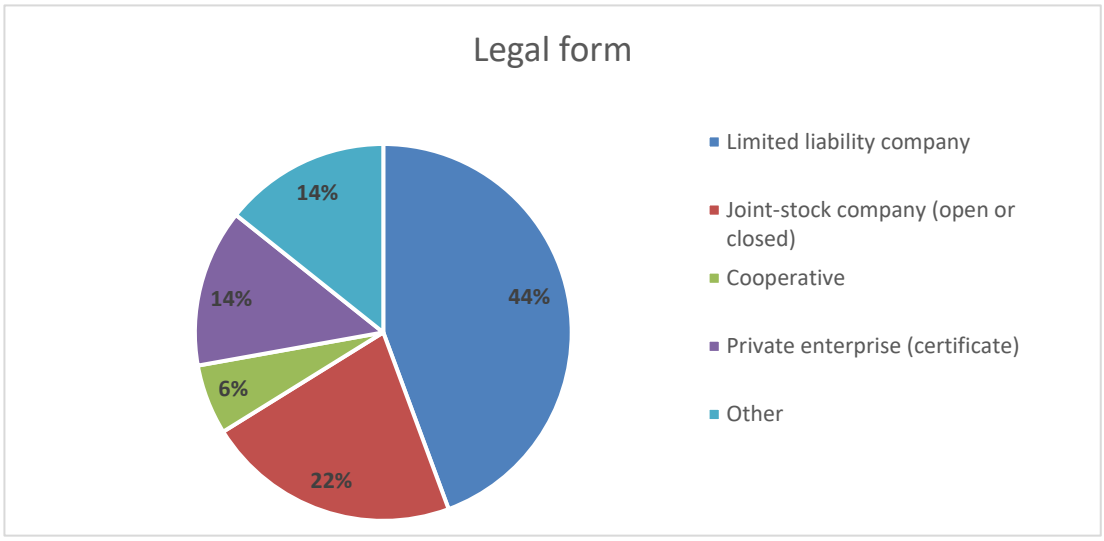

Figure 1.3. Survey participants by the company legal form

Major activities of the enterprises were construction/development (38 respondents) and architecture/design (37 respondents). Other activities also included Manufacturing of timber materials/products (28 respondents), floor and wall coverings (22 respondents), facility management (21 respondents), project management (18 respondents), consulting/training (13 respondents), and research (12 respondents). Some of the companies also market other activities.

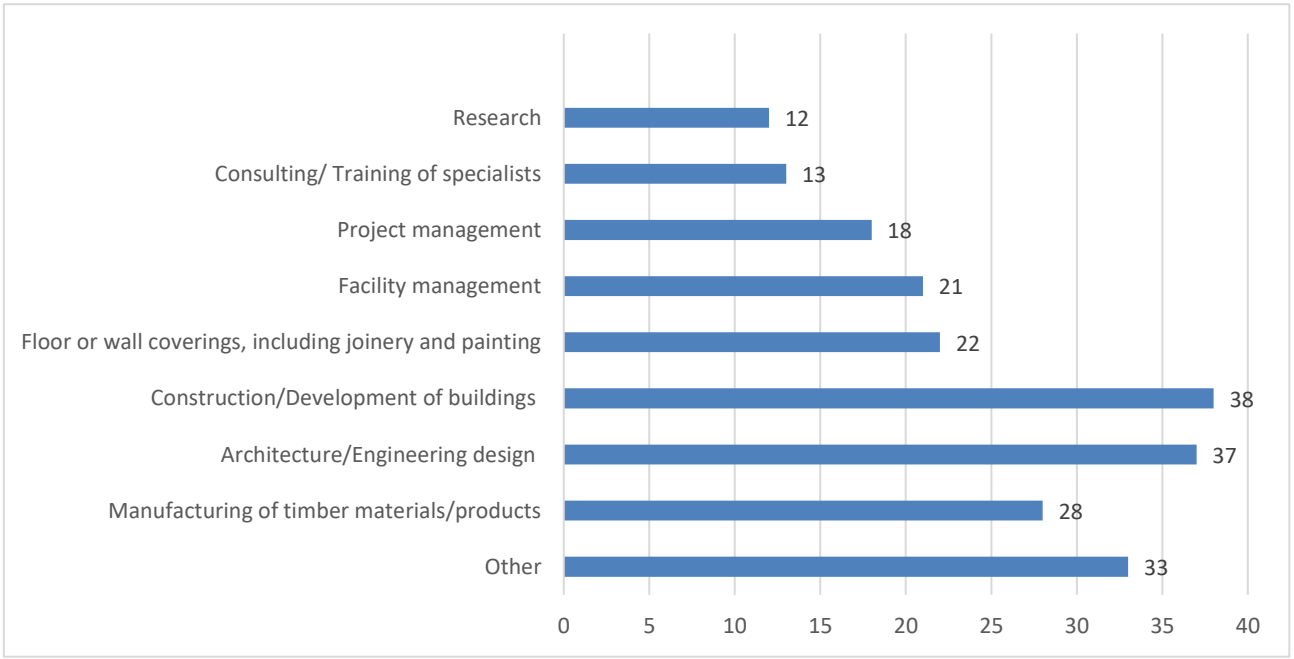

Figure 1.4. Activities of the companies

1.2. Training and skills

Companies were asked a question: “Thinking about skills over the last 12 months, which one of the following comes closest to the situation in your enterprise?”.

The situation in the enterprises over the last 12 months varied. 40% of enterprises had been operating at or near full capacity, 29% of enterprises for some time did not have enough skilled workers, while 16% did not have enough skilled workers for the work they had or could have had. Only 10% enterprises had not sufficient work. 5% of respondents were unsure about the situation (see Figure 1.5).

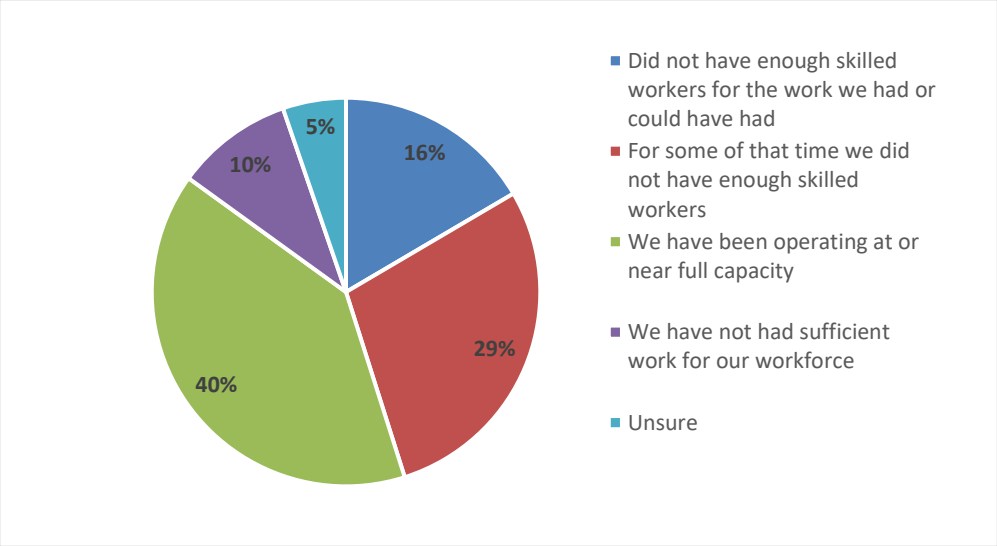

Figure 1.5. Situation in the companies over the last 12 months

The main cause of having hard-to-fill vacancies for skilled staff is that not enough young people being trained in the field of wooden construction in recent years (64 respondents, 48.1%), other important causes are that applicants lack of skills required by enterprises (50 respondents, 37.6%) or lack experience (39 respondents, 29.3%). Lack of motivation was mentioned by 39 respondents (29.3%) and lack of qualification – by 37 respondents (27.8%). Low number of applicants in general was mentioned by 26 respondents (19.5%) and 34 respondents (25.6%) also highlighted competition from other employees (see Figure 1.6).

Companies were asked which competencies and to what extent are required in the timber construction market (see Figure 1.7). It can be observed that, according to the companies, all listed competencies are required in the labour market. However, results show that some of the companies less require soft skills, such as leadership and negotiation. On the other hand, team working and problem solving skills are very required.

Figure 1.6. The main causes of having hard-to-fill vacancies for skilled staff

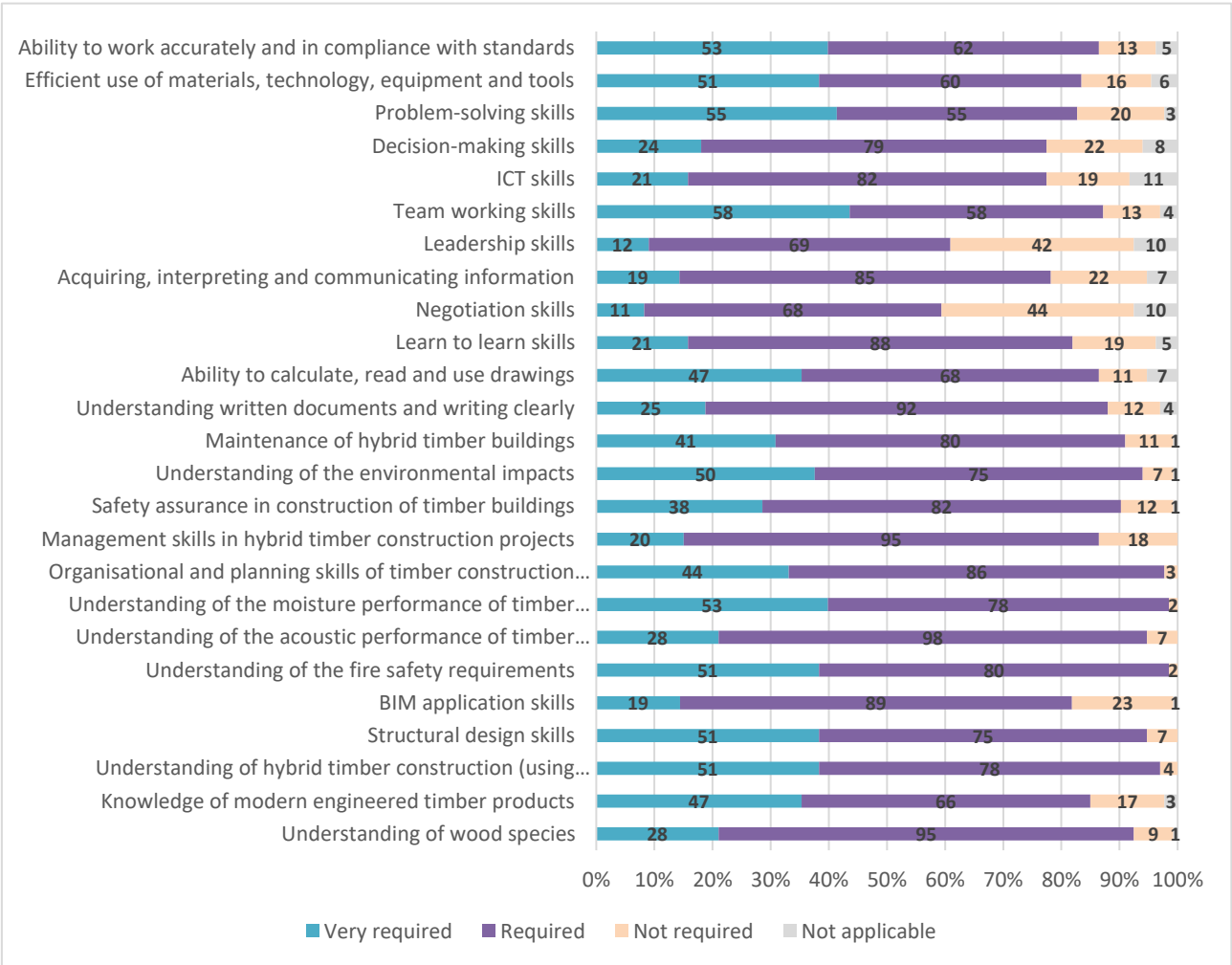

Figure 1.7. Required competencies

Most of the respondents think that they will need to acquire new skills or knowledge over the next 12 months. Main causes are new eco/energy saving design/build methods (100 respondents, 75%), the introduction of new technologies and equipment (96 respondents, 72%), environmental requirements (94 respondents, 71%), new legislative/regulatory requirements (90 respondents, 68%), the development of new products and services (75 respondents, 56%). Less important causes are increased competitive pressure (57 respondents, 43%), the introduction of new working practices (55 respondents, 41%) (see Figure 1.8).

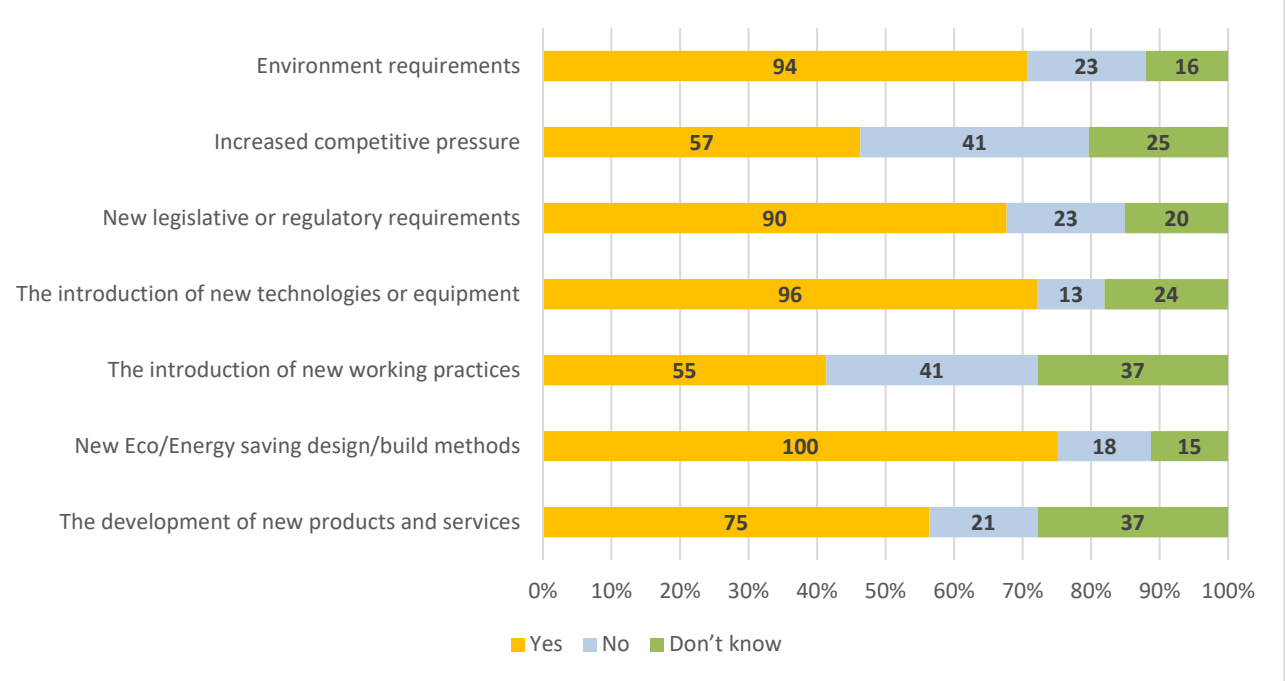

Figure 1.8. The main reasons that lead to the need to improve competencies

Respondents were asked how enterprises are overcoming skill gaps. Most of the enterprises are providing further training inside (62 respondents, 47%) or organizing external trainings (41 respondents, 31%). 36 respondents (27%) answered that influence has been used on (providers of) education in order to ensure the inflow of newcomers, 31 respondent (23%) indicated that their companies used other strategies. Some companies increased hiring (28 respondents, 21%) or changed work practices (7 respondents, 5%). 24 respondents (18%) answered that no measures have been taken (see Figure 1.9).

Companies also provided suggestions for improvement of education of the students. Answers can be summarized as follows:

- Students need more practical skills, obtained on sites;
- Use combined-education, so the education will be centered around 50% schooling and 50% experience from the real life. And don't divide these processes, but combine them;
- Specific modules;
- More interactive digital information and education platforms.

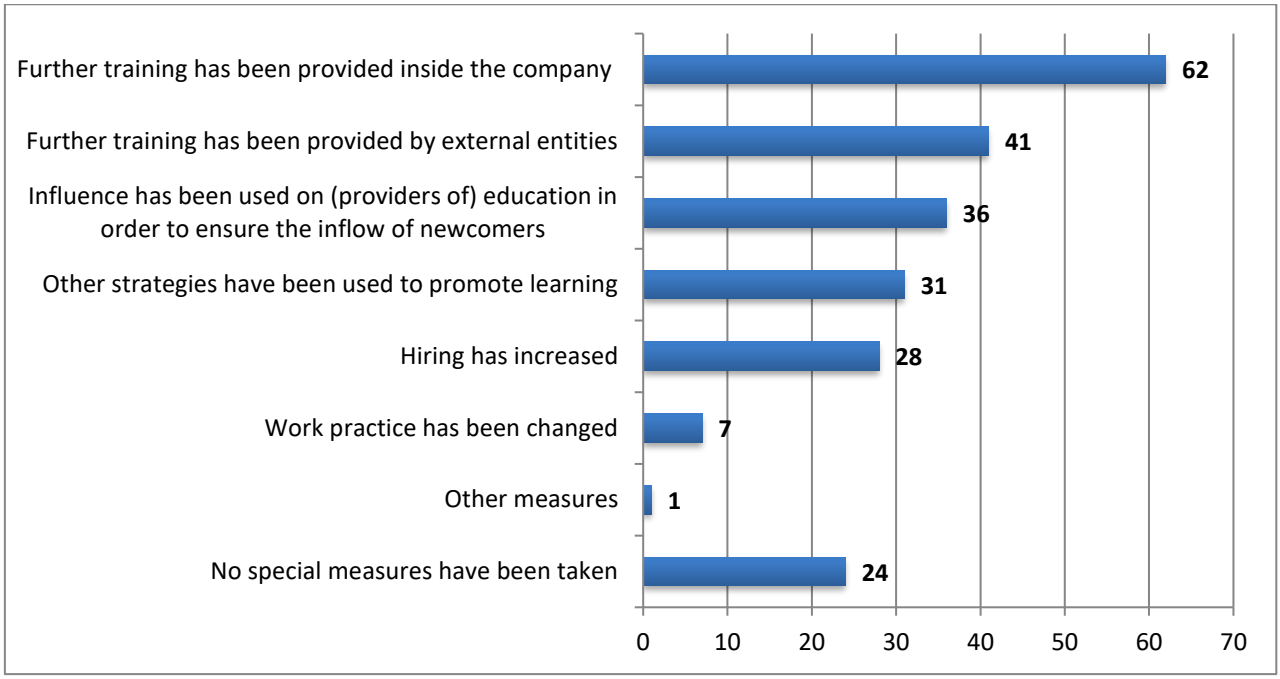

Figure 1.9. Measures for overcoming skill gaps

1.3. Perspectives of hybrid timber construction

Companies were asked to indicate the main barriers for hybrid timber construction development (see Figure 1.10).

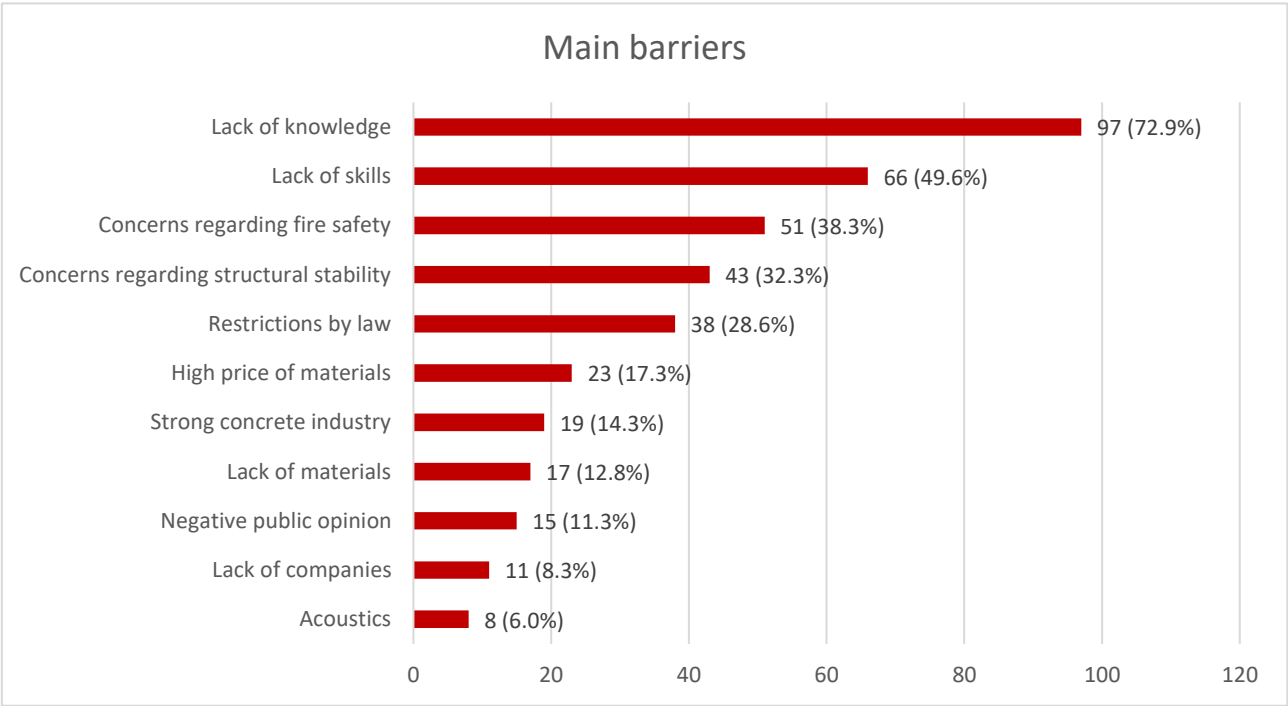

Figure 1.10. Main barriers for hybrid timber construction development

Major barriers for timber construction development distinguished by survey participants are lack of knowledge (97 respondents, 73%), lack of skills (66 respondents, 50%), concerns regarding fire safety (51 respondents, 38%), and concerns regarding structural stability (43 respondents, 32%). Other barriers are restrictions by law (38 respondents, 29%), high price of materials (23 respondents, 17%), competition with concrete industry (19 respondents, 14%), lack of materials (17 respondents, 13%). Less significant barriers are negative public opinion (15 respondents, 11%), lack of companies (11 respondents, 8%) and problems with acoustics (8 respondents, 6%).

Companies also were asked to indicate the main drivers for hybrid timber construction development (see Figure 1.11).

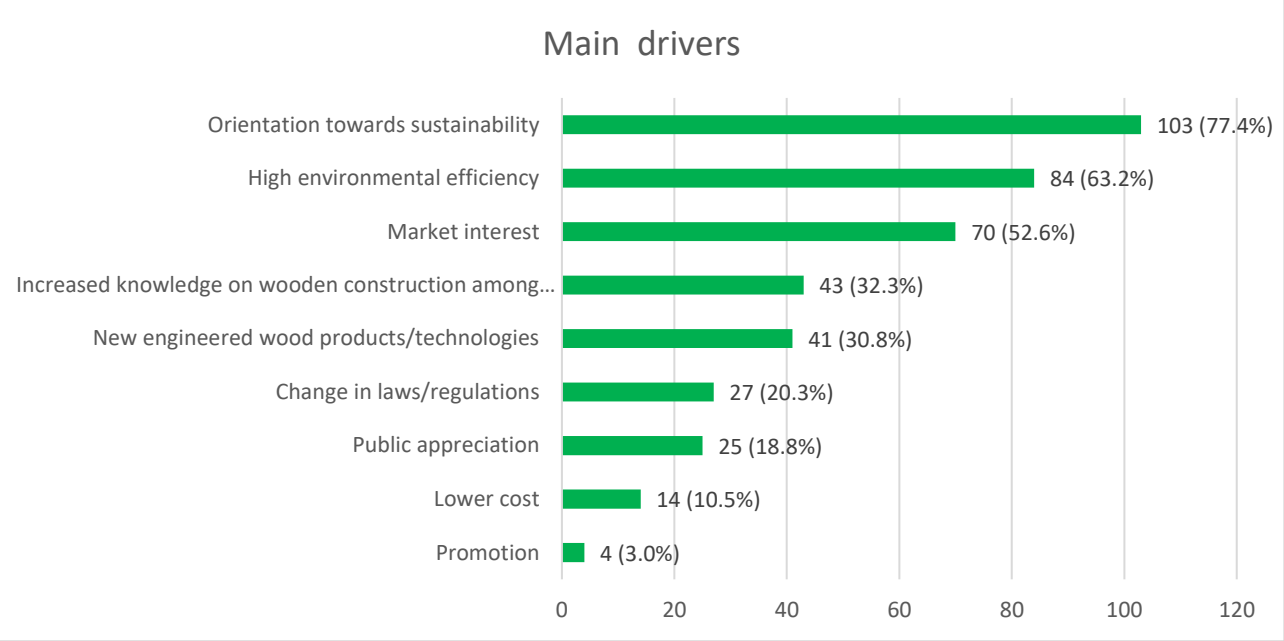

Figure 1.11. Main drivers for hybrid timber construction development

Three major drivers for hybrid timber construction development are orientation towards sustainable construction (103 respondents, 77%), high environmental efficiency (84 respondents, 63%), and increased market interest (70 respondents, 53%). Other significant divers are increase of knowledge on wooden construction by designers and technicians (43 respondents, 32%), new engineered wood products/technological solutions (41 respondents, 31%), change of laws/regulations (27 respondents, 20%), and public appreciation (25 respondents, 19%).

Respondents were asked an open question “What could encourage more extensive building in timber?”. In summary the following aspects could encourage more extensive development of timber construction:

- Education & Research;
- Environmental requirements in legislation;
- More favorable financing;
- Sustainable building culture;
- Marketing/promotional campaigns.

2. ANALYSIS OF AVAILABLE EDUCATION

2.1. Denmark

2.1.1. VIA University College

Ten years ago, VIA was born through the merger of a number of higher education institutions in the Central Denmark Region. During those 10 years, VIA has developed into a respected educational institution in Denmark and internationally.

Today, we are a visible and attractive partner for the professions for which we educate our graduates. The history of the past 10 years is our foundation for the next strategy period, in which we hope to make an even more profound difference to the world around us. VIA's strategy for 2015–2017 proved to be a good framework that made sense to employees and students and evoked commitment and initiative across VIA.

There is an expressed desire to maintain that good pace. Therefore, we have chosen not to develop a completely new strategy for the coming years (2018-2020). Instead, VIA's strategy 2015-17 "Co-creating better societies" has been updated, so we can focus our efforts on creating even better results. The strategy 2018-20 is written based on input from hundreds of employees, students and partners. From the executive and management boards, the ambition is to articulate the significant challenges faced by VIA and society. Together, VIA's students, staff and partners will investigate and develop the solutions, which these challenges call for technology can only be released if it is wielded from a base of profound academic, practical and human insight.

Co-creating better Societies

In 2015, we identified a new strategic direction for VIA, turning our focus outwards. In the past years, we have had great and positive impact on society. However, the need for professions'-oriented education – a signature of the universities of applied sciences – remains great. Therefore, VIA's strategy stays on course. As an educational institution of higher learning, VIA bears the responsibility to actively engage in the development of technology by educating our students digitally and ethically. The digital transformation has created significant changes in society and paved the way for new solutions to societal challenges.

Education for the future

Today's labour market places new demands on our graduates and, thus, on VIA.

A high level of professionalism is the foundation for what we do. It is what makes our graduates able to contribute to innovation and to finding solutions to societal challenges. We encourage talent development as well as developing inclusive learning communities. VIA's programmes must provide knowledge as well as digital skills targeted the specific professions. We need to establish learning spaces that reflect the reality which our graduates encounter in a cross disciplinary labour market. Universal human skills also need renewed focus. In a technology-driven world, students need to develop relational skills to interact with patients, clients, customers and colleagues. This is more urgent today than ever before.

Strengthened partnership with private businesses

Over the coming years, we will strengthen and consolidate VIA as a sought-after partner for private businesses. However, we have to build cross-disciplinary bridges between educational Programmes,

which traditionally target either the public or the private sector in order to match the development of a merger between the two. All of VIA's students will receive instruction in entrepreneurship and innovation. We need to increase the use of contemporary cases in Teaching methods and further systematize our collaboration with businesses.

We need to develop more flexible educational programmes that target local labour needs, and we need to increase our focus on STEM skills (science, technology, engineering and mathematics) so as to contribute to the technology-driven innovation and growth nationally and globally.

A strong social commitment

As a knowledge and educational institution, we have a responsibility to contribute to democratic Development and the UN's 17 sustainable development goals. We must form and educate Responsible world citizens, who actively participate in democratic processes and leave their own marks on the world. We need to create frameworks that activate student engagement in both society and voluntary activities. VIA's international commitment is to contribute to the global provision of education, mobility, research collaboration and export of educational programmes and courses. Regionally, VIA has to work for balanced development and broad, geographic education coverage with flexible educational models. In the Central Denmark Region, campuses and student incubators must be put into play as visible drivers for regional growth. We need to enter into new partnership models that encourage local development.

Flexible and effective collaboration

Between now and 2020, we will continue to strengthen the drive, flexibility and efficiency of VIA. We need to keep our focus on our core task and spend significantly less time on documentation and bureaucracy. We will experiment with new organizational forms in order to create the best conditions for professional, interdisciplinary and strategic development. VIA's management and leaders must set the direction based on curiosity, trust, the delegation of responsibility and a strong culture of feedback. We need to increase our ability to prioritize projects and efforts that have the most impact. We have to reconsider our working methods, processes, roles and tasks in order to create the most possible value internally and externally.

VIA University College, located in the Central region of Denmark, educates future engineers, designers, teachers, education specialists, nurses among others. The university offers more than 11 departments and 40 degree programmes at eight campuses across the region. At each of the campuses, there is a student council or social community responsible for improving the quality of student's life and study environment. A variety of social activities and events are available on campus along with professional courses. Through research and development, VIA makes sure that its programmes are based on the latest knowledge. In addition, the university helps develop the society for which it educates students. VIA cooperates closely with public and private companies and help develop industries and societal solutions.

Table 2.1. Facts and figures

Number of students	18600 students – all educations
Number of international students	2800–3000
Number of graduates/alumni	Around 70% - every year we have more than 20000 students who are applying
Number of academic staffs	2.143 (All not only academic)
Number of faculties (please list faculties)	4 faculties and schools: Faculty of Education & Social Sciences Faculty of Health Sciences Faculty of Continuing Education, and School of Business Technology & Creative Industries
Number of Bachelor degrees offered	42 different professional bachelor programs.
Number of Master degrees offered	0
Number of PhD degrees offered	0
Number of business partners	VIA University Colleges have many thousands business partners. ATCM several hundred every year
Number of international partners	VIA has more than 500 international education partners.
Study programmes related to HybridTim project	Architectural Technology & Construction Management Civil Engineering Global Business Engineering Mechanical Engineering Supply Engineering Value Chain Management International Sales and Marketing Management
Number of international partners	VIA has more than 500 international education partners.

The renowned institution stands for excellent education in the fields of Business, Design, Education and Social Studies, Film and Animation, Health, and Technology and Construction. Prospective students can choose to study at Undergraduate and Postgraduate level. VIA means “by way of” in Latin and that’s how VIA University College see itself- as a station on life’s journey, which helps students learn and grow before becoming highly qualified industry professionals, eager to make a difference in the world. Even though the programmes are interactive and dynamic, some of the programmes’ (including teaching, nursing and social education) roots can be traced back to more than 100 years ago. The curriculum is strongly built on Danish traditions for teaching students in partnership with professional practice. The school is very multicultural, and thus offers an international learning environment that takes on a global approach to education and research. About 50% of the programmes are therefore taught in English and the school is also able to offer international double degrees, as well as student and staff exchange, summer schools and research projects. Since its official status as a research institution in 2013, the Danish university college has been education tomorrow’s leaders, with the goal of having 30 per cent of PhD employees by 2020. Students get to gain valuable experience with research, innovation and development during the duration of their studies. The school is particularly proud of being able to work with public and private organisations in Denmark and abroad, thus enabling its students to network.

Campus Aarhus

VIA University College has its headquarters in Aarhus, where it also operates two newly built campuses. The largest is VIA Campus Aarhus C, which is built in the new residential area

called CeresByen in central Aarhus. Campus Aarhus C houses mainly educations from the department of Education and Social studies, but also includes assorted business, media, design and architectural and constructional vocational programmes. The smaller campus, Campus Aarhus N, is located in the northern neighbourhood of Skejby, close to the Aarhus University Hospital, and houses educations from the Department of health such as nursing and nutritional educations.

Campus Horsens

Campus Horsens holds most of the engineering, technical and business programmes of VIA University College, but soon Danish programmes in nursing and in pedagogy will also be present here to the professional multiplicity.

The increasing campus population is now around 4,000 students – of whom approx. half are international students from more than 40 different countries.

The new student housing placed directly on Campus contributes to the pulse here, as does the Student Bar, social activities and group work after classes.

Above Campus Horsens towers the newly built 8,000 m2 Vitus Bering Innovation Park, named after the famous Horsens resident and Arctic explorer Vitus Bering (1681 - 1741). The VBI Park also plays an important role in the interaction between the programmes and the companies that employ the students after graduation. Another facilitator of contact between students and companies is the Career Service Centre, also based on Campus.

A new and improved campus is currently under construction in front of the train station in Horsens. It is expected to be inaugurated in 2021.

Campus Randers

In Randers VIA University College offers nursing, social education and as one out two university colleges in Denmark, VIA also offers psychomotor therapy.[13] The campus is situated in the middle of Randers in a new three story building, which houses the aforementioned educations as well as COK educations.[14] The latter is not offered by VIA, but by a third party. Furthermore, from 2017 VIA also offers FIF-courses in Randers, which is a preparation course for refugees and immigrants.[15] From 2017 the social education department offers a six-month 30 ECTS course in the Early Childhood-field. In early 2018 it has been decided that a part of the teacher training in Aarhus relocates to Randers from 2018. The teacher training programme is part of the qualification teacher training programme in Aarhus.[17] Approximately 800 students attend the educations housed at campus Randers.[18] In addition to the aforementioned educations, campus Randers also offers counselling in entrepreneurship as part of VIA's growth initiatives and in collaboration with the municipality of Randers as well as Business Academy Dania.

VækstVærket (growth forum)

VækstVærket is located on campus Randers, but has its own facilities[20] as well as budget. VIA and Dania each have a coordinator, which coordinates activities such as courses, teaching etc.

Furthermore, VækstVærket also offers students excursions to various startup villages as well as highly successful cultural get-togethers with students from different countries. In Students from VIA

and Dania can use VækstVærket for study purposes as well as work on growth projects. In addition they also have the option of receiving council from a professional consultant. Finally VækstVærket also offers various courses in entrepreneurship and a chance to partake in projects about entrepreneurship.

Campus Viborg

VIA campus Viborg houses, among other departments, The Animation Workshop, which is considered one of the top animation schools in the world. TAW offers BA educations in Character Animation, Computer Graphic Arts and, since 2013, Graphic Storytelling. Apart from its education activities, TAW hosts the Viborg Animation Festival, the largest animation festival in Denmark.

Rankings

VIA University Colleges are ranked as number 10 in DK – World ranked number 5633 (see Figure 2.1).

Denmark

ranking	World Rank	University	Det.	Impact Rank*	Openness Rank*	Excellence Rank*
1	70	University of Copenhagen / Københavns Universitet	»	165	74	38
2	110	Aarhus University / Aarhus Universitet	»	248	126	81
3	158	Technical University of Denmark / Danmarks Tekniske Universitet	»	274	133	156
4	280	Aalborg University / Aalborg Universitet	»	453	348	232
5	324	University of Southern Denmark / Syddansk Universitet	»	610	308	287
6	796	Copenhagen Business School	»	1123	557	1030
7	1210	Roskilde University / Roskilde Universitet	»	1740	850	1709
8	1404	IT University of Copenhagen / IT-Universitetet i København	»	1642	1383	2037
9	3814	Metropolitan University College	»	6305	5140	3838
10	5633	VIA University College	»	3940	4925	6650
11	6611	University College Lillebælt	»	6780	5285	6650
12	7675	University College Nordjylland	»	8244	5651	6650
13	9801	Danmarks Medie- og Journalisthøjskole	»	6906	6494	6650
14	10806	KEA (BEC Design)	»	8266	6494	6650
15	11303	Aarhus School of Architecture / Arkitektskolen Aarhus	»	8893	6494	6650
16	11315	Kolding Design School / Designskolen Kolding	»	8903	6494	6650
17	11367	Syddansk Erhvervsakademi	»	8970	6494	6650
18	11578	Royal Danish Academy of Music / Det Kongelige Danske Musikkonservatorium	»	9261	6494	6650
19	11909	Center of Higher Education South Jutland	»	9686	6494	6650
20	11991	Royal Danish Academy of Fine Arts School of Visual Arts / Kongelige Danske Kunstakademi Billedkunstskolerne	»	9778	6494	6650

Figure 2.1. Rankings

VIA University College is one of Denmark's largest university college with 8 modern campuses in 7 different cities across the Central Denmark Region. VIA offers more than 40 study programmes in English in e.g. engineering, health, social education, construction, design, business and animation. We have around 18,500 students of which more than 2,800 are internationals.

Internationalisation

VIA offers more than 40 study programmes in English in, e.g., engineering, health, social education, construction, design, business and animation. We have around 18,500 students of which more than 2,800 are internationals.

In collaboration with reputable international partners, VIA offers both exchange, joint and double degrees, summer schools, master's programs and research and development activities. Most recently, we have signed agreements with California State University, Cornell University (New York), SAIT University (Calgary) Canada and Monterrey Bay (Mexico).

Common and double degrees

In collaboration with partners from countries such as China, Poland and Romania, we continuously develop common training courses and double degrees within several subjects. A joint education is a collaboration between education programs from two or more countries that trigger one common diploma, while a double degree triggers a diploma from each institution. The work on common and double degrees is in line with the government's action plan for internationalization in higher education. Learn more about the possibilities of taking a double or joint degree by contacting the relevant programs.

Study and internship

VIA works to get students to study and internship abroad. There are opportunities in most of the world, whether you are reading to an educator, a nurse, a building designer or something entirely fourth. VIA's education programs quality assure the individual offers on an ongoing basis. The possibilities for internships and study visits can be found on the websites of the programs or by contacting a student counsellor.

Summer Schools

Every summer we offer summer schools in English, usually with ECTS points. At summer schools, Danish and international students get new knowledge and inspiration in subjects such as design, health and technology.

Employee Mobility

An increasing number of VIA's employees go on teaching and training abroad. International experiences provide competencies, new knowledge and inspiration to teach and research. VIA's health and education programs have set up teams of teachers who are ready to travel - for example to train staff at nursing homes and kindergartens in Romania and China. VIA International assists with knowledge of financial opportunities in studying abroad, including Erasmus +.

Export of know-how

Higher education is increasingly faced with demands for internationalization. Both students and teachers must strengthen their international competencies, so that VIA and Denmark can do it in a global world. At the same time, Danish educational institutions are encouraged to generate income-covered business - i.e. Revenue that runs separately from the education economy and the taximeter

system. In VIA, we believe that exporting Danish education and know-how meets both requirements. Firstly, export activities generate earnings through the sale of training courses and consulting services. Firstly, the activities strengthen the linguistic, cultural and professional competencies of the employees and students. This strengthens the international competitiveness of our education. In recent years, VIA has experienced a large international demand for education and know-how in the areas of elderly care, energy, pedagogy and design. We have entered into a number of agreements on the sale of education and know-how, among other China and Romania. These agreements are based on our academic cooperation, as well as our partnerships with private companies, authorities and municipalities. In other words, we build our export activities on the strength that we as a university college have in close interaction with practice.

Construction, energy and environment

Denmark is known for its strong knowledge of sustainability, energy, construction and the environment. VIA's programs in the field find that international educational institutions, authorities and companies are seeking cooperation and know-how in these areas. It-is both about developing education and research activities.

2.1.2. Education in timber design and construction at VIA University College

The Architectural Technology and Construction Management program has a duration of 3½ years and is made up of seven semesters totalling 210 ECTS, which are composed of a number of compulsory and elective program elements, including internship and bachelor project.

The compulsory program elements are common to all programs offered in Denmark. However, the individual institution has defined the elective program elements. A further description of these appears from the common and institution-specific part, respectively.

The Architectural Technology and Construction Management program is also offered in Danish. The Danish title is Bygningskonstruktøruddannelsen.

The distribution of ECTS points on compulsory and elective program elements, including internship and Bachelor project, is illustrated in the following Figure 2.2.

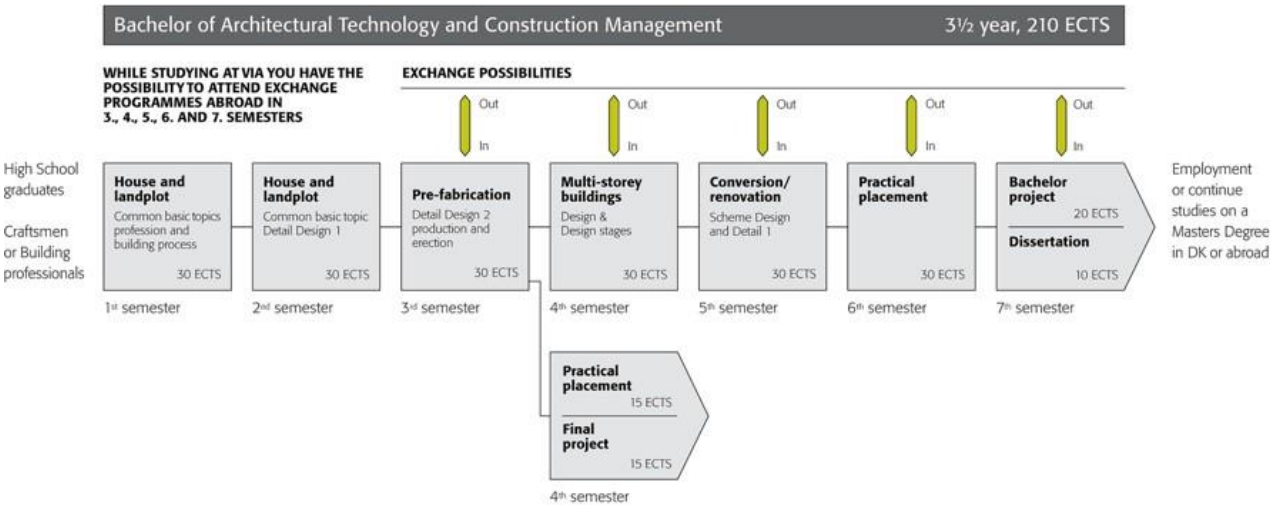

Figure 2.2. Architectural Technology and Construction Management program

The compulsory program elements are always placed in semester 1–3 as well as 6–7, whereas the individual institution can determine the compulsory program element to be placed in the 4th and 5th semester, respectively. This is specified in the institution-specific part where both 4th and 5th semester have an elective module for 10 ECTS credits.

3th semester consists of a National subject element and a local subject element. The National subject element deals with 'Industry and Prefabrication'. Up to this point, students have done a lot of work on the structural design of small houses. At 3th semester, students will be learning about the relationship between designing an industrialized building, organizing the production and delivery of the building elements and, finally, organizing the installation work – Its compulsory that a part of the Prefabrication must be made in wooden elements.

At both 4th and 5th semester (to out of 7 semesters) the semester theme is story buildings, and these semesters there will be opportunities to include mid-rise Timber Buildings.

At 4th semester the theme of the semester project is 'Multi-story buildings – with dwellings and commercial units' where the students can choose Timber buildings.

Working with the project, students will learn about increasingly complex demands to appliance, constructions and materials when designing and implementing a larger, contemporary building. Furthermore, there is an elective programmer element this semester where students have to write a report based on a topic of their choice (Multistory house).

The theme of 5th semester project is 'Renovation'. In the project work, students will learn about the special requirements associated with preliminary studies and the recording, set-up, structures, materials and conversion planning of existing buildings.

In 3th semester it is compulsory to work with a building, where its build up in wooden elements. At 4th, 5th and 7th semester also includes 3 local subject components requiring you to work on elective topics, where they can choose hybrid engineered timber design or/and Timber building. Students work must follow the science-theory-based method to which they are introduced to in 4th semester.

Available study modules are presented in Table 2.2.

Table 2.2. Study modules on timber design and construction at VIA UC

Title of the module	**ECTS**	**Learning outcomes**	**Teaching/learning methods**
VIA University College, ATCM - Elective Program Element. 4th semester	10	A self-chosen area with studies of building in wood – for instance studies around CLT elements, Hybrid EngineeredTimber	Main strategy Problem Based Learning (PBL) – Lectures, practical tasks, laboratory works.
VIA University College, ATCM - Elective Program Element. 5th semester	10	A self-chosen area with studies ofbuilding in wood – for instance studies around CLT elements, Hybrid EngineeredTimber	PBL – Lectures, practical tasks, laboratory works.

VIA University College, ATCM – The Building design subject comprises the Architecture and Building Design, Building Construction and Materials Science elements. 3th semester	3	knowledge of timber, roofing materials and sheet materials in wood	PBL- Lectures, practical tasks, laboratory works.
VIA University College, ATCM - Elective Program Element. 7th semester	10	A self-chosen area with studies of building in wood – for instance studies around CLT elements, Hybrid Engineered Timber	PBL- Lectures, practical tasks, laboratory works.
VIA University College, ATCM 'Multi-Storey - Building over 3 Storeys' national subject element	20	Learn to build 'Multi-Storey Building over 3 Storeys' where the load-bearing material i wood	PBL- Lectures, practical tasks, laboratory works.
VIA University College, ATCM - 3th semester. In the semester's 'Industry and Prefabrication' national subject element, you will mainly be working on one continuing project.	20	Knowledge about basic principles and technologies of drying wood and various wooden products. A semester where thestudents must create a building, of wooden elements	PBL- Lectures, practical tasks, laboratory works.
VIA University College, ATCM - 1st Semester	5	General knowledge of building materials production, properties, application, normative materials, as well as practicaltechniques for testing building materials. Analyze how to choose the technological method for obtaining materials based on the required specific properties and applications. Ability to analyze how to choose the best material for a particular application to obtain the required result.	PBL- Lectures, practical tasks, laboratory works.

Importance and integration of the new module

Forestry and wood products are an important part of the government's climate action plan

The government has released their first climate action plan. The Danish Forest Association's work to promote afforestation, increased use of wood in construction and use of wood for energy purposes has borne fruit. Forest and the use of wood are included as essential elements in the climate action plan.

The Climate Action Plan is a follow-up from the Climate Act and describes the sector strategies agreed with the Folketing, initiated initiatives for the involvement of business and civil society as

well as indicators for the various sectors. In future, the government will have to present a comprehensive climate action plan with a ten-year aim every five years.

In December 2020, the government launched a proposal for a strategy for sustainable construction , which sets the long-term framework for an ambitious change in the construction sector. The strategy must contribute to ensuring a more sustainable and quality-conscious construction that is at the same time financially responsible.

Increased use of wood in construction plays a prominent role and there are large potential CO 2 savings to be gained by replacing conventional building materials such as brick, steel and concrete with wood and wood-based products.

Increased wood construction can at the same time reduce the dependence on mineral raw materials such as sand and gravel and reduce the amount of waste at the end of the construction's service life.

At VIA University Colleges, we will be the frontrunner when it comes to sustainable construction with wood and hybrid solutions that can provide the safety and quality of construction, also when it comes to safety with fire, statics and sound challenges. Wood cannot always stand alone, but other building components can strengthen the quality of the sustainable conversion.

In 4th semester it has so far been compulsory to design and make constructions drawings for a 4-story building, where the load bearing material must be concrete. We are talking about to open up, and give the students the opportunity to use wood constructions as the load bearing material.

We will try to incur the students to choose to study, design and construction of mid-rise and tall wooden buildings, in their elective modules at 4th and 5th semester. We would like to involve some students, in the project, Hybrid Engineered Timber Buildings and have them participating in some of the upcoming workshop, in the program.

We will encourage the students to choose elective topics where they are doing research around Hybrid Engineered Timber Buildings, and buildings in/with wood in general – this could be done in 4th- 5th and 7th semester

2.1.3. Education in timber design and construction at the national level

Education in timber design and construction is provided by the following institutions:

- Aarhus School of Architecture;
- University of Copenhagen;
- The Royal Danish Academy of Fine Arts';
- Forest School in Nødebo;
- Aarhus University School of Engineering;
- KEA, Architectural Technology and Construction Management;
- UCN, Architectural Technology and Construction Management.

Information about the modules is provided in Table 2.3.

Table 2.3. Study modules on timber design and construction in Denmark

Institution	Title of the module	ECTS	Learning outcomes	Teaching/learning methods
The School of Architecture in Aarhus	Wood constructions in Design	30	Opportunities for the student to pursue an interest in wood through optionalproject work, just as wood is included on anequal footing withother constructionmaterials in the teaching. At the sametime, the teachers can organize special teaching courses with the tree in the center.	Lectures, practical tasks, laboratory works, Designtasks
University of Copenhagen	Master of Science (MSc) in Forest and Nature Management	60	Forest and natureareas have many important functions. They protect biologicaldiversity, provide puredrinking water, produce wood and provide the setting for outdoor activities such as hunting, fishing and recreation. As a graduate from the2-year MSc programme in Forest and Nature Management, you will be involved in finding a sustainable balance between ecology, economy and society. You will have completed a modern and international management programme which enables you to developthe world's forests and natural areas	Lectures, practical tasks, laboratory works, Designtasks

			in a sustainable manner.	
The Royal Danish Academy of Fine Arts' Schools of Architecture, Design and Conservation	Designer	30	For a designer, creativity and innovation or innovation are some of the keywords, and in a broad sense, the designer can be said to work on finding the solution to a problem. Often, however, the designer will work on designing and combining elements suchas appearance, function, construction in the manufacture of concrete products, suchas rooms, furniture or utensils. Designers work with all types of materials, including wood.	Lectures, practical tasks, laboratory works, Design tasks
Forest School in Nødebo north of Copenhagen. Forest School is a department under the University of Copenhagen	Forest and landscape engineers	240	Forest and landscape engineers have traditionally been employed as forest rangers in private and public forestry. Although it is still the forest and landscape engineers who contest these positions, today many of the graduates are employed outside the forest fence, where they deal with landscape and nature management in the broadest sense.	Lectures, practical tasks, laboratory works, Designtasks

2.2. Lithuania

2.2.1. Vilnius Gediminas Technical University

About the university

Vilnius Gediminas Technical University (VILNIUS TECH) is a leading higher education institution situated in Vilnius, the capital of Lithuania (https://vilniustech.lt). Established in 1956 VGTU is one of the biggest research universities in Lithuania with a focus on technologies and engineering, and strong emphasis on university-business cooperation.

Vilnius Gediminas Technical University (VILNIUS TECH) is a prestigious European Technical University. It is a remarkable institution which is important for the development and progress of the Lithuanian state. It is attractive to both Lithuanian and international students, teachers, and scientists. The abbreviation for Vilnius Gediminas Technical University is VILNIUS TECH. It expresses the experience in engineering and technologies. It also outlines the intensive application of technologies in the University life, the ever-growing need for technology and its transforming and empowering importance in science, business, everyday life of man and society. It is technology that is becoming a crucial creative tool in the world of tomorrow which aids in facing the challenges and going beyond any boundaries or borders.

Focus on the future technologies and interdisciplinary approach creates the unique ecosystem of innovation and allows engaging the students. Study process constantly combines theory and practical tasks in the labs. The theoretical and practical knowledge is applied in the students' final theses aimed at exploring and solving the real-world problems which requires not only demonstration of excellent knowledge, but also innovative thinking. Creative analytical thinking is promoted by using modern teaching methods and welcoming business partners' contribution to the academic process. Company representatives are delivering lectures and seminars, proposing topics for the final theses, inviting students to test their ideas during internships.

The modern infrastructure of the University encompassing library, laboratories and research centres. VILNIUS TECH has Civil Engineering Research Centre, the most modern center in the Eastern Europe, as well as the Mobile Applications Laboratory, the biggest one in Lithuania and Creativity and Innovation Centre "LinkMenų fabrikas" – modern experimentation and innovation hub, providing students with all the tools for practical learning, developing and implementing their ideas using up to date modern equipment.

University develops the lifelong positive attitude towards innovation based on knowledge and expertise. It results in the new products and services developed by alumni, their technological innovations and leadership. It has a positive effect on the development of community, the country and the region.

The University vision for 2030: VILNIUS TECH is a prestigious and international European technical University, distinguished by the quality of studies and research, its significant impact on the individual, the community and society.

The mission of the University shall be to educate and cultivate a person who is public-spirited, creative, enterprising, competitive, receptive to science and high technologies and to cultural values; to help ensure the state's public, cultural and economic prosperity, social concord and preservation of the national cultural identity.

The goals of University activity are the following:

1) to carry out studies, which provide a person with modern higher university education and a higher education qualification;

2) to develop sustainably scientific thought in different fields, conduct high-level research and experimental (social or cultural) development; to cooperate with national and foreign partners on issues pertaining to science and university higher education;

3) when cooperating with public and economic partners, to promote the development of regions and of the entire country through research, education, artistic and other cultural activities;

4) to develop a society receptive to education, science, art and culture, which is able to make use of science and compete in markets of high technologies, products and services effectively.

The values nurtured in the VILNIUS TECH community and passed on to our partners include:
Sustainability. For us, this is a sustainable approach to natural resources and environment, laying the foundations for long-term economic prosperity and building a future-oriented, cohesive society. It is a comprehensive raising of the needs of the environment and society against one's own, an assessment of one's actions not only from the perspective of today but also of the future.

Connection. We define this as the synergy between different technologies, disciplines, societal groups and solutions, a constant desire to work together and find common ground, promote full involvement, and create a diverse and multicultural environment.

Creativity. We have the courage to experiment, apply non-standard thinking, look for new unique opportunities in any situation, create solutions to overcome the challenges of the present and the future. VILNIUS TECH promotes the culture of technical makers who create for tomorrow.

Openness. We are the university without borders, where cooperation and networking with partners around the world, transparency of activities, acceptance of each person's individuality and uniqueness, opportunity to express one's ideas and be heard by others are important. We are open to the world and new experiences.

Innovativeness. We are constantly looking for more advanced technological solutions that will contribute to the world by creating added value in new or rapidly changing environment.

Rankings

VILNIUS TECH is ranked 701–750 in the QS World University Rankings 2023.

QS rankings by subject area

The results of the QS World University Rankings by Subject 2022 were published in early March 2022. They show that Vilnius Gediminas Technical University (VILNIUS TECH) continues to be among the country's leading higher education institutions. VILNIUS TECH has been ranked in 2 broad subject areas and in 7 narrow subjects.

For several years in a row, the University has maintained its high position in Architecture within the subject area of Arts and Humanities, where this year VILNIUS TECH is ranked 151-200.

As every year, VILNIUS TECH has received recognition in the subject Civil and Structural Engineering, where this year it ranks 201–220.

In the subject area of Engineering and Technology, VILNIUS TECH is ranked 356th this year. In this field, the University has been ranked in 4 subjects. In addition to Civil and Structural Engineering, VILNIUS TECH is also ranked in Mechanical, Aeronautical and Manufacturing Engineering, 401–450, which is the same position as last year. From 2020 VILNIUS TECH maintains the same position, 401–450, also in Engineering - Electrical and Electronic. In Computer Science and Information Systems, VILNIUS TECH ranks 551–600 this year.

After rising significantly in Economics and Econometrics three years ago, VILNIUS TECH has maintained its high position this year and is ranked 251–300 among the world's top universities. In Business and Management Studies, VILNIUS TECH is ranked 351–400 this year.

In terms of overall performance in Social Sciences and Management, VILNIUS TECH ranks 451–500.

Table 2.3. Facts and figures

Number of students	>8,400
Number of international students	17.8 %
Number of graduates/alumni	>80,000
Number of academic staff	930 (75% with degree in science)
Number of faculties (please list faculties)	10 faculties: Antanas Gustaitis' Aviation Institute, Architecture, Business Management, Civil Engineering, Creative Industries, Electronics, Environmental Engineering, Fundamental Sciences, Mechanics, Transport Engineering
Number of laboratories	22 research laboratories
Number of Bachelor degrees offered	44
Number of Master degrees offered	50
Number of PhD degrees offered	11
Number of business partners	>500
Number of international partners	>480
Study programmes related to HybridTim project	Civil Engineering (BSc), Construction and Real Estate Management (BSc)

Internationalisation

Having more than 480 international higher education institutions as partners, VILNIUS TECH offers wide range of international studies and internships. VILNIUS TECH is the leader in Lithuania by the number of students, studying under the Erasmus Exchange Programme abroad.

2.2.2. Education in timber design and construction at VILNIUS TECH

So far education in construction of timber buildings is very limited at VILNIUS TECH. The 3 ECTS module "Steel and Timber Structures" is delivered in two BSc study programmes, namely "Civil Engineering" and "Construction and Real Estate Management" (see Table 2.4).

Two BSc study modules were developed in frames of previous Erasmus+ Strategic Partnerships projects and have been partly integrated in the aforementioned BSc study programmes:

1) "Design, Construction and Management of Wooden Public Buildings" (9 ECTS) – developed during the project "Sustainable Public Buildings Designed and Constructed in Wood" (Pub-Wood), No 2018-1-LT01-KA203-046963. The module is available at: http://www.pubwood.eu/outputs/, it includes e-learning course: https://kursai.vgtu.lt/course/view.php?id=5

2) "Sustainable High-Rise Buildings Designed and Constructed in Timber" (9 ECTS) – developed during the project "Sustainable High-Rise Buildings Designed and Constructed in Timber" (HiTimber), No 2017-1-DK-01-KA203-034242. The module is available at: https://www.hitimber.eu/outputs/, it includes e-learning materials: https://www.hitimber.eu/moodle/.

In the MSc studies some timber construction related modules are included in the "Structural Engineering" study programme, specialization "Advanced Light-Gauge Structures": "Building Information Modeling (BIM) for Steel and Timber Structures" (9 ECTS), "Advanced Timber Structures" (6 ECTS), and "The Assessment of Timber Buildings, Experimental Investigations and Strengthening" (6 ECTS).

Education in timber construction is mostly limited to design stage. Hybrid engineered timber design and construction is included at very small extent.

Table 2.4. Study modules on timber design and construction at VILNIUS TECH

Title of the module	ECTS	Learning outcomes	Teaching/learning methods
Steel and Timber Structures	6	- Ability to choose the type of load bearing steel and timber structures; - Ability to determine the cross sections of main load bearing structures of steel/timber building; - Ability to design timber structures according to Eurocode 5	Theoretical lectures and solving of tasks
Fundamentals of Sustainable Development of Built Environment	3	- Knowledge about the basic features of sustainable environmental development; - Understanding of green building principles	Lectures, literature analysis, case studies, discussions, solution of tasks

Importance and integration of the new module

VILNIUS TECH aims to contribute to sustainable development of the country, therefore promotion of sustainable timber design, construction and management and improvement of education in this area considered as important in achievement of this objective. Moreover, internationalisation of studies and application of innovative study methods (i.e. project based learning) is among priorities in improvement of education process at VILNIUS TECH. HybridTim project fits into research focus areas of the Faculty of Civil Engineering: sustainable building, design of environmental-friendly structures.

It is planned that relevant topics of the new course will be integrated in the subject Fundamentals of Sustainable Development of Built Environment taught in the BSc study programme Construction and Real Estate Management. Moreover, students of this programme will be encouraged to write their theses on this topic.

Parts of the course, related to building with timber, will be integrated into the subject Steel and Timber Structures taught in BSc civil engineering programmes.

2.2.3. Education in timber design and construction at the national level

Education in timber construction at university level is very limited in Lithuania.

There are two big universities that focus their research and education on technological sciences – VILNIUS TECH and Kaunas University of Technology (KTU). Both universities deliver BSc and MSc study programmes in Civil Engineering. Education in VILNIUS TECH was described before.

KTU delivers the BSc study programme "Civil Engineering". It includes study module "Steel and Timber Structures" (6 ECTS) which aims at delivering knowledge about steel and wood structural properties, basis of calculation and construction of structural members and connections, mostly used steel and timber building structures.

At MSc level KTU delivers three study programmes in the field of civil engineering: "Construction Management", "Structural and Building Products Engineering" and "Sustainable and Energy Efficient Buildings".

Study programmes "Construction Management" and "Structural and Building Products Engineering" are mostly focused on concrete and steel structures, none of the modules/subjects are dedicated to timber structures.

Study programme "Sustainable and Energy Efficient Buildings" covers some subjects on sustainability and waste management (see Table 2.4), however timber construction is not addressed at all.

Another Lithuania's university – Vytautas Magnus University Agriculture Academy – delivers MSc study programme "Forestry". The study programme deepens theoretical knowledge in the fields of applied genetics, productivity and dynamic sustainability of forest ecosystems, wetlands, ecological forest regeneration, and forest economics.

Available study modules are described in Table 2.5.

Table 2.5. Study modules on timber design and construction in other universities

Institution	Title of the module	ECTS	Learning outcomes	Teaching/learning methods
Kaunas University of Technology	Building Energy and Environment	6	LO1. Is able to identify the influence of the climatic conditions on building longevity. LO2. Knowledge about effective technologies of energy generation and supply systems, estimation of energy consumption in engineering systems. LO3. Is able to assess the energy performance efficiency in energy generation and supply systems. LO4. Practical skills in energy efficiency certification and energy audits of buildings	Guest lectures, theoretical lectures, modeling, inquiry-based learning, experiential learning

			with respect to state regulations for energy audits and building certification. LO5. Is able to identify the environmental problems caused by the building and natural resources usage.	
Kaunas University of Technology	Waste Management and Recycling Technology	6	LO1. Is aware of social and environmental principles of sustainable planning LO2. Is able to use the obtained knowledge about secondary raw materials processing technologies in professional activities: generating project ideas, formulating design solutions concepts LO3. Knowledge of waste management technologies, is able to manage the execution of the works, prepare the necessary documentation. LO4. Understands the broader interdisciplinary context in civil engineering, encompassing social and environmental principles of sustainable planning	Lectures, laboratory classes
Vytautas Magnus University Agriculture Academy	Ecological Basics of Forest Regeneration	6	The studies of this subject enable to deepening the forestry competencies in the study of ecological basis of forest regeneration problems, development planning, design, technology development and deployment, creating of modern forest science theory and methodology, research methods and technologies for restoring of forests, techniques and methods preserving biodiversity and sustainable ecosystems.	Lectures, seminars
Vytautas Magnus University	Forest Growth and Yield	6	The course focuses on the main factors that influence the demands of wood in	Lectures, practical assignments

Agriculture Academy			national and international markets. On the basis of the experimental material, students will be able to learn about the measurements of trees and stands, analyse growth and yield study methods, also perform assessment of volume and biomass. During the course, course students are also provided with opportunities to study forest growth modeling, on the basis of single tree level simulator BWINPro-S and apply it order to understand Growth Dynamics in Mixed Stands.	
Vytautas Magnus University Agriculture Academy	Economics and Organization of Timber Harvesting	6	Knowledge about the basics of harvesting economics, ability to use the main methods of economic evaluation to assess the harvesting process, to organize harvesting works in the forestry enterprise.	Lectures, practical assignments
Vytautas Magnus University Agriculture Academy	Dynamic Sustainability of Forest Ecosystems	6	The students will gain contemporary knowledge and understanding on dynamic sustainability of forest ecosystems covering forest ecosystem formation, disturbances, development and successions, ecosystems' homeostasis, stability, resistance and resilience and its interrelation with productivity, biodiversity and health condition, structure, site conditions, ontogenesis, etc.	Lectures, seminars

In conclusion, design and construction in timber is not sufficiently addressed in the BSc programmes by the universities in Lithuania.

2.3. Spain

2.3.1. The Technical University of Catalonia

About the university

The Universitat Politècnica de Catalunya – BarcelonaTech (UPC) is a public institution dedicated to higher education and research, specialized in the fields of engineering, architecture and science. The UPC puts its scientific and technological infrastructure at the service of research groups and centres, researchers and students, professionals, companies and institutions.

The UPC has a wide spread presence in Catalonia, with nine campuses located in Barcelona and nearby towns: Castelldefels, Manresa, Sant Cugat del Vallès, Terrassa, and Vilanova i la Geltrú.

The UPC's values are social responsibility; promotion of equality; contribute to sustainability and cooperation and solidarity.

The main objectives are:

- Generate knowledge
- Impact on the economic environment
- Contribute to improve our society

The UPC is an International Campus of Excellence with two relevant projects: the Barcelona Knowledge Campus (BKC) and the Energy Campus. Through these projects, it promotes employability, social cohesion and regional economic development. It interacts with research centres, science and technology parks, businesses and other agents as a hub for attracting talent in emerging research areas. As can be seen in Figure 2.3, the UPC has created a complex network of international alliances with other universities, research institutions and companies that organise new projects and support a good number of initiatives. UPC is the Spanish university that raises more funding from the European Union's Horizon 2020 research program.

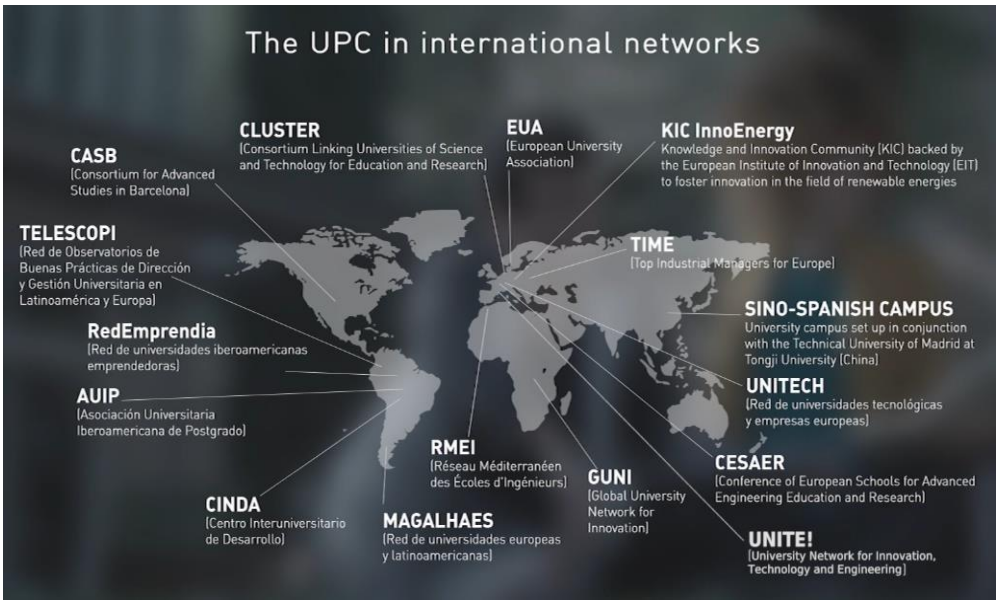

Figure 2.3. International networks in which the UPC is involved (GRI-UPC, 2021)

Table 2.6. Facts and figures

Number of students	28208
Number of international students	1337
Number of graduates/alumni	62854 alumni
Number of academic staff	3317
Number of faculties (please list faculties)	• Barcelona East School of Engineering (EEBE) • Castelldefels School of Telecommunications and Aerospace Engineering (EETAC) • **Barcelona School of Building Construction (EPSEB)** • Manresa School of Engineering (EPSEM) • Vilanova i la Geltrú School of Engineering (EPSEVG) • Barcelona School of Agricultural Engineering (ESAB) • Terrassa School of Industrial, Aerospace and Audiovisual Engineering (ESEIAAT) • Barcelona School of Architecture (ETSAB) • Vallès School of Architecture (ETSAV) • Barcelona School of Civil Engineering (ETSECCPB) • Barcelona School of Industrial Engineering (ETSEIB) • Barcelona School of Telecommunications Engineering (ETSETB) • Barcelona School of Informatics (FIB) • School of Matematics and Statistics (FME) • Barcelona School of Nautical Studies (FNB) • Terrassa School of Optics and Optometry (FOOT) • Interdisciplinary Higher Education Centre (CFIS) Image Processing and Multimedia Technology Centre (CITM)
Number of laboratories	32
Number of Bachelor degrees offered	66
Number of Master degrees offered	81
Number of PhD degrees offered	45
Number of business partners	2605 companies or entities have signed collaboration agreements with the UPC
Number of international partners	1533 agreements for the mobility of students. Participation in 14 international networks
Study programmes related to HybridTim project	Bachelor: - Architectural Technology and Building Construction - Architecture - Civil Engineering Master: - Building Construction Engineering - Architecture - Advanced Studies in Architecture Structural & Construction Engineering

Rankings

The UPC has been considered the best Spanish university and one of the world's 10 best universities in construction and Building Technology in the CWUR Rankings by subject. On the Qs Top under 50 Rankings the UPC is World's 36 best university younger than 50 years. In the following link there can

be found extended information about UPC in several rankings: https://www.upc.edu/ranquings/en/the-upcs-positions-in-the-main-rankings

Internationalisation

The UPC has an internationalisation plan from 2017 to 2021 that can be consulted in https://www.upc.edu/sri/en/strategy/international-policy/international-policy-planning-2017-2021/12-pla-dinternacionalitzacio-de-la-upc_2017_2021.pdf/view

The strategic challenges of this plan are:

1. **To internationalise the institution**

To introduce the international dimension in the life and personality of the UPC as an institution, in its missions and in its community, so that in everyone's mind the world is the scenario for all activities. An international institution with an international community will increase the presence of the UPC in global spheres and therefore enhance its international impact as a recognised, well-established brand.

2. **To internationalise the people**

To promote international culture and skills in all groups of the UPC, whether they are mobile people or non-mobile people, through mobility and internationalization at home (IAH). We need to improve the visibility and recognition of mobility. However, if we wish to be an international community, we must improve our reception of people from abroad.

3. **To internationalise teaching, research and technology transfer**

To increase the internationalisation of teaching and technology transfer, introducing and valorising development cooperation as a new type of international activity. On the understanding that research activity is already highly internationalised, we wish to use it as an engine for internationalising the rest of the missions.

4. **To intensify strategic partnerships and external alliances**

To foster external alliances that can increase and improve the international activity of the UPC and the groups that form part of it. Encouraging this search for and consolidation of strategic partnerships will be a two-way action that will allow us to make visible and position our activity, realise its potential, improve its results in the international sphere, and attract talent and projects.

5. **To develop the right tools and resources for implementing internationalisation activities**

Internationalisation requires specific procedures in some cases. In other cases, there are more general and/or common processes in other areas of activity that require adaptation or flexibility to respond to the requirements of international activity.

2.3.2. Education in timber design and construction at UPC

The UPC teaches wood as a material, as well as the design and construction in wood, in various subjects of the bachelor's degrees related to Architecture, Building Construction and Construction Engineering. It is not usual to find compulsory subjects in which wood is the main topic, but is usually a part of them. As, for example, in the Bachelor's degree in Architectural Technology and Building Construction, where wood appears in the following subjects:

- *Non-stone materials* (6 ECTS): composition and properties of wood, as well as products used in construction.
- *Structures construction* (4.5 ECTS): constructive design of wooden structures.
- *Building pathology* (3 ECTS): pathological processes in wooden structures as well as intervention techniques and systems in existing wooden structures.

The Degree in Architecture Studies also deals with wood construction in subjects as *Construction II* (6 ECTS) and *Construction IV* (7,5 ECTS), *Structures II* (6 ECTS) and *Structures III* (6 ECTS), and in *Industrialized Construction and Innovation* (3 ECTS, elective subject). In the course 2021/22 the presence of wood has increased through the addition of elective subjects focussed on timber. These courses are:

- Designing, Calculating and Building in Timber (4 ECTS)
- Wooden Constructions Seminar / Refurbishment / Energy Strategies (3 ECTS)
- Wood Studio 1:1 Scale (5 ECTS)

Regarding the master's studies, the situation is similar to the one mentioned above.

In the Master's degree in Advanced Building Construction wood is covered in some of the mandatory courses and since the academic year 2020/21 there is an elective course about timber construction.

- *Building Structures* (5 ECTS): wooden structures (resistant properties of wood; checking sections, stability and deformations; checking in a fire situation; and types and structural joints).
- Advanced Materials in Building Construction (5ECTS): a whole range of processed products from wood are considered as a new material and explained in this course.
- Timber Construction in the 21st Century (5 ECTS): different aspects of modern construction with timber are covered in this course.

In the Master's degree in Architecture there is only one elective subject in which wooden structures are taught: *Structural Projects in Architecture* (5 ECTS). So does the subject Inspection, *Analysis and Restoration of Historical Constructions* (5 ECTS) of the Master's degree in Structural & Construction Engineering.

Wood has a little more presence in the Master's degree in Advanced Studies in Architecture, from the following elective subjects: *Evolution of Building Materials and Products* (5 ECTS) and *Innovative and Advanced Structural Materials* (5 ECTS).

The concept of hybrid engineered timber has been recently introduced in some of the mentioned courses.

Available study modules are described in Table 2.7.

Table 2.7. Study modules on timber design and construction at UPC

Title of the module	ECTS	Learning outcomes	Teaching/learning methods
Non-stone materials	6	Composition and properties of wood, as well as products used in construction.	Lectures, laboratory, problems, technical visits
Structures construction	4.5	Constructive design of wooden structures.	Lectures, problems
Building pathology	3	Pathological processes in wooden structures as well as intervention techniques and systems in existing wooden structures.	Lectures, laboratory, exercises, technical visits
Designing, Calculating and Building in Timber	4	How to calculate timber structures	Lectures, PBL
Wooden Constructions Seminar / Refurbishment / Energy Strategies	3	Energy efficiency and benefits of timber	Lectures, PBL
Wood Studio 1:1 Scale	5	Design of timber constructions	Lectures, PBL

Importance and integration of the new module

UPC has a strong commitment with the sustainable development goals (SDG). HybridTim project fits perfectly in the internationalization strategy, and also in the actions to achieve sustainable cities and communities (SDG 11) and to reduce the impact of the building materials by using renewable sources (SDG 12 and 13). We have already detected an increasing interest from the degrees of Architecture and Architectural Technology and Building Construction to enhance the presence of timber construction in their curricula. One possibility is to use some of the materials developed during the project in specific lessons from an existing subject. On the other hand, we think that it is possible to create an elective subject based on the module developed in the HybridTim project.

2.3.3. Education in timber design and construction at the national level

The situation in the degrees of Architecture and Architectural Technology and Building Construction is similar to that explained for the UPC.

Other degrees that also include subjects on timber construction are the degrees on Forestry Engineering and Natural Environment.

2.4. Latvia

2.4.1. Riga Technical University

Riga Technical University (RTU) is a modern internationally recognized university. It is the only polytechnic university in Latvia and the largest university in the country – it educates and trains almost 15 thousand students.

RTU is focused on becoming a third generation university that not only provides high quality education, but also conducts advanced research and ensures innovation and technology transfer, practically implementing scientific discoveries. In the nine faculties of RTU it is possible to obtain high quality education not only in engineering, but also in social sciences and humanities.

Study programs implemented by RTU have been positively evaluated by international experts and are officially accredited. RTU is constantly developing its infrastructure by constructing a campus on Ķīpsala Island. On completion, the campus will be the most advanced engineering study centre in the Baltic Region.

Table 2.8. Facts and figures

Number of students	14006 (01.10.2020.)
Number of international students	3525 (01.10.2019.-01.10.2020.)
Number of graduates/alumni	~ 1500 annually
Number of academic staff	533
Number of faculties (please list faculties)	9 (Faculty of Architecture, Faculty of Civil Engineering, Faculty of Computer Science and Information Technology, Faculty of E-Learning Technologies and Humanities, Faculty of Electronics and Telecommunications, Faculty of Electrical and Environmental Engineering, Faculty of Engineering Economics and Management, Faculty of Mechanical Engineering, Transport and Aeronautics, Faculty of Materials Science and Applied Chemistry) and Riga Business School
Number of laboratories	27
Number of Bachelor degrees offered	50
Number of Master degrees offered	58
Number of PhD degrees offered	20
Number of business partners	68 professional associations worldwide + others
Number of international partners	304 Erasmus+ Universities (~520 universities total)
Study programmes related to HybridTim project	Real Estate Management (Professional Bachelor); Civil Construction and Real Estate Management (Professional Master) Civil Engineering (Professional Bachelor); Civil Engineering (Professional Master); Architecture (Academic Bachelor); Architecture (Professional Master)

Vision: Riga Technical University is an internationally competitive, dynamic and modern university of science and technology.

Mission: We are building a competitive, educated, innovative and creative future.

The keynote of the strategy of the Riga Technical University is the proactive link between the activity of the university and the needs of the national economy, focus on high quality and effectiveness. The basis for the activity of RTU is the study process built on science, innovation and in cooperation with the industry, which ensures preparation of specialists required by the Latvian national economy, thus serving as a foundation for sustainable growth of Latvia.

Rankings

RTU has been ranked in the 701 to 750 range of QS World University Ranking 2021.

Riga Technical University (RTU) has significantly improved its position in the green policy and sustainability rating UI Green Metric World University Ranking, ranking among the 60 greenest universities in the world. In 2020 RTU ranked 56th. It is a significant achievement compared to 2019, when RTU was ranked 93–95. Moreover, RTU remains the only higher education institution in Latvia that has been ranked so high, as no other Latvian university has been able to rank even among 500 greenest universities.

Riga Technical University (RTU) has been ranked in the international rating «U-Multirank» as one of the 25 leading universities in the world in terms of Open Access Publications. This means that a significant number of RTU researchers' publications can be found in open access scientific journals, making research results available to all interested parties. For several consecutive years, RTU has achieved the most convincing results of all universities in Latvia included in this rating.

Riga Technical University (RTU) has been included in the «QS Graduate Employability Ranking 2019», taking the 301–500th place in the university group. RTU received the highest score in Employer Reputation that ranks RTU in 175th place.

Riga Technical University (RTU) has received an excellent evaluation – five stars – at the international university rating QS Stars. Overall, university performance was evaluated considering eight categories, and RTU received the highest evaluation – five stars – in six of them.

Riga Technical University (RTU) has been ranked in the 701 to 750 range of QS World University Rankings 2021, which is the highest score among three Latvian universities included in the ranking. RTU received the highest appraisal for its increase of foreign students, and in this indicator RTU improved its position by 66 places, ranking 371st in the global assessment.

In 2020, Riga Technical University was ranked 54th in QS Emerging Europe and Central Asia (EECA) University Ranking among 350 leading universities.

In the prestigious «The Times Higher Education (THE) World University Rankings 2021», Riga Technical University (RTU) has been recognised as 284th best university in the world in terms of university cooperation with industry. In this aspect, RTU has been on the world's TOP 300 university list for several years and this ranking has grown every year. The ranking includes the best universities in the world, evaluating their performance in five indicators – collaboration with industry, studies, internationalisation, and science and citation.

Riga Technical University (RTU) has been highly evaluated in one of the leading university rankings – «Times Higher Education (THE) BRICS & Emerging Economies University Rankings 2019», taking 196th place.

Riga Technical University (RTU) is ranked in 361st place of best universities in Europe. The Europe ranking is based on the data of the Times Higher Education World University Ranking, in which RTU

was included for the first time in September 2016. The Times Higher Education World University Rankings 2019 ranks more than 1,250 universities around the world. Just over 450 of them are universities in Europe.

Evaluating the performance of Riga Technical University (RTU) in the implementation of the United Nations (UN) Sustainable Development Goal (CNG) 17, RTU is ranked 101-200 in the highest-ranked group of universities and thus becoming also the most highly rated of the four Latvian universities in the ranking «The Times Higher Education Impact Rankings 2020».

Internationalisation

Internationalization is one of the top priorities of Riga Technical University (RTU), which is also highlighted in the RTU Strategy and RTU Development Program for 2014 – 2020. Development of the international environment covers both studies and research; it is an essential aspect of the general university strategy. Our aim is to ensure RTU competiveness at the global scale in the field of studies, research and innovation.

To make sure internationalization is successful it is necessary to motivate academic personnel and students of RTU and promote their purposeful daily work. International achievements of RTU in studies and research are the best affirmation of their quality.

Export of higher education in Latvia has become a noteworthy sector of the Latvian economy, and RTU plays the leading role in this sphere in Latvia.

Cooperating with universities all around the world and educating and training undergraduate, post-graduate and Doctoral students from more than 70 countries, RTU has developed the most comprehensive international university environment in Latvia.

2.4.2. Education in timber design and construction at RTU

Education in design and construction of timber buildings is implemented through various study programmes among various faculties. Elements of design and construction of timber buildings are taught in following study programmes: Real Estate Management (Professional Bachelor); Civil Construction and Real Estate Management (Professional Master); Civil Engineering (Professional Bachelor); Civil Engineering (Professional Master); Architecture (Academic Bachelor); Architecture (Professional Master). However, there is not a holistic study course that provides comprehensive knowledge on design and construction of timber buildings (see Table 2.9).

Hybrid engineered timber design and construction is indirectly included in the study programmes/courses as following topics are covered: Idea of timber and timber materials as construction materials; Calculation of elements of timber structures; Laminated timber beams, the calculation; Protection of timber; Enclosing structures of timber covering; Spatial strengthening of plane timber structures; Peculiarities of the production of timber constructions and building parts; The main issues of safety engineering; Idea of the usage of layered timber material in the design of structures; Main elements of Real Estate Management, management principles, technological process, work and investment planning, regulatory enactments.

Table 2.9. Study modules on timber design and construction at RTU

Title of the module	ECTS	Learning outcomes	Teaching/learning methods
Timber and Plastic Structures	4.5	Ability to calculate the load-bearing capacity of the elements of timber structures and of plane timber structures. Ability to test the strength and stability of compressed and bent plastic elements. Ability to experimentally evaluate the performance of the models of structural elements subjected to loads.	Lectures, individual tasks, practical tasks, laboratory tasks.
Structural Fire Design	3	Ability to design timber members and it joints in fire. Ability to design steel members and it joints in fire. Ability to design reinforced concrete members and it joints in fire. Ability to design Masonry structures in fire.	Lectures, individual tasks, practical classes, practical tasks.
Timber Structures	4.5	Ability to calculate loadbearing capacity of timber structures. Ability to test the strength and stability of timber members with different structural loads. Ability to evaluate experimentally the work of structural members models under loads.	Lectures, individual tasks, practical classes, practical tasks.
Planning and Organization of Building Construction	3	Ability to plan the construction flows. Ability to elaborate a network diagram in a time scale. Ability to prepare the construction activities project. Ability to apply construction flow methods and network graphs, using the possibilities provided by BIM technology.	Lectures, individual tasks, practical tasks.
Management in Building Products Manufacturing	3	Ability to plan the construction flows. Ability to elaborate a network diagram in a time scale. Ability to prepare the construction activities project.	Lectures, individual tasks, practical tasks.
Practical Aspects Building Construction Business	3	Theoretical understanding and practical knowledge about practical aspects of building entrepreneurship, planning and management of reconstruction, renovation or restoration projects in the field of building entrepreneurship and real estate management.	Lectures, case studies, practical tasks, presentation.

		The ability to identify division and characteristics of dwelling/non-dwelling houses and other type of real estate accordingly to EU classification "Building classification" as well as to know well about demands for related objects management which are included into classification. Ability to orient in traditional and modern construction and decoration materials as well as in technologies of construction, decoration and engineering communication works. Knowledge regarding questions connected with management of construction enterprise and administration as well as with main principles of management and administration in the field of building entrepreneurship and real estate management. Ability to evaluate control levels of construction work realization and necessity for further management control level. Knowledge on organizing inspection, supervision and technical maintenance of buildings, building structures and engineering systems.	
Organisation of Real Estate Management and Administration	9	Students are familiar with real estate management and management principles, technological process, work and investment planning, regulatory enactments. Students are familiar with real estate management and management requirements and their implementation, laws and regulations, decision-making principles, short-term and long-term planning of management, maintenance and reconstruction work, long-term investment planning in the management process. Students are able to organize and supervise the performance of unplanned work (emergency response, etc.). Students are able to organize improvement work as well as control of such work.	Lectures, tests, individual tasks, practical tasks.

		Students are able to organize inspection, supervision and maintenance of houses, building structures and engineering systems.	

Importance and integration of the new module

HybridTim project will develop and deliver new trans-disciplinary module on design and construction of engineered hybrid timber buildings, which meets the needs of the HEIs and labour market representatives. That way project will contribute to accelerating integration of science in study process and strengthening the collaboration between universities and industry.

It is planned that the new HybridTim BSc/BA module/elective element “Design and Construction of Hybrid Engineered Timber Buildings” will be integrated in “Real Estate Management” and/or “Civil Engineering” study programmes.

2.4.3. Education in timber design and construction at the national level

Additionally to what Riga Technical University offers, there are study programmes offered by Latvia University of Life Sciences and Technologies which are linked to design and construction of timber buildings. These study programs are “Construction”, “Woodworking” and “Forestry”. Study modules of these study programs are described in Table 2.10.

Table 2.10. Study modules on timber design and construction in Latvian universities

Institution	Title of the module	ECTS	Learning outcomes	Teaching/learning methods
Latvia University of Life Sciences and Technologies	Building materials	6	Knowledge of building materials production, properties, application, normative materials, as well as practical techniques for testing building materials. Ability to choose the technological method for obtaining materials based on the required specific properties and applications. Ability to choose the best material for a particular application to obtain the required result	Lectures, practical tasks, laboratory works.
Latvia University of Life Sciences and Technologies	Architecture	3	Ability to perform the necessary calculations, develop construction drawings, comply with Latvian construction standards and other regulatory enactments. Ability to develop appropriate documentation with appropriate detail at any	Lectures, practical tasks.

			stage of construction design. Ability to orient in the range of materials and solutions, their rational application, costs and other economic and technical characteristics. Ability to develop the architectural part of sketches and technical projects of residential and public buildings. Ability to evaluate, examine and coordinate construction projects in state and municipal institutions.	
Latvia University of Life Sciences and Technologies	Basics of building theory	6	Ability to use static equilibrium equations to determine the support of structural supports. Ability to use the slitting method to determine the internal forces of bars and beams. Ability to determine normal and shear stresses in stretched, compressed, bent and compressed / stretched bent bars. Ability to apply Hooke's law to determine bar deformations.	Lectures, practical tasks.
Latvia University of Life Sciences and Technologies	Effects on building structures	3	Ability to evaluate the most significant effects of the design of flat floor structures (beams or trusses on columns, portal frames, etc.).	Lectures, practical tasks.
Latvia University of Life Sciences and Technologies	Construction mechanics	4.5	Ability to choose the most appropriate calculation scheme for the real design and formulate the calculation task, as well as to check the calculation results by performing control calculations according to alternative schemes.	Lectures, practical tasks, laboratory works.
Latvia University of Life Sciences and Technologies	Timber and plastic constructions	1.5	Ability to perform calculation of wooden building elements and connections based on the limit state method and	Lectures, practical tasks, laboratory works.

			applying the methodology of the 5th Eurocode.	
Latvia University of Life Sciences and Technologies	Automated design of wooden buildings	3	Skills in designing wooden buildings, as well as ability to assess the advantages and limitations of automated design. Ability to use SEMA Soft program.	Lectures, laboratory works, individual tasks.
Latvia University of Life Sciences and Technologies	Basics of wood	4.5	Knowledge of wooden structure, physical and mechanical properties and methods of their determination. Ability to identify 22 industrially important tree species, describe their characteristics and applications. Ability to choose the most suitable tree species for a certain use.	Lectures, practical tasks, laboratory works.
Latvia University of Life Sciences and Technologies	Basics of forestry	3	Knowledge about forestry terminology, regulatory framework and ecological processes that take place in forest ecosystems. Ability to identify and describe the basic elements of the forest. Ability to orientate in forestry processes related to forest regeneration, care, development, division of fellings in Latvia, hunting farms and related areas.	Lectures, practical tasks.
Latvia University of Life Sciences and Technologies	Hydrothermal treatment of wood	3	Knowledge about basic principles and technologies of drying wood and various wooden products. Ability to formulate and solve issues related to changes in wood moisture, organize drying of wooden materials and perform quality control. Ability to assess, analyze and improve the drying farm in the factory.	Lectures, practical tasks, laboratory works.
Latvia University of	Logistics of wooden industry	3	Ability to use the acquired knowledge in practical work,	Lectures, practical tasks.

Life Sciences and Technologies			make strategic decisions in the field of logistics, optimize various types of logistics, collect and use market information, organize transport management in the company, work in a team and actively discuss current issues in the field of logistics of wooden industry. Ability to analyse the situation in the field of logistics and evaluate the obtained results, make decisions on the necessary measures.	
Latvia University of Life Sciences and Technologies	Reforestation	1.5	Ability to substantiate the choice of the most suitable type of forest regeneration, species composition, thickness, agrotechnical maintenance regime. Ability to calculate the economic indicators of reforestation and afforestation and knowledge about the most important factors influencing these indicators.	Lectures, individual work

2.5. Austria

2.5.1. Vienna University of Technology

About University

The TU Wien is Austria's largest research and educational institution in the field of technology and natural sciences. More than 4,000 scientists are researching "technology for people" in five main research areas at eight faculties. The content of the studies offered is derived from the excellent research. More than 27,000 students in 55 degree programmes benefit from this. As a driver of innovation, TU Wien strengthens the business location, facilitates cooperation and contributes to the prosperity of society.

Technology for People

At TU Wien, we have been conducting research, teaching and learning under the motto 'Technology for people' for over 200 years. TU Wien has evolved into an open academic institution where discussions can happen, opinions can be voiced and arguments will be heard. Although everyone may have different individual philosophies and approaches to life, the staff, management personnel and students at TU Wien all promote open-mindedness and tolerance.

Preventing discrimination and improving equal opportunities

Preventing discrimination against people and improving equal opportunities are at the heart of our interactions with one another and our environment. This also means that we learn from history by critically examining our past. We actively speak out against discrimination and promote equal opportunities.

Promoting scientific excellence and top-quality teaching

Our identity as a research university means that we build our reputation through our research. The content of the teaching we offer is based on this research. TU Wien combines basic and applied research and research-oriented teaching at the highest level. Through their knowledge and their strong relationships, our graduates and scientists contribute to the transfer of knowledge and technologies across society and the economy. The members of TU Wien thus help to ensure that Austria remains internationally competitive as a research location and help to stimulate its innovative potential.

Vision, mission, objectives

Developing scientific excellence and teaching a comprehensive set of skills

TU Wien is actively and responsibly involved in the creation of technical, economic, cultural, social and ecological structures. In order to enable universities to perform their specific social tasks – scientific research and teaching, as well as promoting public awareness – the essential values of freedom of research and teaching must be preserved and developed.

TU Wien gives all members an equal opportunity to utilise their potential and in particular promotes equal opportunities for women, who are traditionally under-represented in the field of technology.

Developing scientific excellence

TU Wien continues to develop research – both within subject specialisations and in interdisciplinary combinations – in an innovative manner. It will maintain the high standard that it has achieved and

increase this still further by concentrating its strengths and through networking and collaboration. Research at TU Wien is based on twin pillars: fundamental research at a sufficiently differentiated subject level together with the interdisciplinary integration of such research, and application-orientated university research for which the fundamental research in turn forms an important premise. Together, fundamental research and application-orientated university research represent the key elements of the research output at TU Wien. With regard to the main role of university research – generating knowledge to increase understanding and for the benefit of society – the research objectives derived from these elements are directed towards utilising this understanding and knowledge.

Due to the increasing costs of fundamental research and application-orientated university research, key areas of focus will be set to define positioning both within TU Wien and in the network of university and non-university research at an international level.

Teaching a comprehensive set of skills

The range of courses offered by TU Wien is designed to meet two objectives. The first of these concerns specialist knowledge and technical skills. Since this specialist knowledge must increasingly be made effective within complex social processes, then as a second objective, communicational and social skills must also be promoted. The combination of personal resources developed on the basis of these educational goals is not in demand on the employment market but also serves to maintain the long-term competitiveness of our graduates. In order to cope with the rapid growth in specialist knowledge within scientific and technical disciplines, our studies teach the ability to acquire knowledge for oneself alongside a solid grounding in the principles. In addition, TU Wien also provides a wide range of continuing education opportunities for its graduates.

At TU Wien, teaching and research form a single unit: excellent teaching depends on excellent research, and only leading researchers are able to take our students forward to the highest levels of science and technology.

Table 2.11. Facts and figures

Number of students	28000
Number of international students	9000
Number of graduates/alumni	3150
Number of academic staff	5050
Number of faculties (please list faculties)	8 Faculties with 51 Institutes - Architecture and Planning - Civil Engineering - Electrical Engineering and Information Technology - Informatics - Mechanical and Industrial Engineering - Mathematics and Geoinformation - Physics - Technical Chemistry
Number of Bachelor degrees offered	19
Number of Master degrees offered	33
Number of PhD degrees offered	3
Number of business partners	Several hundred
Number of international partners	48 partner universities
Study programmes related to HybridTim project	- Bachelor Architecture - Master Architecture - Bachelor Civil Engineering - Master Civil Engineering Science - Bachelor Environmental Engineering - Master programme Environmental Engineering - Master Materials Sciences

Rankings

The rankings are provided in Table 2.12.

Table 2.12. Rankings

World Rankings	2020	2019	2018	2017	2016	2015
QS – World University Rankings	191	192	199	182	183	197
THE – World University Ranking	401-500	351-400	251-300	301-350	251-300	251-300
Leiden Ranking	270	299	274	259	286	202
Shanghai Ranking – (ARWU)	301-400	301-400	301-400	401-500	401-500	401-500

QS WU Ranking by Subject 2020 (Top 100)	TU Wien	Uni Wien	ETH Zürich	TU München
Computer Science & Information Systems	51-100	151-200	9	36
Architecture / Built Environment	51-100	-	4	26

In this year's QS Ranking, the TU Wien can again secure a place among the top 200 universities, the ranking has improved by one rank compared to the previous year (from rank 192 in the previous year to rank 191 in 2020). In the QS Ranking by Subject, TU Wien can record a place among the top 100 universities worldwide in the fields of Computer Science & Information Systems and Architecture/Built Environment for another year. In THE Ranking 2021, TU Wien was ranked in the range 401-500 (2020: 351-400). As in previous years, the strongest indicators in THE-ranking are third-party funding income and internationalization.

The change compared to the previous year can be explained by the performance in the Citations indicator. The indicator for citations has decreased slightly. When interpreting the results, it is important to bear in mind that detailed results are only presented up to rank 200. After that, only ranking groups are given. This does not allow for in-depth analysis. The weighting in the calculation of the Citations indicator is also not transparent. This suggests that changes in this regard have affected this year's performance. In THE's ranking by subject focus, the TU Wien is once again shown as one of the world's top 100 universities in the field of computer sciences (rank 80).

Internationalisation

TU Wien embodies internationality in its teaching, research and services. A visible sign of this is TU Wien‘s successful participation in international teaching and research programmes and its presence in multilateral university networks. The percentage of international researchers and teachers at TU Wien is almost a third of the scientific personnel. The internationalisation of research and teaching is indispensable for the successful work, visibility and further development of a research-orientated institution such as TU Wien. Ultimately, it increases quality in all areas.

Internationalisation is not an end in itself, but rather part of a strategy for the whole university. It originates in and is supported by direct benefits for researchers and teachers. Here, the focus is on finding the most suitable partners for the University’s own issues. International cooperation therefore occurs primarily through the researchers themselves. This should not and must not be restricted through this internationalisation concept. Through targeted measures, TU Wien strives for improved coordination of individual activities to increase consistency with the strategic objectives.

Current research findings have a direct influence on TU Wien’s courses and curricula. That the “researched teaching” approach generates an internationally attractive and high-quality choice of degree programmes is demonstrated by the high proportion of international students of around 30 per cent, which also contributes to the visibility, prominence and reputation of TU Wien in the international context. Everywhere that TU Wien presents itself as an entire institution, rather than individual departments, or that added value arises through international networking, the object of the university management’s guiding measures is international cooperation. These measures then determine the targeted use of financial and human resources.

Based on strategic principles and the associated objectives, this strategy paper contains a catalogue of measures, which enables compliance with fundamental guidelines within the diversity of international activities, and emphasis on certain features. In addition, interfaces with the faculties' areas of responsibility are defined.

Above all, the guiding measures aim to conclude bilateral university partnerships, taking into account regional and thematic priorities, strengthening the attractive, intercultural teaching and research environment at TU Wien, promoting the mobility of students, teachers and researchers and developing suitable marketing strategies to increase international visibility and targeted recruitment of the "best brains".

Strategic principals

- TU Wien orientates its international exchanges with excellent universities according to strategic considerations.
- TU Wien strengthens its opportunities for systematically recruiting qualified students, junior scientists and professors from abroad by creating an attractive, intercultural research and study environment.
- TU Wien promotes the international mobility of its students, junior scientists and professors.
- TU Wien strives to improve its international visibility and marketing.

2.5.2. Education in timber design and construction at TU Wien

The main courses for timber engineering are held by the Research Unit of Structural Design and Timber Engineering (ITI) from the Faculty of Architecture and Planning - Institute of Architectural Sciences and the Research Unit of Simulation of Materials and Structures from the Faculty of Civil Engineering Institute of Mechanics of Materials and Structures. Throughout the education for architects and civil engineers the design and construction of timber buildings is implemented in various courses. Advanced timber engineering knowledge is established in the master programmes. In the bachelor programmes timber engineering does mostly not have dedicated courses, but is rather thought as a part of the main topic of the course, which for instance could be building construction, or building physics.

Even though there is no holistic study programme on timber engineering the Research Unit of Structural Design and Timber Engineering (ITI) is able to offer a unique blend of courses due to its special position. In between architecture and civil engineering with the two main teaching areas "structural engineering for architects" and "timber construction for architects and civil engineers", the department takes a bridging position between the two construction faculties at the TU Vienna. The staff members form an interdisciplinary team of architects & civil engineers, some of whom work simultaneously in different areas of practice. The manifold questions from practice flow into the work at the department.

Hybrid timber engineering is both directly and indirectly taught in design studios and courses (see Table 2.13). Especially in the master programmes of architecture and civil engineering more in-depth construction knowledge is established. Mainly in form of specialisations during the studies.

Table 2.13. Study modules on timber design and construction at TU Wien

Title of the module	ECTS	Learning outcomes	Teaching/learning methods
Building Construction 1 (A_VO)	3	Students, through their acquired understanding of structural engineering, are able to correctly assess the appropriate use of resources, the logical application of building materials and structures as a supporting preparation for structural design.	Lectures, sketching, construction drawings, appropriation of the basic, terminology, comparison between the functional and conceptual concerns in the design, Lecture with written exam
Building Construction 1 (A_VU)	8	In an initial design exercise, students acquire the ability to combine aspects of analytical perception and synthesizing design. They are able to synchronously develop different partial aspects in the design. Students develop a coherent project design that is reduced in its complexity. In doing so, students acquire the fundamentals of structural engineering and materiality and are able to switch from a perceptive to an active design role	Lecture with written exam
Building Construction 2 (A_VO)	3	students will possess a detailed understanding of various building designs and their relationship to their respective architectural forms.	Lecture with written exam
Building Construction 2 (A_VU)	8	Students acquire the competence to simultaneously work out aspects of architecture and technical building equipment within a building construction design, from initial conceptual considerations to in-depth design and detailed elaboration in all scales relevant to building construction. scales relevant to building construction. They develop the ability to grasp basic subject-specific problems and to formalize the cognitive performance developed in the design process.	Examination-Inherent Performance Assessment
Building Technology (A_VO)	3	After positive completion of the module, students are able to understand the essential principles of the technical design of buildings and apply them in planning. Students will have mastered the fundamentals of building and room acoustics, daylighting and artificial lighting design, fire protection and building services installations and related fields.	Lecture, written exam
Structural Design and construction 1 (A_VO/VU)	7	After completing the module, the prospective architects have a basic understanding of (flexural) beams, columns, plane frames, trusses, cable structures, arched structures as well as plate and slab structures with regard to the	Written exam and exam immanent assessment of the exercise part

		load-bearing behaviour and the respective material-adequate design. They are able to apply assessment criteria that enable an adequate choice of materials and the selection of a structure that is adequate for the design. After completing this module, students will be able to use simple design routines for structural components, based on Eurocode verification formats. They develop an understanding of the determining design factors of statics and dynamics. Students acquire the competence to check, evaluate and apply structural systems according to their design with regard to the respective boundary conditions such as assembly possibilities, economic efficiency, choice of materials, sustainability (dismantlability, durability, reusability) and the choice of the structural system. Consideration of these parameters in structural design is the main focus.	
Structural Design and construction 2 (A_VO/VU)	7	After completing the module, students will be able to understand spatial structures such as vaults, shells, folded structures, diaphragm and pneu structures in terms of their load-bearing behaviour and the respective material-appropriate design (construction methods, joining, nodes, ...) and to develop their basic features. You will acquire the ability to make in-depth assessments with regard to assembly options, economic efficiency, choice of materials, sustainability, dismantlability, etc, material selection, sustainability, decomposability, durability and their influence and their influence on the choice of structural system.	Written exam and exam immanent assessment of the exercise part
Building physics and building construction (A_VO)	6	After positive completion of the module, students will be able to understand the essential technical principles of building physics and building ecology necessary for the development of a building design and have a good command of the relevant terminology. Students acquire the necessary expertise to evaluate constructions in terms of building physics. Students acquire the skills to correctly apply structural engineering, construction and building physics principles to create an architectural solution. They are able to arrange materials and components in building construction in a way that is appropriate to the design and ready for realization, and to join them in a way that is appropriate to the materials.	Lectures, support by e-learning elements, written examination
Monument preservation (A_VO)	3	Students that pass this module, will gain an overview of the history of historic preservation and its theories. The module opens up a broad professional horizon that enables students to understand the requirements of historic preservation that are relevant today and to grasp the part expected of architectural practitioners in this regard. Through the interaction and interplay of different perspectives, they recognize the importance and usefulness of the research area for academic and design	Lecture, pictorial scripts, required reading, written examination

		work. The module challenges students to explore their self-competence, to assess their individual inclinations and interests and, with a view to their future work in the profession, to sharpen their values, critical faculties and particular responsibilities. The students acquire the ability to recognize analogous problem situations and to situate them in new contexts. The concrete illustration of the learning material enables the cultivation of visual memory and the linking of objects with relevant actors.	
Construction History (A_VO)	5	After completing the module, students are able to analyse and critically evaluate existing architectural, spatial and constructive solutions. They acquire the necessary knowledge to also question criteria such as qualities of use and design coherence and thus acquire the fundamental knowledge of the functioning and complexity of objects as well as the consequences in effect and perception in application. They possess the ability to interpret and use phenomena for their own design work from the perspective of the history of construction and building technology as well as from the perspective of functional typology and the history of urban development in the mirror of selected thematic focal points.	Lecture, pictorial scripts, short exercises during lecture, written examination
Evolvement of Structural Timber Buildings (A_VO)	2.5	After successful completion of the course, students are able to understand and roughly classify historic wood architecture in their evolvement. They learn to read historic wood architecture as result of a combination of conditions and influences: topography, environment, climate, users, producers, purpose of use. Students achieve awareness that building seen as action always engenders reactions: regarding social consequences, regarding psychological consequences, considering resources and not last pollutant entry. They will be able to recognize functional backgrounds of building measures even then when a layperson is unable to see it hidden behind the decorative finish.	The students are asked to discuss and reflect the content of the lectures interrupting ad hoc or immediately after each lecture. Provoking statements and aimed questions intend to encourage the students to evaluate their knowledge on the topic. The offered new perspectives finally confirm and support knowledge or lead to the realization of necessary reconsideration.

Architecture and Structures - Study Trip (A_EX)	2	Varying depending on site	Varying depending on site
Timber Engineering (CE_VO)	5.5	- Identify wood mechanics - chose and apply wood based products and composites depending on the demand of the project - structurally model and verify linear structural elements both manually and with software support according to EC5 for ultimate load, serviceability load and fire - include aspects of machining, assembly and durability in the process of the design	For personal respective practical training, after an introductory lecture six pieces of homework with issues from the theoretical course have to be realized in collaboration with other students
Structural engineering and construction physics (CE_VO/UE)	11.5	Professional and methodological competencies: Acquisition of the basic knowledge of building physics and structural engineering, incorporating the previous knowledge already acquired in the bachelor's program on the material-specific design of building structures. Students acquire the knowledge and skills for the structural and structural-physical design of building structures as well as for the preparation or control of detailed plans. Cognitive and Practical Skills: In the subject-specific exercises, students apply what they have learned to practical, structural and building physics designs. The ability to work independently on subtasks concerning complex building construction is acquired. Social competencies and self-competencies: self-organization in group work and learning groups and learning groups, recognition of interdisciplinary contexts, ability to work in teams in the innovative design and further development of building structures using systemic and component-specific approaches.	The module includes lectures and calculation exercises as well as design exercises in which a complete planning task is to be worked on constructively and in terms of building physics. Performance is assessed through oral and written examinations
Structural analysis and Strength of Materials (CE_VO/UE)	16	Professional and methodological competencies: Students have a basic understanding of the methods and concepts of strength of materials and structural analysis and are able to apply them to simple problems and in particular in the more advanced courses. A deepening into more specific and complex problems is possible in a reasonable time on the basis of the imparted knowledge. Cognitive and practical competencies: Skills in the application of the acquired fundamentals are consolidated and promoted through independent solving of exercise examples. Students acquire the competence to understand mathematical and physical relationships.	Frontal lecture (with examples) in the lectures, Presentation of exercise examples in the exercises, Weekly homework in the context of the exercises, Tutorials or review sessions

		Social skills and self-competencies: The aforementioned skills are essential prerequisites for engineering innovation competence. Work discipline in the course of independent treatment of engineering-mechanical problems.	before tests or exams, Written exercise tests during the semester, Oral examination of theoretical understanding
Building Materials (CE_VU)	3	- Understand basics of matter and what control their mechanical/physical properties. - Understand energy involved in manufacturing/transporting main construction materials, be sensitive to material sourcing and sustainability, understand main foreseeable challenges about sourcing construction materials. - Be educated on the history of construction materials, and how economics often drives the choice. - Be able to list and differentiate main construction material types. Understand their properties, their main use and manufacturing methods/sourcing, their limitation, durability. - Understand how the mechanical properties of the materials impact their load-bearing capabilities. - Understand available technics to assess materials in existing aging structures.	Lectures, laboratory
Mechanics (CE_VO/UE)	14.5	Professional and methodological competencies: Recording and mathematical reduction of Quantitative assessment of the course of forces in statically determined load-bearing structures under different static loads. Model building for supporting structures under dynamic loads, Quantitative determination of stresses from dynamic loads, Modeling and analysis of flow processes. Cognitive and Practical Skills: Ability to qualitatively evaluate computer calculated internal forces. Qualitative assessment of the susceptibility of structures to vibration, ability to apply simplified numerical calculation methods.	Written exam and exam immanent assessment of the exercise part.

Notes: CE – Bachelor programme Civil Engineering; A – Bachelor programme Architecture; VO – Lecture; UE – Exercise; VU – Lecture + Exercise; PR – Project; EX – Excursion.

Importance and integration of the new module

In a globalised knowledge-based community, international collaborative programmes within research and teaching are an essential part of university life. Successful participation in international programmes, maintaining contacts in transnational networks and the strategic targeting of university partnerships all contribute to the successful positioning of TU Wien's researchers and graduates at an international level.

The international approach to research and teaching is essential for a research orientated institution to work successfully, develop and remain visible. TU Wien therefore pursues a strategy of successful international networking. This includes forming bilateral university partnerships to take advantage of regional and subject-based strengths, securing an attractive, intercultural teaching and research environment at TU Wien, promoting the mobility of students, teaching staff and researchers and developing suitable marketing strategies to increase international visibility and attract the "best minds".

Besides design studios with very specific topics like urban planning and dwelling, two design studios have the more general topic of building construction („Hochbau 1" and „Hochbau 2"). One of them being in the second and one in the fifth semester. Especially the one in the fifth semester (8 ECTS), at which point the basics of building construction are already established, would lend itself for hybrid timer buildings. The design studio did already focus on more advanced building construction in the past and would therefore fit nicely to the increased complexity of timber as a building material and the usage of different materials in one building.

Furthermore students could be encouraged to choose for the elective seminar on architectural sciences in the sixth semester timber and hybrid timber constructions, for which also more different courses on this topic could be offered.

2.5.3. Education in timber design and construction at the national level

The map of the universities is provided in Figure 2.4.

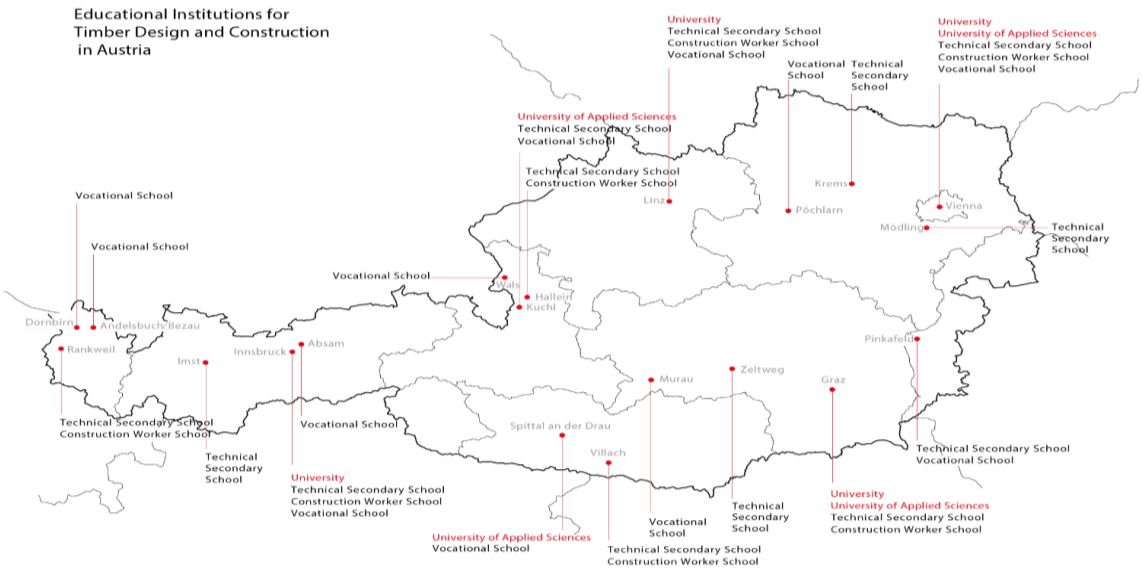

Figure 2.4. Map of educational institutions for timber engineering (based on: Zuschnitt 78, p.3 proHolz Austria 2020)

Similar to the TU Wien most universities and universities of applied sciences in Austria enable small scale specialisations in terms of timber design and construction for buildings, which mostly occur in the master programmes. For the sake of completeness, the following section states all university level educational institutions for architecture, civil engineering and timber engineering as it is

possible to focus on timber design and construction during the studies and these would also be the institutions in which then the newly created study module could be implemented (see Table 2.14).

Table 2.14. Programmes related to timber design and construction

Institution	Architecture		Civil Engineering		Timber Engineering	
	B	M	B	M	B	M
Academy of fine arts Vienna (U)	x	x				
BOKU University of Natural Resources and Life Sciences, Vienna (U)			x	x	x	x
FH Campus Wien (UAS)	x	x	x	x		
FH Joanneum (UAS)			x	x		
FH Kärnten – Spittal Campus (UAS)	x	x	x	x		
FH Salzburg – Kuchl Campus (UAS)					x	x
TU Wien (U)	x	x	x	x		
TU Graz (U)	x	x	x	x		
University of Applied Sciences upper Austria (UAS)			x	x		
University of Art and Design Linz (U)	x	x				x
University of Innsbruck (U)	x	x	x	x		
University of Applied Arts Vienna (U)		x				

Note: U – University; UAS – University of Applied Sciences; B – Bachelor Programme; M – Master Programme

Besides the standard educational programmes for architecture, civil engineering and timber engineering there are some noteworthy programmes that are already a step further and do offer a more advanced and more holistic approach on the topic of timber design and construction in the building construction industry:

University of Art and Design Linz: Master Course for Wood and Timber Architecture (M)

The university course “überholz” (Master Course for Wood and Timber Architecture) is an extra-occupational training for architects, structural engineers and timber constructors. As students are required to be postgraduates or still enrolled students in the fields of architecture and civil engineering it is possible for the program to go much more in depth than with any other standard programme. The founding of the course in 2004 is based on the motivation to create an interdisciplinary training and thus to sustainably raise the qualities of timber construction in Austria.

FH Salzburg Kuchl Campus: Forest Products Technology & Timber Constructions (B, M)

The FH Salzburg offers the probably most holistic academic educational programme for timber design and constructions. In the bachelor and master programme students are thought about basics of science, engineering, wood science, civil engineering, wood technology and wood construction. Moreover, a specialisation in “Forest Products Technology”, “Timber Constructions” or “Furniture Design and Interior Architecture” is possible. In the list of study modules below only the courses with main focus of timber are listed. As the whole study programme is geared toward forest products and timber construction naturally all other courses will also have these goals in mind.

FH Campus Wien: Civil Engineering and Construction Management (M)

The FH Campus Wien offers both a bachelor and a master’s programme for civil engineering, but only the masters programme offers a specialisation which focuses strongly on timber and hybrid engineered timber construction. The whole programme is focused on sustainability as students are

able to specialise in "Sustainable infrastructure construction", "sustainable building construction" and “Restoration and revitalization”

FH Campus Wien: Green Building (Architecture B, M)

As the name of the academic study suggests, this architecture programme focuses more on sustainability than traditional programmes at the cost of artistical and historical aspects. Even though there are not many courses explicitly only focusing on timber, the design studios put strong emphasis on timber constructions, as the head of the programme Martin Aichholzer has an architecture firm which focuses mainly on timber buildings.

Table 2.15 includes some study modules which main focus is timber design and construction.

Table 2.15. Study modules on timber design and construction in Austrian universities

Institution	Title of the module	ECTS	Learning outcomes	Teaching/learning methods
BOKU University of Natural Resources and Life Sciences, Vienna (U)	Basics in timber construction (TE_VU)	3	basics in designing timber- constructions, properties and behaviour of timber, structural design & dimensioning, details of construction (junctions, ...)	lecture with exercises
FH Campus Wien (UAS)	Steel and Wood Construction (A_VO)	2	Basics, material properties, design based on calculations of torque of shear force, torsion load, trusses, frames, stability, fire protection, connections, wind-bracing, corrosion protection, welding and screw connections, exercises, evidence according to Eurocode 1 of 1993 and 1995-1 EUROCODE.	Lecture with exam
FH Campus Wien (UAS)	Technical Timber Construction 1 VO (CE_VO)	1	Teaching of the relevant contents of the EN 1990 and EN 1995 standards as well as material-specific expertise as a basis for the design and dimensioning of timber structures.	Seminar + Final Written Exam
FH Campus Wien (UAS)	Technical Timber Construction 2 ILV (CE_VU)	4	Teaching of the relevant contents of the EN 1990 and EN 1995 standards as well as material-specific expertise as a basis for the design and dimensioning of timber structures. Demonstration of the calculation and design procedures according to EN 1995 on the basis of selected problems (examples).	Seminar + Final Written Exam
FH Joanneum (UAS)	Detailed Solutions in Construction Design (CE_VU)	5	The static-constructive construction tasks of a building in structural engineering are dealt with: development of a static calculation, static-constructive design, load assumptions, dimensioning of individual components with variation in	Lecture with integrated exercises

			materials and due to economic considerations (steel, wood, concrete), constructive detailed solutions.	
FH Joanneum (UAS)	Timber Construction	4	Types of wood and wood materials, chemical and physical material properties, calculation and dimensioning methods for structures made of wood and wood materials according to Eurocode 5, dimensioning of standardised and individually designed fasteners, constructive design.	Lecture with integrated exercises
FH Kärnten – Spittal Campus (UAS)	Timber Construction (CE_VU)	3.5	Students understand the particulars when using structural timber members. They are capable to dimension simple timber structures and to choose connection solutions in accordance to given requirements. They understand the requirements of constructive timber protection and fire protection as well. They consider those in design and construction. Students are capable to dimension basic timber structures (e.g. frameworks, roof structures, frames, basic bridges) and to conduct required limit state analyses. They can elaborate appropriate connection details.	Lecture with integrated exercises
FH Salzburg – Kuchl Campus (UAS)	Building & Timber Construction 1 (TE_VO)	1	The students are able to: - name the main types of wooden structures and the associated components and explain their properties in general - name and explain the specific characteristics of timber construction compared to other construction methods - name and generally describe classic elements of wooden buildings and their applications in timber construction.	Lecture with exam
FH Salzburg – Kuchl Campus (UAS)	Building & Timber Construction 2 (TE_VO)	1	- name timber construction systems and present the main construction and functional principles - describe and evaluate the principle characteristic details of timber construction methods on the basis of their properties with regard to statics and building physics - state and describe the advantages and disadvantages of timber construction methods with regard to installation properties.	Lecture with exam

FH Salzburg – Kuchl Campus (UAS)	Cabinetry and Interior Design (TE_VO)	1	- distinguish and characterize the classic construction principles of furniture and the associated joining techniques - name the essential materials in the manufacturing of furniture and to differentiate them based on their properties and fields of application - discuss the different ways of looking at furniture depending on the particular problem and to evaluate the respective construction principle - understand spaces and the spatial impact in connection with the contained objects and furniture and define initial design measures.	Lecture with exam
FH Salzburg – Kuchl Campus (UAS)	Economics (TE_VO)	1	The students are able to explain economical correlations and their effects on the areas of the wood industry.	Lecture with exam
FH Salzburg – Kuchl Campus (UAS)	Materials Science Wood (TE_VO)	2	- identify and differentiate the main wood-based materials - name the key figures for the characterization of wood-based materials and indicate the approximate scales - describe the main areas of application of wood-based materials and the reasons for choosing them.	Lecture with exam
FH Salzburg – Kuchl Campus (UAS)	Wood Physics (TE_VO)	1.5	- identify the essential physical properties of wood as well as their most important influencing factors and describe their dependence on environmental conditions - name the key indicators for the description of wood-physical properties and use them in applied problems to calculate state and process variables - compare individual types of wood in terms of selected wood-physical properties.	Lecture with exam
FH Salzburg – Kuchl Campus (UAS)	Wood Science - Wood Anatomy (TE_VU)	1	- explain the process of wood formation related to photosynthesis - name the different types of tissue that build up the trees and characterize them according to their respective functions - explain the importance of climatic influences on wood formation in trees and describe the resulting macroscopic wood characteristics	Lecture with project

			- recognize the different wood tissues and describe them in terms of their biological significance.	
FH Salzburg – Kuchl Campus (UAS)	Forestry Studies (TE_VU)	1.5	- recognize the forest as an ecosystem and explain the importance of forest management measures - name the main wood species in the Austrian forest and to explain the differences with regard to their significance for the forest - name and explain the key data for Austrian and international forests.	Lecture with project
FH Salzburg – Kuchl Campus (UAS)	Ecology & Environmental Science (TE_VU)	1.5	- understand and describe the basic correlations between selected ecosystems and their parameters - recognize and generally describe the impact of people and their actions on ecological systems - give examples of human-induced problems for ecosystems.	Lecture with project
FH Salzburg – Kuchl Campus (UAS)	Introduction to Construction Physics (TE_VU)	1.5	- evaluate construction methods and components with regard to thermal insulation properties, sound insulation properties, moisture protection properties and airtightness - check construction methods and components with regard to the requirements of building physics regulations on the basis of characteristic values.	Lecture with project
FH Salzburg – Kuchl Campus (UAS)	Materials Science (TE_VU)	1.5	- describe modern wooden materials and their production processes - characterize wood-based materials as lightweight materials and evaluate possible constructions - name areas of application for lightweight wood materials and to describe their special properties.	Lecture with project
FH Salzburg – Kuchl Campus (UAS)	Organic Chemistry and Process Technology (TE_VO)	1	- identify the essential organic functional groups and the importance of associated molecules and reaction types in the timber industry - describe the composition of wood depending on the type of organic tissue - describe the application of process technologies in the timber industry and explain them on the basis of simple facilities.	Lecture with exam

FH Salzburg – Kuchl Campus (UAS)	Wood Classification (TE_UE)	1	- distinguish hardwood from coniferous wood - differentiate the Central European conifers based on their anatomical characteristics and to name applications for these wood species - differentiate the Central European hardwood species based on their anatomical features and name applications for these wood species.	Exercise
FH Salzburg – Kuchl Campus (UAS)	Wood Science, Wood Quality and Wood Protection (TE_VO)	2	- name the quality characteristics of sawn timber and round timber and evaluate them using suitable measurement parameters - evaluate log quality depending on the type of wood - evaluate sawn timber quality depending on the type of wood - describe the hazard potential of wood quality when using wood.	Lecture with exam
FH Salzburg – Kuchl Campus (UAS)	Introduction to Engineered Wood Products (TE_VO)	2	- record and describe the production processes in the wood-based panel production, to name the essential process and plant parameters and to describe the interrelationships with the respective product quality - describe the products of woodworking and wood processing and to describe the essential fields of application, as well as their advantages and disadvantages in use and to select them for the respective application.	Lecture with exam
FH Salzburg – Kuchl Campus (UAS)	Wood Processing & Woodworking 1 (TE_VO)	1	- record and describe the production processes in woodworking and wood processing, to name the essential process and plant parameters and to describe the correlations with the respective product quality. - describe the products of woodworking and wood processing and to describe the essential fields of application, as well as their advantages and disadvantages in use and to select them for the respective application.	Lecture with exam
FH Salzburg – Kuchl Campus (UAS)	Data analysis for the Wood Industry (TE_VO)	2	- create and evaluate statistic variables for the evaluation of production processes and for quality control - develop simple statistic test methods to control the production processes in	Lecture with exam

			ongoing productions and to derive procedures for carrying out quality checks.	
FH Salzburg – Kuchl Campus (UAS)	Research Methods: Forest Products Technology and Chemistry (TE_UE)	2	- apply laboratory methods of wood and natural fibre chemistry and use qualitative and quantitative investigation methods - present chemical laboratory results quantitatively correct and to describe the findings of the analysis.	Exercise
FH Salzburg – Kuchl Campus (UAS)	Wood Chemistry (TE_VU)	1.5	- describe the chemical structure of wood and to differentiate according to the species - explain the essential chemical behaviour of wood based on its chemical composition and to chemically evaluate possible wood modifications - explain and discuss the adhesive behaviour of wood due to chemical characteristics.	Lecture with project
FH Salzburg – Kuchl Campus (UAS)	Wood Processing & Woodworking 2 (TE_VU)	3	- evaluate current plants in the wood industry with regard to productivity and compare the products based on suitable quality indicators - explain the development of the markets for wood industry products and plants and derive new opportunities for further development for companies.	Lecture with project
FH Salzburg – Kuchl Campus (UAS)	Building & Timber Construction 3 (TE_VO)	2	- develop a wooden building from the foundation to the roof - recognize the relevant influencing parameters - consider relevant areas of expansion and development.	Lecture with exam
FH Salzburg – Kuchl Campus (UAS)	Bonding Technology and Joints (TE_VU)	3	The students can name tried and tested joining techniques for wood and timber construction and can use them depending on load, installation situation and service class in production as well as in constructions in new buildings and renovations.	Lecture with project
FH Salzburg – Kuchl Campus (UAS)	Fire Protection (TE_VO)	1	- describe and evaluate the performance of building products made of wood with regard to combustion behaviour and possible exposure time - evaluate their possible applications depending on legal fire protection requirements or with regard to the achievement of the required protection goals - explain and apply the basic rules of fire protection.	Lecture with exam

FH Salzburg – Kuchl Campus (UAS)	Engineered Wood Products 2 (TE_VU)	3	- differentiate the process engineering in the production of wood-based materials and are able to clarify the essential differences between the raw materials and their treatment on a technical basis - describe the necessary systems for the production of a wood-based material manufactured in compliance with the law and to precisely define the process parameters - evaluate the impact of process parameters on the economic efficiency of the process.	Lecture with project
FH Salzburg – Kuchl Campus (UAS)	Trends in the Wood Market (TE_VO)	1	- understand and apply the legal framework for concluding contracts and the acquisition of raw materials in the timber industry - understand the specifics of the timber industry and comply with the essential legal requirements for the marketing of wood-based products - determine important imported wood species and their properties.	Lecture with exam
FH Salzburg – Kuchl Campus (UAS)	Wood Drying Basics (TE_VU)	1.5	- develop a drying program for an ideal-typical species of coniferous wood and an ideal-typical species of hardwood - analyze the quality of the wood drying process during and after the process and to intervene in the drying process in a targeted manner.	Lecture with project
FH Salzburg – Kuchl Campus (UAS)	Manufacturing Technology (TE_VU)	3	The students are able to design and calculate production plants for wood products.	Lecture with project
FH Salzburg – Kuchl Campus (UAS)	CIM - Industry 4.0 (part 2) (TE_VO)	1	The students are able to apply the methods and ways of thinking of Computer Integrated Manufacturing (CIM) in the sense of Industry 4.0 on the basis of specific tasks.	Lecture with exam
FH Salzburg – Kuchl Campus (UAS)	CIM - Industry 4.0 Basics (TE_VU)	1	- describe the concept of Computer Integrated Manufacturing, and present and apply the essential elements - trace the creation and collection of data from planning to production and to represent it in production processes in accordance with the Internet of Things and the principles of Industry 4.0.	Lecture with exam

FH Salzburg – Kuchl Campus (UAS)	Furniture and Component Testing (TE_VO)	1	The students are able to recognise the importance of furniture and parts testing as a fixed component of R&D or as a task of technical product management and to anchor it in product development in a targeted manner.	Lecture with exam
FH Salzburg – Kuchl Campus (UAS)	Surfaces Technology 2 (TE_VO)	1	The students are able to assess the wide range of possible applications in surface technology in a differentiated way and to represent them conceptually in projects and application scenarios using examples.	Lecture with exam
FH Salzburg – Kuchl Campus (UAS)	Experimental Furniture Construction/Workshop (TE_VU)	1.5	- stimulate creative interventions from different perspectives and to illuminate them from different perspectives - discuss specific design decisions in intercultural teams and to develop common solutions.	Lecture with project
FH Salzburg – Kuchl Campus (UAS)	FEM-Simulation and Rapid Prototyping (TE_VU)	3	The students can describe the principles of furniture statics and use FEM software for simulation. They can name the different possibilities of rapid prototyping and evaluate their advantages and disadvantages in connection with the development of furniture. They are able to apply selected methods of rapid prototyping in practice.	Lecture with project
FH Salzburg – Kuchl Campus (UAS)	Construction - Wood Protection (TE_VO)	1	The students can explain the requirements for structural wood preservation and the distinction to chemical wood preservation. They have the ability to evaluate building elements, components and detailed solutions with regard to the potential hazards and to find appropriate design variants or adaptations of existing solutions to improve wood preservation.	Lecture with exam
FH Salzburg – Kuchl Campus (UAS)	Construction Implementation – Costs (TE_VO)	1	The students can explain Önorm B2016 "Pricing of construction services" and a standard structure of costing (calculation), which includes the following areas: Direct service costs (wages, material, equipment); Construction site overheads; Business overheads; Other overheads; Building interest rates; Risk; Profit. They can create, maintain and extend a project plan, as well as identify and document deviations.	Lecture with exam
FH Salzburg – Kuchl	Construction Physics 3 (TE_VU)	1.5	The students are able to simulate and calculate the areas of thermal insulation, moisture proofing and sound insulation	Lecture with project

Campus (UAS)			more specifically, partly by using software packages.	
FH Salzburg – Kuchl Campus (UAS)	Wood Construction - Detailed Plans (TE_VU)	1.5	Using the example of a real project, students can plan and represent the critical structures and details, taking into account fire protection in timber construction, including connections and building service technology installations.	Lecture with project
FH Salzburg – Kuchl Campus (UAS)	Specialisation Project (TE_VU)	8	The students are able to independently handle a business or research project in wood technology and/or the wood industry and to document it in such a way that a scientific paper can be created.	Lecture with project
FH Salzburg – Kuchl Campus (UAS)	Costs and Calculations for Furniture (TE_VO)	1	- carry out interior design planning based on given framework conditions such as interior and furniture and technical specifications and, in particular, to calculate economically - prepare offers for specific tenders based on the assessment of material costs, workload and other operating costs - determine prices for furniture depending on quantity and sales strategy and to calculate variations.	Lecture with exam
FH Salzburg – Kuchl Campus (UAS)	Construction Physics 2 (TE_VO)	1	- name, evaluate and take into account the guidelines for thermal protection, moisture-proofing and sound insulation when developing and planning detailed solutions in timber construction - create an energy performance certificate.	Lecture with exam
FH Salzburg – Kuchl Campus (UAS)	Timber Constructions 1 (TE_VU)	3	- construct load-bearing systems for timber structures - design and dimension on the basis of the action/load combinations and under consideration of safety concepts (EC) - check the usability of the selected structures. They can name the relevant materials for timber engineering and evaluate their possible applications.	Lecture with project
FH Salzburg – Kuchl Campus (UAS)	Timber Constructions 2 (TE_VU)	3	The students can dimension connections, constructions and bonding agents used in timber construction on the basis of the valid norms (EC) and prove their usability.	Lecture with project
FH Salzburg – Kuchl Campus (UAS)	Construction - Modelling and Simulation (TE_UE)	1	- create and simulate a 3D model of a building, a room or a piece of furniture - convert a 3D scanned object into a 3D model	Lecture with project

			- prepare a 3D model for CNC manufacturing and to carry out the production.	
FH Salzburg – Kuchl Campus (UAS)	Materials Science: Strength Theory and Testing (TE_VU)	1.5	The students can explain and mathematically describe the principles of linear elasticity theory and apply them to questions regarding the dimensioning of components.	Lecture with project
FH Salzburg – Kuchl Campus (UAS)	Industrial Information Technology (TE_VU)	3	- name the essential components of industrial information technologies and compare their characteristics - select the basics of information technologies in the timber industry based on the specific requirements and to describe the requirements for the interfaces.	Lecture with project
FH Salzburg – Kuchl Campus (UAS)	Fire Prevention 2 (TE_VO)	1	The students can explain the OIB Guideline 2, the guidelines and the OIB Guidelines 2.1, 2.1 and 2.3 and apply them to the planning and construction of buildings and construction projects.	Lecture with exam
FH Salzburg – Kuchl Campus (UAS)	Quality Management (TE_VU)	3	The students can name the methods and processes of QM and can apply them practically in the operational environment.	Lecture with project
FH Salzburg – Kuchl Campus (UAS)	Markets for Forest Products (TE_VU)	2	The students are able to recognize, evaluate and proactively control operational and strategic market changes and their effects on the companies in the industry.	Lecture with project
University of Innsbruck (U)	Methods in Structure and Design (A_UE)	5	Comprehensive design skills, linked to parameterised digital methods, considering the interaction between structure and design, which are analysed both, physical and digital experiments for wooden alternatives.	experimental physical and digital models to investigate the correlation between structure and design. These experiments will be used to develop a material system that will be studied in various scales.
University of Innsbruck (U)	Timber Construction 1 (CE_VO)	2.5	After the successful completion of the VO Timber Structures 1, the students are able to understand the specific properties of timber as a structural material and its reaction towards environmental conditions. The students are able to apply	The contents and competencies are conveyed by lectures, supported by work on the blackboard

			this knowledge in the design and dimensioning of timber structures, with special consideration of appropriate connections between timber components.	and presentations. Material to illustratively demonstrate the subject presented is provided.
University of Innsbruck (U)	Timber Construction 1 (CE_UE)	2.5	After successful participation in UE Timber Construction 1, students are able to understand timber structures taking into account the specific properties of wood as a material, and to apply this knowledge to the design of such structures, with special consideration of the material-appropriate connection of timber components.	The contents of the lecture will be deepened via the exercise sessions within UE Timber Construction 1.
TU Graz (U)	Basics of Timber Engineering (CE_VU)	6	Students should be able to make a conceptional and structural design of an elementary timber construction. In addition, students should be able to propose the most efficient solution out of the diversity of wood products and connection techniques for a given problem. Within the exercise lectures integrated in this course special attention is put on the conceptional and structural design of different solutions for a timber construction. This means that students should be able to propose the utilisation of different and adequate products as well as detailed solutions for one and the same construction.	Lecture with exercise character; in general cases of special hygienic requirements, e.g. in frame of COVID-19, partly or complete online teaching, exercising and training (e.g. via e-mail, slide videos, exercising videos and / or life-streaming of lectures / exercises as well as online meetings, etc.) might occur.
University of Applied Sciences upper Austria (UAS)	Timber Construction (CE_VO)	3	…	…

Note: CE – Bachelor Programme Civil Engineering ; A – Bachelor Programme Architecture; TE – Timber Engineering.

3. GOOD PRACTICES AT THE INTERNATIONAL LEVEL

The partners have analysed the education in timber design and construction at the international level – in both the EU and other countries. Examples of available study modules are provided in Table 3.1.

Table 3.1. Study modules in timber design and construction in other countries

Institution	Title of the module	ECTS	Learning outcomes	Teaching/learning methods
KTH Royal Institute of Technology (Sweden)	Steel and Timber Structures	7.5	The general the aim of the course is to provide detailed knowledge in analysis and design of structural members in steel and timber. After passing the course, the student should be able to: • Determine the design resistance of steel beams with unsymmetrical cross-sections considering bending moment, axial force, shear force, and patch loading. • Explain and analyse the influence of instability phenomena as lateral torsional buckling, flexural buckling and local buckling for steel beams with slender cross-sections. • Determine the design resistance for bolted and welded connections in steel structures. • Explain and analyse phenomena as vibration and lateral torsional buckling of timber beams. • Determine the design resistance for straight and tapered glulam beams, also considering holes and notches. • Determine the design resistance for nailed, bolted and screwed connections in timber structures. • Using a commercial software for design of steel and timber structures.	N/A
TU Delft (Netherlands)	Construction Materials and Sustainability	5	Define material science and material engineering. • Classify main construction materials. • Tell importance of standards and standardization in material production, selection and use	Lecture hours and self-study

			• Define and illustrate the basic properties of atoms, different atomic bonds, crystal structures and dislocations. Relate bonding properties to the physical properties of materials. • Relate chemistry to mechanics • Define stress and strain, classify different material behavior under stress, define Poisson's ratio. Classify and analyze E-modulus on stress-strain diagrams • Differentiate elastic and plastic behavior. Define and compute tensile and compressive stress, list effect of testing parameters, define material hardness.	
TU Delft (Netherlands)	Building Structures 1	4	Demonstrate understanding of various aspects of low-rise buildings and be able to design low rise building structures, with a specific focus on: •Functional, structural and construction requirements for housing and industrial buildings •Relationship between load bearing structure and finishing structure for roof, facade and ground floor for housing and instustrial buildings •Steel and concrete elements on intermediate level (know requirements related to transport, assemblage and maintenance, design and calculate of structures with some complexity, select suitable detail and construction options) •Timber elements on introductory level (design and calculate simple structures, select suitable detail and construction options, understand thermal behaviour)	Workshops and design exercise
TUM	Technology and utilization of wood	3.5	After participating in the module events, the student is able to describe, analyse and evaluate the treatment and processing procedures for converting raw wood into different products. Another learning outcome is to analyse and evaluate development	N/A

			potentials.	
Bern University of Applied Sciences (Switzerland)	Technology and Physics	9	Knowledge about physics, sawmill technology, construction design and timber house construction.	Lectures, practical tasks, individual projects.
University of Twente (Netherlands)	Designing constructions	15	Knowledge about how the principles of circularity can be applied to the whole cycle of buildings and infrastructure (from the first initiative to demolition); Knowledge of the supporting structures of buildings, for example, strength calculations, stiffness, stability and distribution of forces.	Lectures, practical tasks.
Rosenheim University of Applied Sciences (Germany)	Design of timber construction	3	Knowledge about design of timber construction	Lectures, practical tasks.
Rosenheim University of Applied Sciences (Germany)	Timber construction	4	Knowledge about timber construction	Lectures, practical tasks.
University of Westminster (UK)	Design, Materials and Fabrication	20	Knowledge about design of timber construction	Studiobased design modules, taught modules divided between cultural context and environmental and technical studies subjects. Laboratory experimentation, monitoring and surveying exercises and prototype fabrication and testing.
University of Westminster	Environmental Design and Technology	10	Knowledge about physics, wood construction technology, construction design and timber house construction.	Studiobased design modules, taught modules

				divided between cultural context and environmental and technical studies subjects. Laboratory experimentation, monitoring and surveying exercises and prototype fabrication and testing.
SAIT (Southern Alberta Institute of Technology) (Canada)	Architectural Technologies ARCH 305 - Research and Design II	3	Design principles and methodology are applied to commercial structures by analyzing client needs, site considerations, case studies and schematic design. The design process will be similar to semester two though the task at hand will be more complex. Emphasis will be placed on representing the work to stakeholders. This course will guide students through the	Lectures, practical tasks,laboratory works,Design tasks
SAIT (Southern Alberta Institute of Technology) (Canada)	Architectural Technologies ARCH 353 - Technology IV	3	In this course, students will expand their knowledge of the tools and technologies explored in the previous courses. They will also explore new and emergingtools and trends which can be integrated into their semester project. An integral component ofthis course is the use of simulation tools to test performance and refine projects. The student will be expected to use an interdisciplinary and innovative approach in their use of tools and technologies within their project.	Lectures, practical tasks,laboratory works,Design tasks

4. MAPPING OF THE COMPETENCIES

Partners were asked to evaluate the development extent of the competencies, relevant to education in design and construction of sustainable hybrid timber buildings at their universities. Summary results are presented in Table 4.1.

Table 4.1. Mapping of the competencies across partner universities and according to labour market needs

Competencies	Very extensively	Extensively	Not extensively	Not at all
Understanding of wood species **(R)**	VIA UC	UPC, TU Wien	VILNIUS TECH, RTU	
Knowledge of modern engineered timber Products **(R)**	VIA UC	UPC, TU Wien	VILNIUS TECH, UPC, RTU	
Understanding of hybrid timber construction (using different materials) **(VR)**		VIA UC, UPC, TU Wien	VILNIUS TECH, RTU	
Structural design skills **(VR)**	VIA UC	VILNIUS TECH, UPC, RTU, TU Wien		
BIM application skills **(R)**	VIA UC	VILNIUS TECH, UPC, RTU, TU Wien		
Understanding of the fire safety requirements **(VR)**	VIA UC, VILNIUS TECH, RTU	TU Wien	UPC	
Understanding of the acoustic performance of timber buildings **(R)**		VIA UC, UPC, RTU, TU Wien		VILNIUS TECH
Understanding of the moisture performance of timber buildings **(VR)**	VIA UC	TU Wien	VILNIUS TECH, RTU	
Organisational and planning skills of timber construction projects **(R)**		VIA UC	VILNIUS TECH, UPC, RTU, TU Wien	
Management skills in hybrid timber construction Projects **(R)**			VIA UC, VILNIUS TECH, UPC, RTU, TU Wien	
Safety assurance in construction of timber Buildings **(R)**		VIA UC, RTU, TU Wien	VILNIUS TECH, UPC	
Understanding of the environmental impacts **(VR)**	UPC, RTU, TU Wien	VIA UC, VILNIUS TECH		

Maintenance of hybrid timber buildings **(R)**	RTU		UPC, TU Wien	VIA UC, VILNIUS TECH
Understanding written documents and writing Clearly **(R)**	VIA UC, VILNIUS TECH, UPC, RTU, TU Wien			
Ability to calculate, read and use drawings **(R)**	VIA UC, VILNIUS TECH, UPC, TU Wien	RTU		
Learn to learn skills **(R)**	TU Wien	VIA UC, VILNIUS TECH, UPC, RTU		
Negotiation skills **(R)**		VIA UC, VILNIUS TECH, UPC, RTU, TU Wien		
Acquiring, interpreting and communicating Information **(R)**	VILNIUS TECH, RTU, TU Wien	VIA UC, UPC		
Leadership skills **(R)**		VIA UC, VILNIUS TECH, UPC, RTU, TU Wien		
Team working **(VR)**	VIA UC, UPC, TU Wien	VILNIUS TECH, RTU		
ICT skills **(R)**	VILNIUS TECH, TU Wien	VIA UC, UPC, RTU		
Decision-making skills **(R)**	TU Wien	VIA UC, VILNIUS TECH, UPC, RTU		
Problem-solving skills **(VR)**	VIA UC, TU Wien	VILNIUS TECH, UPC, RTU		
Efficient use of materials, technology, equipment and tools **(VR)**	VILNIUS TECH, UPC	VIA UC, RTU, TU Wien		
Ability to work accurately and in compliance with standards **(VR)**	VIA UC, VILNIUS TECH, UPC	RTU, TU Wien		

Note: R – required; VR – very required. Yellow colour – extensively developed at partner universities; Red colour – not extensively developed at partner universities.

Analysis of the competencies revealed that in some of the universities (VIA UC, TU Wien, UPC) students acquire extensive understanding of wood species, knowledge of modern engineered timber products, understanding of hybrid timber construction (using different materials). However, these competencies at VILNIUS TECH and RTU are developed to a very limited extent.

All universities provide students with the structural design and BIM application skills.

At university programmes attention is paid on fire safety requirements, but not sufficient knowledge is provided on acoustics and moisture performance of timber buildings. Safety assurance in construction of timber buildings is developed at VIA UC, RTU, TU Wien, but to limited extent at VILNIUS TECH and UPC.

All universities indicated that organisational and planning skills of timber construction projects and management skills in hybrid timber construction projects are not extensively developed. The same is relevant for maintenance of the hybrid timber buildings.

All universities provide knowledge on the environmental impacts, develop understanding of written documents and writing, ability to calculate, read and use drawings and develop soft skills of students, such as learn to learn skills, negotiation skills, acquiring, interpreting and communicating information, leadership skills, team working, ICT skills, decision-making skills, problem-solving skills. In addition, all universities provide extensive skills on efficient use of materials, technology, equipment and tools and ability to work accurately and in compliance with standards.

Acquired results were compared with the survey results of business companies. Competencies that are very required in the labour market shall be developed in the new course, namely:

- Understanding of hybrid timber construction (using different materials)
- Structural design skills
- Understanding of the fire safety requirements
- Understanding of the moisture performance of timber buildings
- Understanding of the environmental impacts
- Team working
- Problem-solving skills
- Efficient use of materials, technology, equipment and tools
- Ability to work accurately and in compliance with standards.

CONCLUSIONS

Survey of the business companies revealed that the situation over the last 12 months varied. 40% of enterprises had been operating at or near full capacity, 29% of enterprises for some time did not have enough skilled workers, while 16% did not have enough skilled workers for the work they had or could have had.

The main cause of having hard-to-fill vacancies for skilled staff is that not enough young people being trained in the field of wooden construction in recent years, other important causes are that applicants lack of skills required by enterprises or lack experience. Therefore, education in hybrid timber design and construction shall be extended and improved.

Most of the enterprises are providing further training inside or organizing external trainings, some of the companies make influence on providers of education in order to ensure the inflow of newcomers.

Most of the respondents think that they will need to acquire new skills or knowledge over the next 12 months. Main causes are new eco/energy saving design/build methods, the introduction of new technologies and equipment, environmental requirements, new legislative/regulatory requirements, and the development of new products and services.

Companies provided suggestions for improvement of education of the students, i.e., students need more practical skills, obtained on sites; specific modules and more interactive digital information and education platforms shall be developed. These results confirmed that the HybridTim course is being developed on time.

Major barriers for timber construction development distinguished by survey participants are lack of knowledge, lack of skills, concerns regarding fire safety, and concerns regarding structural stability. Other barriers are restrictions by law, high price of materials, competition with concrete industry, lack of materials.

Three major drivers for hybrid timber construction development are orientation towards sustainable construction, high environmental efficiency, and increased market interest. Other significant divers are increase of knowledge on wooden construction by designers and technicians, new engineered wood products/technological solutions, change of laws/regulations, and public appreciation.

HybridTim consortium includes five high quality education institutions in terms of national and international rankings, internationalization, cooperation with business partners.

The project fits into general strategies of the universities as part of the international, academic development and research activities. Each university has a clear strategy how to integrate a new module/it's part into existing study programmes.

Analysis of available education revealed that education in hybrid timber design and construction is extensively developed at TU Wien, developed at VIA UC and UPC, but only indirectly included in some subjects at RTU and VILNIUS TECH.

Education in hybrid timber design and construction is extensively developed in Austria, developed in Denmark, Spain, to lower extent in Latvia and almost not developed in Lithuania.

Modules on timber design and construction are included into the study programmes of highly ranked universities, such as TUM, TU Delft, KTH. This reveals the significance of such education.

Mapping of competencies revealed a very required competencies in the labour market that shall be developed in the new course, namely:

- Understanding of hybrid timber construction (using different materials)
- Structural design skills
- Understanding of the fire safety requirements
- Understanding of the moisture performance of timber buildings
- Understanding of the environmental impacts
- Team working
- Problem-solving skills
- Efficient use of materials, technology, equipment and tools
- Ability to work accurately and in compliance with standards.