D7. REPORT FORMATIVE MAP CONSTRUCTION SECTOR

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Executive Summary

The purpose of the WP2 is in one hand to identify the main trends and innovations the construction sector is facing or will be facing in the coming years and in the other hand to identify the impacts of these evolutions on the occupations and the training needs of the construction sector. This WP2 is divided into three main tasks which are the study of the economic-business framework of the sector through secondary sources (desk research), the identification of prospecting trends in the sector (interviews) and the competence reality study of the sector (Delphi Panel).

The research undertaken in relation to the creation of a formative map showed that there are key challenges in relation to quality in vocational education and training within the European construction sector and on how the EQAVET Recommendation can support the development and improvement of national education and training systems in relation to the construction sector.

According to integrating ECVET, we suggest an overall learning time of hours of learning could be established, including direct contact hours, hands-on practice, self-study and assessment hours. The allocation of ECVET points should be based on using a convention according to which 60 points are allocated to the learning outcomes expected to be achieved in one year of formal full time VET. It is up to the competent institutions in charge of designing qualifications to decide which specific programme will be chosen as a point of reference. The duration of the selected reference programme, together with the ECVET convention on ECVET points (60 points for 1 year), will give the number of ECVET points allocated to the qualification. The learning outcomes, according to the EQF framework, are to be found in a synoptic table and consider especially the levels of EQF, in the trades of the construction sector.

An important issue is that generic skills such as problem orientation, problem solving, communication, design and entrepreneurial skills – which are critical for cross-occupational collaboration in work teams and for exploiting value-added creativity at the enterprise level- need to form part of education and training programmes within the construction sector, as 21st century jobs and occupations require the development of these new skills within the sector, such as green and tech skills.

Introduction

The purpose of this report is to give an insight into the main trends and innovations the construction sector is facing or will be facing in the coming years in order to identify the impacts of these evolutions on both the sector's training needs. This report focuses on the formative map of the construction sector carried out by the University of Limerick. Both reports hold the same structure as both organisations used the same methodology.

The diagnosis will first be elaborated by collecting the prospective point of view of different areas to understand the construction sector. These areas are: the economic-business area, the occupational and competence area, the training fields. Then, the analysis of the construction sector will help design the skills and formative maps of the sector, as it will also allow the correlation and correspondence between professional competences and related training actions.

The specific tasks to collect the information necessary to the development of both maps are:

1. The study of the economic-business framework of the sector through secondary sources,
2. The identification of prospecting trends in the sector: changes and difficulties with interviews with experts,
3. The competence reality study of the sector: skills panorama, ESCO, EUROSTAT, etc. Experts Delphi Panel.

Objectives of WP2

Detecta aims to identifying and providing detailed evidence on skills needs, and gaps in craft economic sector. This would make it possible to address such gaps through training provision, whether it be VET-based or any other education and training sector.

Work package 2 aim was to provide a prospective diagnosis of the construction sector. Initially, a perspective view generated by a review the skills and training landscape in the construction sector. These areas are the economic-business area; the occupational and competence area; and the training fields.

Then, the analysis of the construction sector will help design a formative training map of the sector, as it will also allow the correlation and correspondence between professional competences and related training actions.

The specific tasks to collect the information necessary to the development of both maps are:

4. The study of the economic-business framework of the sector through secondary sources,
5. The identification of prospecting trends in the sector: changes and difficulties with interviews with experts,
6. The competence reality study of the sector: skills panorama, ESCO, EUROSTAT, etc. Experts Delphi Panel.

Diagnosis of the Construction Sector

To collect the perspectives of the different areas, the understanding of the construction sector has been divided into three main steps (see above). UFEMAT as leader organisation of this WP has designated Constructiv to realise those tasks in collaboration with the University of Limerick.

Step 1: The Desk Research

The first step to diagnose the construction sector was the study of the most recent secondary sources that describe and characterize the construction sector at European level. The methodology followed in this analysis was the pre-analysis, the coding, the categorization and the interpretation of these sources. The coding and categorization methods respected the tables provided by FORTEC (see table).

REPORTS AND STUDIES:		
URL	•	
URL information	•	
Typology	Statistics	
	Bibliographic	
	Statement	
Resume		

ANALYSIS OF RELEVANCE OF THE SOURCE			
INCLUSION CRITERIA	INDICATOR OF RELEVANCE	% value	% value (maximum)
Accessibility	Degree of openness	0	10%
	Localisation	0	10%
	Percentage of Accessibility	0	20%
Frequency and update	Frequency	0	10%
	Updating	0	15%
	Percentage of frequency and update	0	25%
Rigour	Origin and impact	0	10%
	Systematisation	0	10%
	Percentage of rigour	0	20%
Completeness	Totality, credibility and representativeness	0	15%
	Percentage of completeness	0	15%
Adequacy	Typology of source	0	20%
	Percentage of adequacy	0	20%
	Total	0	**100%**

The desk research was divided into two stages, on one hand the compilation of statistics through a data inventory based on available European and national data and on the other hand the compilation of publications, articles, reports. The final version of this inventory gathered quantitative data identified in reports but also indicators:

- Eurostat indicators inventory
- Skills panorama indicators inventory
- List of public employment services across Europe
- Surveys: Construction Europe Barometer, …
- Publication/articles: European Builders Confederation, …
- List of occupations in shortage extracted from the Trends Identification Report

The Construction 2020 Strategy and Action Plan addresses the sector's challenges up to 2020 and sets out strategic priorities. Practitioners and policy-makers are working together to implement the action plan, with a special focus on five areas: innovation and finance; skills and mobility; sustainable resource use; regulatory fitness; and access to international markets (European Commission, 2012).

In 2015, the European Commission launched the European Construction Sector Observatory to provide analysis and comparative assessments of market conditions and policy developments (an analytical report on skills was published in July 2017); it details a significant shortfall of qualified workers for on-site construction enterprises and to a lesser extent for the construction products' industry. Moreover, education and training systems across Europe display great variety in the degree of centralisation or decentralisation, the structure of training provision, the role of the social partners, financial structures and curriculum content (European Construction Sector Observatory, 2017).

In the same year, the Commission also launched its promotion of the European Alliance for Apprenticeships (EAfA) in the construction sector, which has been the only individual sector involved so far. 56 pledges from the sector represent one quarter of all EAfA pledges and the majority of pledges by SMEs.

Numerous changes including demographic, structural and technological are affecting the composition of the workforce, employment levels, job content and how workers experience their working lives (Eurofound, 2017). The principal challenges that the sector will face over the medium term all point towards skill needs being high and dynamic as the skill content of jobs is likely to change (UK Commission for Employment and Skills, Sector Skills Insights: Construction, 2012).

Within the construction industry we are confronted with a labour market contradiction: on the one hand unemployment rates remain at high levels in many Member States, in particular amongst youngsters, whilst, on the other hand, many vacancies are available in the construction industry.

Despite a number of initiatives to make the construction sector more attractive, there are still difficulties in attracting and retaining women and, in several countries, young people in general. Combined with an ageing workforce, there is therefore a clear need to address such recruitment problems in the industry, amongst others through a more open and permeable labour market and construction process.

Workers and construction companies are faced with challenges in matching the right skills and professional qualifications with the needs of the companies. Several factors can explain this situation:

GREEN AGENDA & LOW CARBON

"Green" policies, and in particular energy efficient work, require close coordination between the different occupations on a worksite, placing demands on these occupations that go beyond their immediate scope of responsibilities to understanding the building fabric as a unified system. This requires enhanced technical knowledge and soft skills associated with, amongst others, communication, team working and self-management.

Modern methods of construction and the implementation of low carbon systems and materials will require new skills and adaption and upgrading of the skills of people working in the sector. A workshop 'Future skill needs for the green economy', held at CEDEFOP in Greece in 2008, noted in relation to the construction sector that the jobs directly created from thermal renovation of buildings were expected to be of relatively low qualification level. Also stating that workers already in the sector should receive training in sustainable building further noting that blue collar workers will need to be offered lifelong learning programmes (CEDEFOP, 2009).

Once a green building project is approved for construction work to begin, people with appropriate skills are required to implement it. Green building brings new technologies and techniques to construction. These change the skills required, although most roles can still be filled by skilled construction trades workers from existing occupations with only a limited amount of additional training (International Labour Office (ILO), 2011).

TECHNOLOGICAL CHANGE & INNOVATION

Innovation and technological changes, very often driven by external providers, are growing at an increasingly rapid pace. They have a strong influence on market needs and are thereby putting pressure

on existing training schemes, which have to take such changes into account. Anticipating future skills needs is therefore a significant challenge for companies, as well as for training providers.

Across the EU legislative and technological changes are pushing dramatic advances in the sustainable building arena. BIM and nZEB are now being adopted or plan to be in 50% of the 27 countries (World Economic Forum, 2016) as default technologies and required standards in particular for public sector investments. The recent World Economic Forum report Shaping the Future of Construction (World Economic Forum, 2016) outlined how labour productivity in construction was largely stagnated in Europe, however new construction techniques such as BIM is beginning to improve the market (see Figure 4).

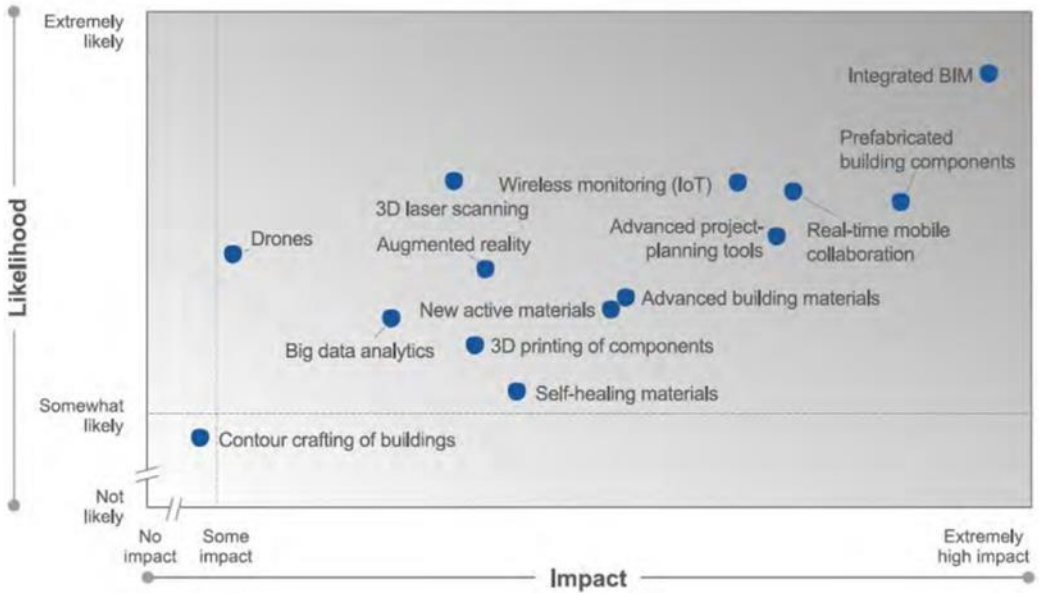

Figure 1 Impact likelihood matrix of new technologies extracted from WEF 2016

Modern methods require upskilling, reskilling and multi-skilling. Use of more off-site construction brings about a shift in the mix of skills required. Automated tools requires new skills and makes some redundant. Many countries recognise the need for high quality, high-level technical education to underpin the delivery of technologically advanced products and services and are scaling up their vocational education curriculum and sectors accordingly. The United Kingdom, Canada, Germany, Austria among other countries are focusing on building strong, innovative vocational education sectors to support their future workforce strategies (Jones, 2018).

BIM

The EC publication "New Skills Agenda for Europe" identified an essential need to focus on digital skills in the industry to increase productivity launching Digital Skills and Jobs Coalition with the outcome of the EU BIM Taskforce publishing "Handbook for the introduction of Building Information Modelling by the European Public Sector". The development and deployment of digital technologies and processes is central to the required transformation of the construction industry. Building Information Modelling (BIM) is gaining currency as a platform for central integrated design, modelling, planning and

collaboration. BIM provides all stakeholders with a digital representation of a building's characteristics – not just in the design phase but throughout its life cycle (European Commission, 2016).

The uptake and sophistication of BIM vary considerably from country to country, and from company to company – according to their size and position in the value chain. For some large engineering companies, BIM is already part of business as usual, but most small companies across the value chain have little BIM experience. In fact, even some of the major contractors have never used BIM on any of their projects. The difference in adoption rates within Europe is considerable; for example, 16% of E&C companies in the United Kingdom have never used BIM, while in Austria the figure is 49%.

A serious challenge relates to the increasing sophistication of technology, which demands new and broader skill sets at all levels of a company.

DEMOGRAPHIC CHANGE & THE TRAINING & RETRAINING NEEDS OF MIDDLE-AGED AND OLDER PEOPLE

The construction industry has what is considered an ageing workforce that will seriously affect the industry, as essential skills will be lost when employees retire. This is exacerbated by the fact that the number of new recruits is declining and there will be nobody available to replace those retiring. Further, key skills can be lost through retirement and it is imperative that young entrants be attracted to the industry (UNESCO & Commonwealth of Learning, 2017).

Bloom, Canning and Fink (2010) predict that by 2050, more than 22 per cent of the world's population will be aged 60 or older, compared with 10 per cent in 2000. Further noting that re-skilling older workers in the ever-changing work environment presents some challenges. The older workers may have lower qualifications than the younger generation and lack confidence in their ability to change. They may need encouragement and special provision to entice them into further training (Bloom, Canning, & Fink, 2010).

SUSTAINABILITY

Energy efficiency is one of the main drivers of skills development in the sector. The European Commission agreed to decarbonise the European building stock by 2050. It is foreseen that 3-4 million workers will need to be updated in this field. Different materials for new builds, retro-fitting, etc. require enhanced skills and new skills. Low energy requirements introduces increased need for specialist, technical and professional skills.

The EU Energy Performance of Buildings Directive (EPBD) promotes improved energy performance in new and existing buildings and initiated further amendments in 2018. Aiming to accelerate the cost-effective renovation of existing buildings, with the vision of a decarbonised building stock by 2050 and the mobilisation of investments. The Energy Efficiency Directive (EED) set out a roadmap with milestones for a 40% emissions reduction, 27% share for renewable energy and at least 27% improvement in energy efficiency by 2030 and 60% emissions reduction by 2040 and for 2050 to reduce EU wide emissions by 80% to 95%, compared with 1990 levels. From these directives the Nearly Zero Energy Building (NZEB) standard evolved with a definition of the term as given by the EU.

SKILLS MISMATCHES

While there are reports of skill shortages and surpluses in particular industries, reflecting the waxing and waning of those industries in the economy (for example, the demand for engineers in the resources

industry is no longer as acute as it was a few years ago), at the same time there are widespread reports of skills mismatches. Many individuals with mid- to high-level qualifications find that their skills are underused in the workplace, while others find that they need higher-level skills to do their job (Mavromaras, McGuinness, O'Leary, Sloane, & Fok, 2010); (Ryan & Sinning, 2011). This is particularly a problem for those in middle-level qualifications: the group most likely to say that their skills are underused in work are those with diplomas and advanced diplomas ((Wheelahan, Buchanan, & Yu, 2015).

To address the significant gap in data and research evidence on skill mismatch across EU Member States, CEDEFOP also engaged in collection of new data via the European skills and jobs survey (ESJS). This new rich source of information at EU level, examining drivers of skill development and dynamic evolution of skill mismatch in relation to changing complexity of tasks and skill needs in jobs, was carried out in spring 2014 in all Member States and surveyed about 49,000 adult employees. This report presents and summarises research and analysis carried out with this new data source, with a view to understanding better the skill mismatch phenomenon and providing policy-makers with insights that can help shape policies. In-depth analysis of the ESJS data has revealed a number of interesting facts about the occurrence, cost and determinants of different forms of skill mismatch affecting EU workers (CEDEFOP, 2015).

Step 2: The Experts Survey

The second phase consisted in interviewing experts from organisations. In total, UL obtained 18 interviews relevant to the study from different organisations to collect their broad vision of the training landscape that are affecting the sector and their impacts on the occupations. In the process of collecting these 18 interviews, UL contacted in excess of 70 individuals. The fall out of these numbers 52 focussing heavily on the type of training with the majority falling outside the remit of this study with a focus on construction management training.

In total, 18 interviews (interview script in annex 2 and list of interviewees in annex 3) were undertaken

Some Results

The 18 responses came from 12 different countries being Ireland, Italy, Spain, Germany, Bulgaria, Slovenia, Czech Republic, Greece, Romania, Croatia, Malta, and the United Kingdom. This means that we reached 75% of the 12 Erasmus+ programme countries identified in the project (see map).

In the survey, the construction organisations were asked questions related to their organisation, it's experience in the construction sector and training activities both historical and current. The second part of the interview focused on the individual, their role, the type of training their organisation provide e.g. modules, level and duration. The focus area of this training, its mode of delivery and the take up rates.

At this point that the training companies have a heavy focus on management training. A fall out of 52 interview due to relevance is just a reflection off this. The 18 respondents deemed relevant provided excellent feedback with good quantitative data on their activities. Although our discussions did highlight the craft training was only a small part of their portfolio.

Step 3: The Delphi Panel

The third phase consisted in the realisation of a Delphi panel with experts in the occupational training area. The Delphi Panel Script in annex 4. The Delphi Panel Results in annex 5. The List of experts in annex 6. The Delphi Panel technique is a recognised methodology of structuring a group communication process. It is effective in allowing a group of individuals to deal with a complex problem, in this case the determination and structuring of professional competences and training needs corresponding to the impacts of the four trends identified on the occupations/skills/knowledge in the construction sector.

Nine experts were appealed to participate in the Delphi Panel. The Delphi Panel method utilises two steps. First, the expert is asked to evaluate each statement collected from the organisation's interviews on a scale between 1 and 10. Taking their expertise into account, they could confirm (or not) each statement and comment their answers. When they had all answered to the first evaluation, UL calculated the mean for each statement, accepting each mean equal or above 5 as a confirmation of the statement. Second, a report Is created gathering the main results of the first sending of the Delphi Panel and this report was sent to the experts. They could then validate the results and still express their opinion regarding those results.

The table below shows that each topic received a mean score superior to 7/10. The interview topics were confirmed by the Delphi Panel of experts. Each statement received a score equal or above 6 out of 10 (minimum mean 8.0 and maximum mean 9.0). We can then conclude that all the statements were confirmed by the experts appealed to participate to this Delphi Panel.

THEME	MEAN
DIGITALISATION - OCCUPATIONS	7,8
DIGITALISATION - SKILLS	8,7
DITIALISATION - KNOWLEDGE	8,3
CIRCULAR ECONOMY - OCCUPATIONS	8,7
CIRCULAR ECONOMY - SKILLS	9,0
CIRCULAR ECONOMY - KNOWLEDGE	8,6
S.A.P. - OCCUPATIONS	8,0
S.A.P. - SKILLS	8,3
S.A.P. - KNOWLEDGE	8,2
HEALTH & SAFETY	8,0

The high correlation could only achieved by the exhaustive selection of the training experts and interviewees for this survey. Initial interviews highlighted significant bias towards the training of management grades within the construction sector. A detailed interview with UL staff gave concern that training exclusively focused on the Architects and Engineers and their ongoing CPD requirements.

Initial interviews with internationally expert expressed the significant need for this type of research but the difficulties they had encountered when attempting research in this area. Many of the interviewee expressed the absolute need for this type of research. They had themselves reviewed this area on craftsman, trades and blue collar worker but on review had maintained their research focus on white collar grades.

Formative Map

In this sector the players are focusing on the quality assurance of vocational training in the construction sector. The main objective is to provide an opportunity for key stakeholders to analyze topics considered crucial with a view to formulating guidelines and/or principles for supporting quality assurance of VET or its process in the continuing education training sector. We should be encouraged to reflect on how quality assurance of VET is addressed and managed in Europe, as well as highlight the importance of involving the social partners in quality assurance procedures for the provision of VET in line with the EQAVET Framework. We will also consider how to most appropriately support the implementation of European Quality Assurance Reference Framework for VET in relation to the construction Sector.

There are key challenges in relation to quality in vocational education and training within the European construction sector and on how the EQAVET Recommendation can support the development and improvement of national education and training systems in relation to the construction sector.

The construction sector is of strategic importance to the EU as it:

- provides the buildings and infrastructure needed by the rest of the economy and society
- represents more than 10% of EU GDP and more than 50% of fixed capital formation
- is the largest single economic activity and
- is the biggest industrial employer in Europe. The sector employs directly almost 20 million people as stated by FIEC.

Strategic outlook

According to the Competitive sectors studies, the key strategic challenges for the construction sector with implications for VET and ECVET include:

- ✓ Access to finance;
- ✓ Regulatory environment;
- ✓ Growing international (global) competition;
- ✓ Fragmented industry structures;
- ✓ Weak growth prospects in EU markets;
- ✓ Demands for convenience;
- ✓ The major drivers of structural change;
- ✓ General macroeconomic environment;
- ✓ Labour market conditions;
- ✓ Demographic change;
- ✓ Poor innovation performance in the sector;
- ✓ Poor productivity levels; and
- ✓ Narrow skill sets;

An important issue is that generic skills such as problem orientation, problem solving, communication, design and entrepreneurial skills – which are critical for cross-occupational collaboration in work teams and for exploiting value-added creativity at the enterprise level- need to form part of education and training programmes within the construction sector, as 21st century jobs and occupations require the development of these new skills within the sector, such as green and tech skills.

The future

The Cedefop report "Skills supply and demand in Europe Medium-term forecast up to 2020" predicts that the general impact of the recession will be:

- ✓ fewer jobs overall and only modest job creation;
- ✓ a more highly qualified workforce;
- ✓ continued trend towards jobs in services;
- ✓ domination of knowledge- and skills intensive jobs; and
- ✓ high- and medium-level qualified in demand.

The key aspects of quality in vocational education and training can be deduced from the recommendations from the EU Study to include:

- ✓ Establishing strategic partnerships between industry and education and training providers: to ensure that national VET and ECVET systems provide training for the construction sector which is sufficiently flexible in terms of content and modes of delivery to meet the diversity of demand in the sector, and secondly that education and training providers together with the sector have the capacity to identify emerging trends likely to impact on medium term skills demands. A key focus should be to support development in management capacity (especially for SMEs) in key areas such as human resources, finance and quality, and health and safety management (MS, CVET & Sector);
- ✓ Supporting skills development through the dissemination and exchange of best practice to national stakeholders (EU) and through negotiations of collective agreements and the rights to CVET at the local/and or national sector level;
- ✓ Improving strategic capacity to deploy ICT, e.g. building information management systems, e-invoicing systems and ERP/accounting systems, in business processes, develop business models and products through government and sector initiatives and industry partnership with CVET institutions (Sector, MS, Intermediary bodies, CVET institutions);
- ✓ Improving the capacity and systems of public and private clients procurement departments to select the economically most advantageous proposals and take into account relevant sustainability conditions in construction contracts by providing easy to use guidelines for small businesses – including easy to access on-line advice and developing standard proposal assessment tools and creating standards for roles of clients, advisors and contractors (EU, Sector, MS, banks, CVET institutions);
- ✓ Investing in awareness raising: Member States and sector organisations should consider launching and supporting campaigns to make the construction sector more attractive to talent (MS and sector).

The future competitiveness of the construction sector is critical not just for the different subsectors, but for the European economy as a whole. First, improving the performance of the construction sector will likely improve the performance of most other economic sectors as well as increase the quality of life for Europeans. Secondly, it would likely also contribute to reducing the challenges relating to environment and climate issues.

There is a need to invest in developing further quality assurance in the Construction sector, both for ensuring that students are provided with training of high standard as well as for ensuring that sector workers possess the necessary skills

According to integrating ECVET, we suggest an overall learning time of **hours of learning** could be established, including direct contact hours, hands-on practice, self-study and assessment hours. For completeness purposes, it mentioned that, according to the prevailing terminology:

- Contact hours refer to theoretical (non-practical hours). In case of the live tele-conferencing contact sessions, if it is conducted in school setting and supervised, then it is considered as part of the contact hours.
- Self-study hours refer to the study of something by oneself without direct supervision or attendance in a class. In case of site visits, if not supervised, are considered as self-study.
- Hands-on hours refer to practical sessions, which can also be supervised. In case of site visits, if supervised, they are considered as hands-on practice.
- Assessment hours should include the time needed to prepare the assignment (e.g. if a student has to spend 6 hours reading a book in order to be able to work on an assignment, those 6 hours should be included). In the case of an exam, indicate only the time allocated to the exam, for example 2 hours.

As regards the already mentioned assignment of credit points (ECVET) to a training programme, and following the ECVET Recommendation to enable a common approach for the use of ECVET points for a given qualification in the EU, the allocation of ECVET points should be made as follows:

- Allocation of ECVET points to a qualification is based on using a convention according to which 60 points are allocated to the learning outcomes expected to be achieved in one year of formal full time VET. (level 4 in EQF framework)
- It is up to the competent institutions in charge of designing qualifications to decide which specific programme will be chosen as a point of reference (e.g. the initial VET or the most common programme).
- The duration of the selected reference programme, together with the ECVET convention on ECVET points (60 points for 1 year), will give the number of ECVET points allocated to the qualification.

In this sense, and taking into account the widely accepted approach of **1 ECVET point (credit) = 25 hours of total learning**, which corresponds to an average of 1500 hours for 1 year full VET (as applied, for example, in the Erasmus programme in the case of mobility of workers – also consistent with the ECTS model). However, this is only indicative, as firstly the training program to be used as a reference should be decided, while the distribution of learning hours may need to be revised according to the national needs as well as the organizational frameworks of mentors, trainers, teachers and counselors involved in the construction sector and/or the green - sustainable development.

The learning outcomes will be as follows, according to the EQF framework. We have to mention that the project has been focusing in VET and Professional Certificates in the construction sector in Spain, France, Ireland and Belgium. For that reason, we consider especially these levels of EQF, in the trades of the construction sector:

Level 1 Knowledge: Basic general knowledge Skills: Basin skills to carry out simple tasks Competence: work or study under direct supervision in a structured context	BASIC SKILLS / INTRODUCTORY
Level 2 knowledge: Basic factual knowledge of a field of work or study Skills: Basic cognitive and practical skills required to use relevant information in order to carry out tasks and to solve routine problems using simple rules and tools Competence: Work or study under supervision with some autonomy	TECHNICIAN/APPRENTICE
Level 3 Knowledge: Knowledge of facts, principals, processes and general concepts, in a field of work or study Skills: A range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools, materials and information Competence 1: take responsibility for completion of tasks in work or study Competence 2: Adapt own behaviour to circumstances in solving problems	HIGH SCHOOL DIPLOMA
Level 4 knowledge: Factual and theoretical knowledge in broad contexts within a field of work or study Skills: A range of cognitive and practical skills required to generate solutions to specific problems in a field work or study Competence 1: Exercise self-management within the guidelines of work or study contexts that are usually predictable, but are subject to change.	YEAR ONE OF DEGREE

Competence 2: Supervise the routine work of others, taking some responsibility for the evaluation and improvement of work or study activities.	
Level 5 Knowledge: Comprehensive, specialised, factual and theoretical knowledge within a field of work or study and an awareness of boundaries of that knowledge. Skills: A comprehensive range of cognitive and practical skills required to develop creative solutions to abstract problems. Competence 1: Exercise management and supervision in contexts of work study activities where there is unpredictable change. Competence 2: Review and develop performance of self and others.	ASSOCIATE DEGREE

Conclusions

This report aimed to identifying the training landscape for the construction sector within the scope of the Work Package 2 of the DETECTA project.

UL aimed to realise the diagnosis of the construction sector needs identified in the Constructiv WP2 report in order to identify the prospective trends that are and will continue to affect the sector in terms of occupations/skills/knowledge, whilst identifying the training landscape and methods utilised to achieve the future training of blue-collar construction trades.

This WP2 was divided in three main tasks, a study of the formative educational offering of training in the EU construction sector through secondary sources (desk research), the identification of prospecting trends in the sector (interviews) and the competence reality study of the sector (Delphi Panel).

During the desk research, numerous articles and projects were analysed and lead the study to identify the significant challenges and opportunities that currently exist in the training and development for future need in the construction sector in the EU. Numerous changes including demographic, structural and technological are affecting the composition of the workforce, employment levels, job content and how workers experience their working lives (Eurofound, 2017). The principal challenges that the sector will face over the medium term all point towards skill needs being high and dynamic as the skill content of jobs is likely to change (UK Commission for Employment and Skills, Sector Skills Insights: Construction, 2012).

Within the construction industry we are confronted with a labour market contradiction: on the one hand unemployment rates remain at high levels in many Member States, in particular amongst youngsters, whilst, on the other hand, many vacancies are available in the construction industry.

Despite a number of initiatives to make the construction sector more attractive, there are still difficulties in attracting and retaining women and, in several countries, young people in general. Combined with an ageing workforce, there is therefore a clear need to address such recruitment problems in the industry, amongst others through a more open and permeable labour market and construction process.

Workers and construction companies face challenges in matching the right skills and professional qualifications with the needs of the companies. Several factors can explain this situation:

During the interviews, the identification of entities that undertook training activities for construction trades proved difficult. The review of initial offering identified an extensive bias toward construction management training with over 100 training organisation initially identified. This figure reduced to 52 and on screening only 18 respondent organisations deemed appropriate to participate to the survey.

The 18 responses came from 12 different countries being Ireland, Italy, Spain, Germany, Bulgaria, Slovenia, Czech Republic, Greece, Romania, Croatia, Malta, and the United Kingdom. This means that we reached 75% of the 12 Erasmus+ programme countries identified in the project (see map).

In the survey, the construction organisations were asked questions related to their organisation, it's experience in the construction sector and training activities both historical and current. The second part of the interview focused on the individual, their role, the type of training their organisation provide e.g. modules, level and duration. The focus area of this training, its mode of delivery and the take up rates.

At this point that the training companies have a heavy focus on management training. A fall out of 52 interview due to relevance is just a reflection off this. The 18 respondents deemed relevant provided excellent feedback with good quantitative data on their activities. Although our discussions did highlight the craft training was only a small part of their portfolio.

During the last stage of the study (Delphi Panel), 8 experts from the occupational field were appealed to participate in the validation of the interviews results. The results of the interviews were treated into statements divided up per trend. The comments of these experts allowed us to complete the main results with one new skill that had not been mentioned before which is the cooperation skill. Initial interviews with internationally expert expressed the significant need for this type of research but the difficulties they had encountered when attempting research in this area. Many of the interviewee expressed the absolute need for this type of research. They had themselves reviewed this area on craftsman, trades and blue collar worker but on review had maintained their research focus on white collar grades.

INTRODUCTION

According to CEDEFOP's 2016 skills forecast future trends in skill demand and supply across the EU are being driven by demographic change, better access to education, technological advance and climate change. These drivers are expected to impact employment, occupations and qualifications in all sectors across the EU from 2015 to 2025. The outlook for construction at European level is relatively stable. Around 6% of the European labour force is expected to be working in this sector in 2025, similar to 2015. However, in two thirds of Member States, employment in construction is forecast to be higher than the EU average, including Croatia (12%), Luxembourg (11%) and, Ireland (10%), which had seen jobs in construction nearly halved between 2005 and 2015. In contrast, employment in construction is expected to shrink in Germany, Romania and the UK. In 2025, more than half of the jobs in construction will be for craft and related trades workers. However, the sector will experience increasing skills demand, with some 13% employed as technicians and associate professionals in 2025, compared to 11.5% in 2015. Skills needed in construction are likely to change to meet demands for 'green' and energy efficient buildings that follow new designs and use new materials. The forecast indicates that demand for people with high-level qualifications could double, to account for one third of all jobs in construction by 2025 (CEDEFOP, 2016).

PROFILE OF THE CONSTRUCTION SECTOR

The European construction sector is a driver of economic growth and employment in each EU member state, accounting for 8.2% of gross domestic product (GDP) whilst providing 18 million jobs throughout the EU. Up to 95% of construction, architecture and civil engineering firms are micro-enterprises or SMEs (European Commission, 2018).

The economic crisis that started around 2008 severely hit the construction sector across much of Europe, leading to high levels of unemployment in this sector in many countries. At the same time, demand for workers in retrofitting and new green construction is increasing. This demand should continue to grow over the coming years, as governments seek to bring emissions of greenhouse gasses under control, as green building technologies and techniques mature, and indeed as many governments seek to boost employment in construction (International Labour Office (ILO), 2011).

What is the construction sector?

The construction value chain includes a wide range of economic activities, stretching from the extraction of raw materials, the manufacturing and distribution of construction products up to the design, construction, management and control of construction works, their maintenance, renovation and demolition, as well as the recycling of construction and demolition waste.

The European construction industry is generally divided into the following sectors:

- Civil and utility construction including the construction of homes, offices etc.
- Civil engineering construction of structures other than buildings, such as land improvements, roads and waterways)
- Installation companies? Electrical installations, radiators etc.
- Painting and finishing contractors
- Other.

The focus of this report is on the onsite construction (Construction within NACE Rev. 2 section F) (see Figure 2). The sector covers a wide variety of activity, from building skyscrapers to housing estates and routine repair and maintenance: infrastructure; housing; commercial; industrial; repair and maintenance.

n.e.c. : not elsewhere classified				* part of
Division	Group	Class		ISIC Rev. 4
SECTION F — CONSTRUCTION				
41			Construction of buildings	
	41.1		Development of building projects	
		41.10	Development of building projects	4100*
	41.2		Construction of residential and non-residential buildings	
		41.20	Construction of residential and non-residential buildings	4100*
42			Civil engineering	
	42.1		Construction of roads and railways	
		42.11	Construction of roads and motorways	4210*
		42.12	Construction of railways and underground railways	4210*
		42.13	Construction of bridges and tunnels	4210*
	42.2		Construction of utility projects	
		42.21	Construction of utility projects for fluids	4220*
		42.22	Construction of utility projects for electricity and telecommunications	4220*
	42.9		Construction of other civil engineering projects	
		42.91	Construction of water projects	4290*
		42.99	Construction of other civil engineering projects n.e.c.	4290*
43			Specialised construction activities	
	43.1		Demolition and site preparation	
		43.11	Demolition	4311
		43.12	Site preparation	4312*
		43.13	Test drilling and boring	4312*
	43.2		Electrical, plumbing and other construction installation activities	
		43.21	Electrical installation	4321
		43.22	Plumbing, heat and air conditioning installation	4322
		43.29	Other construction installation	4329
	43.3		Building completion and finishing	
		43.31	Plastering	4330*
		43.32	Joinery installation	4330*
		43.33	Floor and wall covering	4330*
		43.34	Painting and glazing	4330*
		43.39	Other building completion and finishing	4330*
	43.9		Other specialised construction activities	
		43.91	Roofing activities	4390*
		43.99	Other specialised construction activities n.e.c.	4390*

Figure 2 SECTION F extract from NACE Rev. 2 - Statistical classification of economic activities in the European Community / Eurostat Methodologies and Working Papers

Division 41 Construction of buildings

The 41 division includes general construction of buildings of all kinds. It includes new work, repair, additions and alterations, the erection of pre-fabricated buildings or structures on the site and also construction of temporary nature.

Division 43 specialised construction activities

Division 43 includes specialised construction activities (special trades), i.e. the construction of parts of buildings and civil engineering works or preparation therefore. These activities usually require specialised skills or equipment, such as pile-driving, foundation work, carcass work, concrete work, brick laying, stone setting, scaffolding, roof covering, steel erection etc. These activities involve skilled trades in:

- heating and ventilation
- Plumbing
- Electrical engineering
- Welding/metal work
- Glazing

- Bricklaying and stonework
- Carpentry
- Plastering
- Roofing
- Floor and wall tiling
- Painting and decorating

Within NACE 2 section M (Figure 3): professional and managerial skills related to: (Professional, scientific and technical activities), division 71 for architectural and engineering activities; technical testing and analysis involve the provision of architectural services, engineering services, drafting services, building inspection services and surveying and mapping services. It also includes the performance of physical, chemical, and other analytical testing services.

n.e.c. : not elsewhere classified				* part of
Division	Group	Class		ISIC Rev. 4
SECTION M — PROFESSIONAL, SCIENTIFIC AND TECHNICAL ACTIVITIES				
71			Architectural and engineering activities; technical testing and analysis	
	71.1		Architectural and engineering activities and related technical consultancy	
		71.11	Architectural activities	7110*
		71.12	Engineering activities and related technical consultancy	7110*
	71.2		Technical testing and analysis	
		71.20	Technical testing and analysis	7120

Figure 3 SECTION M extract from NACE Rev. 2 - Statistical classification of economic activities in the European Community / Eurostat Methodologies and Working Papers

These activities involve skilled professionals in:

- Civil engineering
- Structural engineering
- Construction management
- Surveying
- Financial planning
- Architecture

Who are construction workers

Building and related trade's workers (excluding electricians[1]) fulfil a variety of different roles in the demolition, construction, renovation and maintenance of buildings. Examples of occupations within this group include: house builders, bricklayers, concrete placers, roofers, insulation workers, glaziers, plumbers and painters. A range of specialised skills are required, which are heavily dependent upon the specific job tasks carried out.

The EU Skills Panorama website[2] provides that workers in this occupation construct, maintain and repair buildings (residential, commercial, and other). Their jobs involve, for example: constructing and repairing foundations, walls and structures of brick, stone and similar materials; cutting, shaping and finishing

1 Defined as ILO ISCO 08 group 71 Building and related trades workers, excluding electricians. ILO (2012) International Standard Classification of Occupations ISCO-08.

2 https://skillspanorama.cedefop.europa.eu/en

stone for building, ornamental and other purposes, as well as wooden structures and fittings; and general building maintenance tasks. Occupations include, amongst others, house builders, stonemasons, carpenters and joiners, roofers, plasterers, plumbers, floor layers and tile setters, glaziers, and painters. Typically, the skill level required is equivalent to completed first stage of secondary education, but in some jobs, completion of the second stage of secondary education that includes specialized vocational education and on-the-job training is required.

Employment in the construction sector

According to Eurostat, the total number of persons employed in the broad construction sector[3] at EU level reached 21.1 million in 2015. This represents a 1.2% increase since 2011 and 3.4% increase compared to 2014 alone, the highest net increase since the beginning of the economic crisis, signalling the recovery of the sector. The sum of the persons employed in Germany, United Kingdom, France, Italy and Spain represents 60.7% of the total workforce of the EU construction sector (European Construction Sector Observatory, 2017).

CHALLENGES & TRENDS FOR CONSTRUCTION SECTOR ACROSS EUROPE

EU & Construction Sector

The Construction 2020 Strategy and Action Plan addresses the sector's challenges up to 2020 and sets out strategic priorities. Practitioners and policy-makers are working together to implement the action plan, with a special focus on five areas: innovation and finance; skills and mobility; sustainable resource use; regulatory fitness; and access to international markets (European Commission, 2012).

In 2015, the European Commission launched the European Construction Sector Observatory to provide analysis and comparative assessments of market conditions and policy developments (an analytical report on skills was published in July 2017); it details a significant shortfall of qualified workers for on-site construction enterprises and to a lesser extent for the construction products' industry. Moreover, education and training systems across Europe display great variety in the degree of centralisation or decentralisation, the structure of training provision, the role of the social partners, financial structures and curriculum content (European Construction Sector Observatory, 2017).

In the same year, the Commission also launched its promotion of the European Alliance for Apprenticeships (EAfA) in the construction sector, which has been the only individual sector involved so far. 56 pledges from the sector represent one quarter of all EAfA pledges and the majority of pledges by SMEs.

Challenges for Construction

Numerous changes including demographic, structural and technological are affecting the composition of the workforce, employment levels, job content and how workers experience their working lives (Eurofound, 2017). The principal challenges that the sector will face over the medium term all point

3 The workforce employed in the construction sector is defined by all construction related activities within EU28 economies (construction related manufacturing activities, narrow construction, real estate activities, and architectural and engineering activities, collectively referred to as the broad construction sector).

towards skill needs being high and dynamic as the skill content of jobs is likely to change (UK Commission for Employment and Skills, Sector Skills Insights: Construction, 2012).

Within the construction industry we are confronted with a labour market contradiction: on the one hand unemployment rates remain at high levels in many Member States, in particular amongst youngsters, whilst, on the other hand, many vacancies are available in the construction industry.

Despite a number of initiatives to make the construction sector more attractive, there are still difficulties in attracting and retaining women and, in several countries, young people in general. Combined with an ageing workforce, there is therefore a clear need to address such recruitment problems in the industry, amongst others through a more open and permeable labour market and construction process.

Workers and construction companies are faced with challenges in matching the right skills and professional qualifications with the needs of the companies. Several factors can explain this situation:

Green Agenda & Low Carbon

"Green" policies, and in particular energy efficient work, require close coordination between the different occupations on a worksite, placing demands on these occupations that go beyond their immediate scope of responsibilities to understanding the building fabric as a unified system. This requires enhanced technical knowledge and soft skills associated with, amongst others, communication, team working and self-management.

Modern methods of construction and the implementation of low carbon systems and materials will require new skills and adaption and upgrading of the skills of people working in the sector. A workshop 'Future skill needs for the green economy', held at CEDEFOP in Greece in 2008, noted in relation to the construction sector that the jobs directly created from thermal renovation of buildings were expected to be of relatively low qualification level. Also stating that workers already in the sector should receive training in sustainable building further noting that blue collar workers will need to be offered lifelong learning programmes (CEDEFOP, 2009).

Once a green building project is approved for construction work to begin, people with appropriate skills are required to implement it. Green building brings new technologies and techniques to construction. These change the skills required, although most roles can still be filled by skilled construction trades workers from existing occupations with only a limited amount of additional training (International Labour Office (ILO), 2011).

Technological Change & Innovation

Innovation and technological changes, very often driven by external providers, are growing at an increasingly rapid pace. They have a strong influence on market needs and are thereby putting pressure on existing training schemes, which have to take such changes into account. Anticipating future skills needs is therefore a significant challenge for companies, as well as for training providers.

Across the EU legislative and technological changes are pushing dramatic advances in the sustainable building arena. BIM and nZEB are now being adopted or plan to be in 50% of the 27 countries (World Economic Forum, 2016) as default technologies and required standards in particular for public sector investments. The recent World Economic Forum report Shaping the Future of Construction (World Economic Forum, 2016) outlined how labour productivity in construction was largely stagnated in

Europe, however new construction techniques such as BIM is beginning to improve the market (see Figure 4).

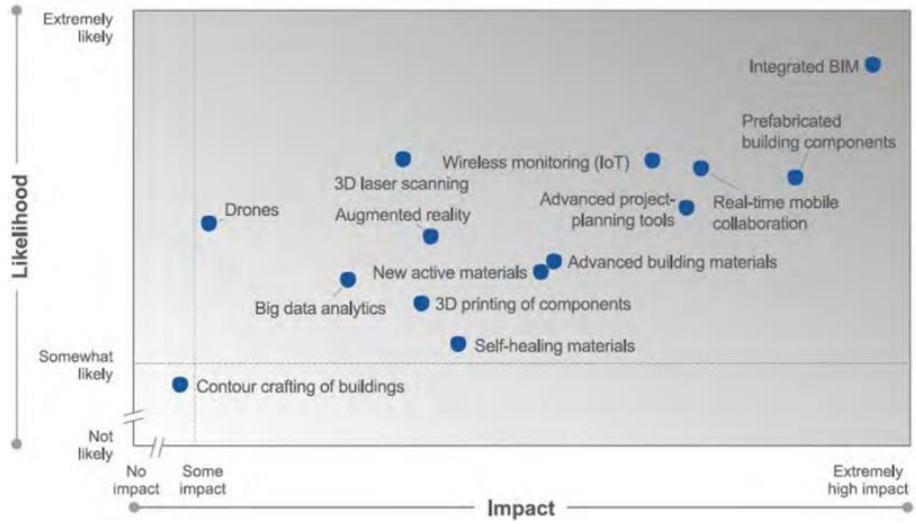

Figure 4 Impact likelihood matrix of new technologies extracted from WEF 2016

Modern methods require upskilling, reskilling and multi-skilling. Use of more off-site construction brings about a shift in the mix of skills required. Automated tools requires new skills and makes some redundant. Many countries recognise the need for high quality, high-level technical education to underpin the delivery of technologically advanced products and services and are scaling up their vocational education curriculum and sectors accordingly. The United Kingdom, Canada, Germany, Austria among other countries are focusing on building strong, innovative vocational education sectors to support their future workforce strategies (Jones, 2018).

BIM

The EC publication "New Skills Agenda for Europe" identified an essential need to focus on digital skills in the industry to increase productivity launching Digital Skills and Jobs Coalition with the outcome of the EU BIM Taskforce publishing "Handbook for the introduction of Building Information Modelling by the European Public Sector". The development and deployment of digital technologies and processes is central to the required transformation of the construction industry. Building Information Modelling (BIM) is gaining currency as a platform for central integrated design, modelling, planning and collaboration. BIM provides all stakeholders with a digital representation of a building's characteristics – not just in the design phase but throughout its life cycle (European Commission, 2016).

The uptake and sophistication of BIM vary considerably from country to country, and from company to company – according to their size and position in the value chain. For some large engineering companies, BIM is already part of business as usual, but most small companies across the value chain have little BIM experience. In fact, even some of the major contractors have never used BIM on any of their projects. The difference in adoption rates within Europe is considerable; for example, 16% of E&C companies in the United Kingdom have never used BIM, while in Austria the figure is 49%.

A serious challenge relates to the increasing sophistication of technology, which demands new and broader skill sets at all levels of a company.

Demographic Change & the training & retraining needs of middle-aged and older people

The construction industry has what is considered an ageing workforce that will seriously affect the industry, as essential skills will be lost when employees retire. This is exacerbated by the fact that the number of new recruits is declining and there will be nobody available to replace those retiring. Further, key skills can be lost through retirement and it is imperative that young entrants be attracted to the industry (UNESCO & Commonwealth of Learning, 2017).

Bloom, Canning and Fink (2010) predict that by 2050, more than 22 per cent of the world's population will be aged 60 or older, compared with 10 per cent in 2000. Further noting that re-skilling older workers in the ever-changing work environment presents some challenges. The older workers may have lower qualifications than the younger generation and lack confidence in their ability to change. They may need encouragement and special provision to entice them into further training (Bloom, Canning, & Fink, 2010).

Sustainability

Energy efficiency is one of the main drivers of skills development in the sector. The European Commission agreed to decarbonise the European building stock by 2050. It is foreseen that 3-4 million workers will need to be updated in this field. Different materials for new builds, retro-fitting, etc. require enhanced skills and new skills. Low energy requirements introduces increased need for specialist, technical and professional skills.

The EU Energy Performance of Buildings Directive (EPBD) promotes improved energy performance in new and existing buildings and initiated further amendments in 2018. Aiming to accelerate the cost-effective renovation of existing buildings, with the vision of a decarbonised building stock by 2050 and the mobilisation of investments. The Energy Efficiency Directive (EED) set out a roadmap with milestones for a 40% emissions reduction, 27% share for renewable energy and at least 27% improvement in energy efficiency by 2030 and 60% emissions reduction by 2040 and for 2050 to reduce EU wide emissions by 80% to 95%, compared with 1990 levels. From these directives the Nearly Zero Energy Building (NZEB) standard evolved with a definition of the term as given by the EU.

Skills Mismatches

While there are reports of skill shortages and surpluses in particular industries, reflecting the waxing and waning of those industries in the economy (for example, the demand for engineers in the resources industry is no longer as acute as it was a few years ago), at the same time there are widespread reports of skills mismatches. Many individuals with mid- to high-level qualifications find that their skills are underused in the workplace, while others find that they need higher-level skills to do their job (Mavromaras, McGuinness, O'Leary, Sloane, & Fok, 2010); (Ryan & Sinning, 2011). This is particularly a problem for those in middle-level qualifications: the group most likely to say that their skills are underused in work are those with diplomas and advanced diplomas ((Wheelahan, Buchanan, & Yu, 2015).

To address the significant gap in data and research evidence on skill mismatch across EU Member States, CEDEFOP also engaged in collection of new data via the European skills and jobs survey (ESJS). This new rich source of information at EU level, examining drivers of skill development and dynamic evolution of skill mismatch in relation to changing complexity of tasks and skill needs in jobs, was carried out in spring 2014 in all Member States and surveyed about 49,000 adult employees. This report presents and summarises research and analysis carried out with this new data source, with a view to understanding

better the skill mismatch phenomenon and providing policy-makers with insights that can help shape policies. In-depth analysis of the ESJS data has revealed a number of interesting facts about the occurrence, cost and determinants of different forms of skill mismatch affecting EU workers (CEDEFOP, 2015).

Current State in Ireland

Employment in Ireland is depicted in Figure 5 which presents national employment by broad economic sector (NACE Rev 2 defined) extracted from the 2018 National Skills Bulletin (National Skills Council, 2018). In quarter 4 2017, 133,000 persons were employed in the construction sector, accounting for 6% of national employment, with 94% of male gender. The 25-54 age group accounted for the majority of persons employed, at 76%. The share of employees aged 55 and over was in line with the national average of 17%.

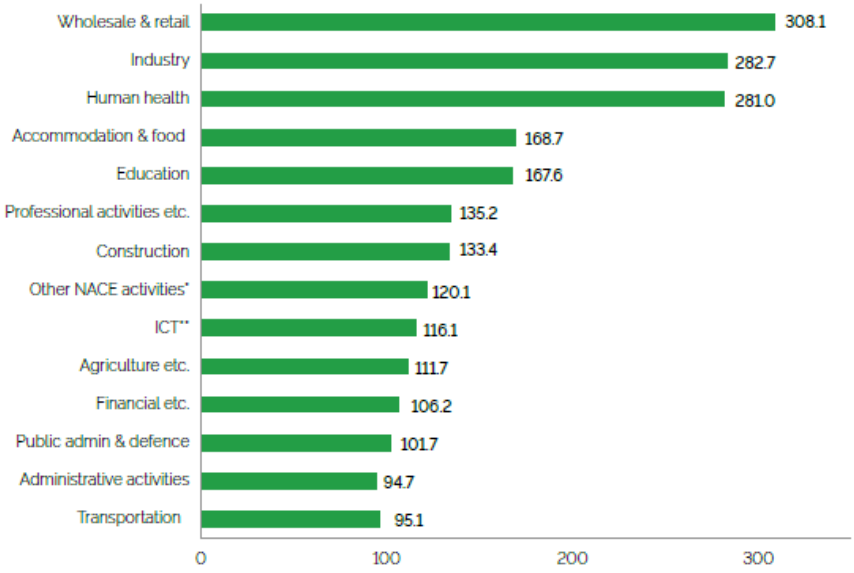

Figure 5 Employment by Sector (000s), Quarter 4 2017, from the 2018 National Skills Bulletin by SLMRU in SOLAS on behalf of the National Skills Council

Between quarter 4 2016 and quarter 4 2017, construction was the second strongest growing sector of the economy, growing by 10% with an additional 12,000 persons employed. Of the total employment in the construction sector, 65% were in specialised construction activities (e.g. bricklaying, scaffolding, construction equipment renting), 28% in construction of buildings, with the remainder in civil engineering.

Additionally, 135,200 persons were employed in professional, scientific and technical activities, accounting for 6.1% of national employment. Of this, 31% was in engineering activities (including architectural activities and technical testing). Although this sector observed a decline in the most recent year, strong growth has been recorded over the five year period where employment increased by 26,000 (29.1%) in this sector. Unemployment in the construction sector stands at 9,500 at an unemployment rate of 6.7%.

The share of persons employed in the selected construction occupations who had attained higher secondary/FET qualifications was 46%, above the national average share of 36%. Those who had attained

third level qualifications (26%) was well below the national average share (48%). Note: electricians are within the other construction trades with a growth rate of 3.2%.

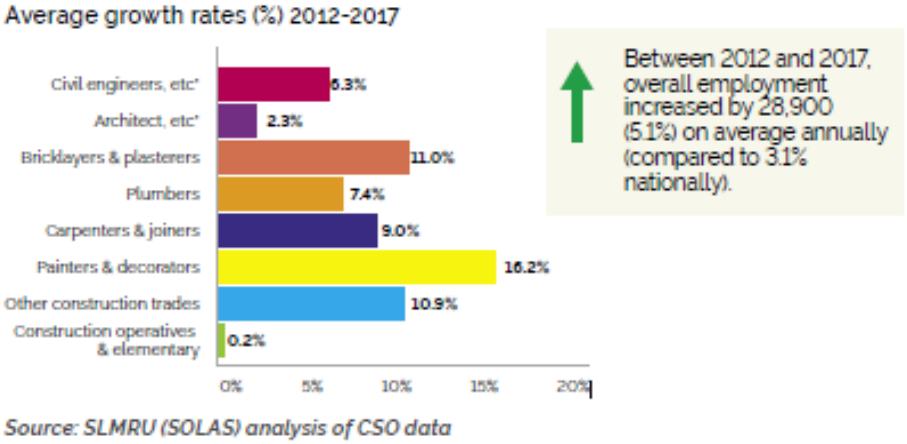

Figure 6 Average Growth Rates (%) 2012-2017 from the 2018 National Skills Bulletin by SLMRU in SOLAS on behalf of the National Skills Council

Construction Occupations

In terms of employment growth for these occupations, most relates to skilled trades and operative/elementary occupations. Growth for professional roles has been smaller. Despite this employment growth, however, there remain over 11,000 job ready job seekers who had previously worked in the construction sector, although most of these are in the lower skilled occupations (National Skills Council, 2018).

Shortages have been identified for:

- professionals: civil engineers, construction project managers, quantity surveyors
- trades: shuttering carpenters, shift managers, glaziers, steel erectors, curtain wallers
- operatives: scaffolders, pipe layers

Other Craft Occupations n.e.c.

Further growth in these occupations is likely to be driven by activity in the medium-high and high tech manufacturing sectors, and to a lesser extent, by the construction (e.g. electricians) and wholesale/retail (e.g. mechanics) sectors.

Shortages have been identified for:

- welders (e.g. TIG/MIG)
- toolmakers, CNC programmers and fitters (e.g. mechanical/ maintenance) in niche areas e.g. high-tech manufacturing
- deboners (relates to a labour shortage)

In addition, although shortages have not been identified, issues relating to electricians may emerge until the output from the apprenticeship system recovers

Shortage of Trades

Demand and Supply Indicators by Occupational Group can be seen in Figure 7 extracted from the 2018 National Skills Bulletin.

Bulletin description	Number Employed, 2017 (Annual Average)	% Female	% Full-Time	Aged 55 years and over	% Irish Nationals	% Third Level Graduates	Annualised Employment Growth Rate, 2012-2017	New Employment Permits Issued, 2017 (Number)	SLMRU Recruitment Agency Survey	Shortage Indicator
Civil engineers & construction project managers	11,000	-	92%		90%	86%	6.3%	15	X	●
Architects & town planners, architectural technologists, & surveyors	12,400	-	96%		81%	89%	2.3%	14	X	●
Construction related technicians	-	-	-					1		
Bricklayers & plasterers	9,900	-	95%		81%		11.0%			●
Plumbers	9,100	-	92%		91%		7.4%		X	●
Carpenters & joiners	18,100	-	97%		90%		9.0%		X	●
Painters & decorators	8,100	-	89%		[69%]		16.2%			●
Other construction trades	24,100	-	93%	[20%]	81%		10.9%	2	X	●
Construction operatives & elementary	38,900	-	85%	[15%]	79%		0.2%			●
Electrical & electronic trades, etc.	36,200	-	97%	[15%]	92%	34%	3.2%	7		●
Other skilled trades	11,800	-	82%		83%		-0.3%	2		●

Figure 7 Demand and Supply Indicators by Occupational Group extracted from the National Skills Bulletin by SLMRU in SOLAS on behalf of the National Skills Council, 2018.

Trends in the Construction Sector

The trend in construction will be towards greater demands in terms of professional and technological specialisation. Refurbishment and tasks related to sustainable and environmentally friendly construction will emerge as major activities in the short, medium and long term, and as a solution for introducing quality into the housing stock.

In a review of the employment and skills needs of the construction industry in Ireland, it was noted that new methods of construction would result in a significant change in the skills profile. They will result in a relative decline in the demand for craft workers in the 'wet trades'; an increase in demand for glaziers and those involved in erection of panels (including timber frame) and in an increase in demand for a range of professionals including logistics managers and designers (Skills and Labour Market Research Unit (SLMRU), 2008).

According to CEDEFOP several key drivers, including demographic structure, technological advancements, and climate change will significantly impact future employment, occupational structure and employees' skills and qualifications across sectors and across Europe (CEDEFOP, 2016).

CEDEFOP notes that whilst young people will need to stay longer in education due to complex jobs requiring higher skills. Labour market demand for skills is changing much faster than education patterns, leading to skill mismatches and labour market imbalances. Continuing vocational education and training

(VET) and adult learning are therefore important in tackling skill mismatches and obsolescence (CEDEFOP, 2016).

Around 14 of every 15 jobs will become available due to the need to replace workers leaving the labour market. The large share of people new at their jobs in 2025, due to high replacement demand and changes in job content and type of job tasks performed in some occupations or sectors, will naturally create a need for high quality education and training in touch with changing skill needs in the labour market (CEDEFOP, 2016).

CEDEFOP's skills forecast 2018 suggests that demand for workers qualified at the higher level will continue to grow, driven by shifts in the sectoral employment structure and skill-biased technological change. The EU labour market is transforming from heavy industry towards digital technology and services necessitating different and higher level skills in the move towards a knowledge economy. CEDEFOP's 2016 skills forecast suggests that employment in construction will grow during 2015-2025 and Member States will need to replace an ageing workforce. Around 1 million new workers will be needed by 2025. Skills requirements are likely to change to meet the demand for green buildings. According to an evaluation of the Build Up Skills (BUS) initiative, 3-4 million workers will require training on energy efficiency alone. Also, a digital transformation will be essential in delivering more efficient buildings and construction processes (CEDEFOP, 2016).

The challenges within the construction sector will therefore be to ensure the training of an adequate number of new entrants to take over from retiring professionals and upskill the existing workforce. Today construction workers are asked to acquire new skills related to energy efficiency and green technologies, as well as ICT skills (such as BIM management). Moreover, the sector requires not only project management skills, but also personal skills such as problem-solving and the ability to work as a team (European Builders Federation, 2017).

CEDEFOP Forecast Highlights 2015 and 2025

Ireland

Following the economic crisis in 2008, Ireland's GDP started to recover in 2013. In 2013, Ireland's unemployment rate was 13.1%, above the EU average of around 11%. The European Commission forecasts GDP growth for Ireland of 3.6 in 2015 as well as in 2016.

Employment is forecast to rise, passing its 2008 pre-crisis level by 2023 and continue to increase. Most employment growth will be in construction. Most job opportunities, around 19% will be for professionals. Around half of the labour force will have high-level qualifications, compared to about 42% in 2013 (CEDEFOP, 2015).

The construction sector is thriving and enjoying a period of sustained growth after it was hit abysmally during the recession. Since the sector hit rock bottom in 2013, employment has grown by 50,000 in the construction industry. But this isn't enough. With over 35,000 new houses required annually for the next five years and an expected 112,000 new jobs required in construction by 2020 there are vast opportunities for work in the industry. The problem is there are too many opportunities and not enough graduates or apprentices to take up employment. There has been a significant growth in the number of students entering construction courses but despite this there still are not enough graduates to meet the

demand. Graduates of surveying are especially lacking. Apprentices too are in demand and play a crucial role in the growth of the sector.

Belgium

Following the economic crisis in 2008, Belgium's GDP started to recover in 2010. In 2013, Belgium's unemployment rate was 8.4%, below the EU average of 11%. The European Commission forecasts GDP growth for Belgium of 0.9% in 2015 and 1.0% in 2016. Employment passed its 2008 pre-crisis level in 2014 and is forecast to continue to increase. Most employment growth will be in non-marketed (mainly public sector) services. Most job opportunities, around 30%, will be for professionals. Around 46% of the labour force will have high-level qualifications, compared to 40% in 2013 (CEDEFOP, 2015).

Spain

Following the economic crisis in 2008, Spain's GDP started to recover in 2013. In 2013, Spain's unemployment rate was 26.4%, well above the European Union (EU) average of 11%. The European Commission forecasts GDP growth for Spain of 1.7% 2015 and 2.3% in 2016. Employment is forecast to rise but remain below its 2008 pre-crisis level. Most employment growth will be in distribution and transport (mainly hotels & catering). Between now and 2025, most job opportunities, around 27% will be for service and sales workers. Around 38% of the labour force will have high-level qualifications, compared to 35.5% in 2013 (CEDEFOP, 2015).

CURRENT EDUCATION & TRAINING PROVISION FOR THE CONSTRUCTION SECTOR

A range of institutions, including private training providers and higher and further education institutions, provides skills training for the construction sector. The importance of different institutions varies by sub-sector within the construction industry, and whether training is designed for initial entry into the construction industry or is part of on-going vocational education and professional development.

One of the challenges for Vocational education and training (VET) is to respond quickly to changes in the labour market, to provide the right skills for employment and enable learners to respond to these changes(CEDEFOP, 2015a). The Bruges communiqué whilst raising awareness of the importance of VET, at both national and European level, also emphasises that integrating changing labour market needs into VET provision in the long term requires a better understanding of emerging sectors and skills, and of changes to existing occupation (European Commission, 2010).

VET in Europe

VET is key for skills development in construction as it is the main gateway to the construction sector and entry to the labour market for young people and VET further provides knowledge and skills necessary for construction workers to progress in their careers (European Construction Sector Observatory, 2017)

There are differences in the levels of participation and quality of VET training across the EU which are linked with the quality of VET. Up-to-date curricula reflecting industry needs and priorities and educators that are knowledgeable on the latest developments within the industry are key factors in determining quality (European Construction Sector Observatory, 2017).

Tertiary Education in Europe[4]

In 2015, according to Eurostat, across the EU-28 engineering, manufacturing and construction-related studies accounted for 15.8 % of all tertiary education students being the second most common field of education where almost 74% of these students were male (2014 data for Greece and Italy; excluding the Netherlands).

Analysis of the data provides insight on the positive changes in tertiary graduates in the construction sector in several Member States, indicating that there is an increase of high skilled workers. The number of low skilled workers in the sector had decreased on average in the EU construction sector workforce prior to 2008, while the numbers of medium and high skilled workers in the construction sector had increased.

CEDEFOP Spotlight on VET Series by Country[5]

These publications (available at present a concise picture of essential features of VET in Europe providing a concise overview of VET in a specific country. Along with basic information about a country's VET qualifications and programmes, Spotlights indicate progression routes, describe distinctive features of the system and present main challenges and policy responses.

Austria

VET

Vocational education and training (VET) plays an important role in Austria with 75% of all learners who have completed compulsory schooling are in VET programmes. Young people can choose from a wide range of dual track (apprenticeship) and mainly school-based programmes. School based VET starts in the last year of compulsory schooling (year 9), and apprenticeship usually in year 10, as the minimum age is 15. These VET programmes lead to different qualification levels (from EQF 3 to EQF 5) and cover all economic sectors. While most school-based VET comes under the responsibility of the education ministry, governance of apprenticeship is shared by the ministries of economy and education, the social partners and the Länder. There is also a variety of post-secondary and tertiary level VET programmes.

The major VET programmes include:

- Three- to four-year (mainly) school-based programmes (BMS, age 14 to 17/18, ISCED-P 354) leading to qualifications to exercise the respective occupation(s) and have access to regulated activities immediately after the final exam. Those who complete the Berufsreifeprüfung (exam for people whose initial VET does not automatically qualify them for entry into higher education) also have general access to tertiary level studies;
- Five-year (mainly) school-based programmes (BHS, age 14 to 19, ISCED-P 354-554), which lead to double qualifications for senior positions in business and general access to higher education at the same time (Reife- und Diplomprüfung). As with graduates of BMS, access to regulated trades is possible. More than 50% progress to higher education;
- Dual track (apprenticeship) training (age 15 onwards, ISCED-P 354) in some 200 apprenticeships. Training takes place at a company and at vocational school. In company training is based on

4 ISCED levels 5-8

5 http://www.CEDEFOP.europa.eu

training regulations valid throughout Austria, which are within the remit of the economy ministry, but largely shaped by the social partners. The school-based part comes under the responsibility of the education ministry (curricula) and the Länder. Graduates can obtain further qualifications by taking, for instance, the master craftsperson exam or Berufsreifeprüfung;

- Those at universities of applied sciences (FHS, age 18 onwards, ISCED P-665/767): these are tailored to specific occupation fields and award academically founded professional qualifications (bachelor-master). A period of work placement is mandatory in most FHS programmes. Access requires higher education entrance qualifications but can also be granted to people with VET qualifications relevant to the field of study.

CVET

Adult learning/CVET: (young) adults can acquire the same qualifications within formal education and training as those open to the young: building on prior learning (VET as well as general education), these programmes help people upgrade their qualifications or obtain additional ones. Outside formal education and training, learners can acquire different (legally regulated) qualifications through continuing VET. The CVET landscape is highly diverse and offers a wide range of courses: social partner institutions are the key providers.

Belgium

Belgium is a federal State comprising three regions (Flanders, Wallonia and Brussels) and three communities (Flemish community – BEFL, French community – BEFr, and German-speaking community – BEdG). Despite multiple authorities responsible for education and training and diverging education and training systems, there is a political coherence which, as defined in the 2014 national reform programme, aims to reduce early leaving from education and training, increase rates of participation in lifelong training, as well as increase and value qualifications, and reduce inequalities within each region. At all levels, vocational and educational training (VET) policies closely involve social partners in a tradition of social dialogue.

VET

VET systems cover compulsory education, higher education, adult education programmes, programmes alternating work and learning, and vocational training organised by public authorities for job-seekers, employees and entrepreneurs. The three communities for education and regions for vocational training and employment organise these systems.

- Compulsory education covers learners aged 6 to 18 years. VET pathways exist for those aged 14 and over. These take the form of technical or vocational secondary education programmes. Technical secondary education programmes prepare students for accredited training and/or high-level technical education with award of a higher secondary education diploma. Vocational secondary education programmes focus on practice to prepare learners for labour market entry. Both types of programmes lead to a qualification certificate (after the sixth year) or a higher secondary education diploma following successful completion of a seventh year in the vocational track.
- Learners aged 15 or over can also opt for part-time programmes, alternating work and learning, organised either by schools or by public training centres. The first type of work-based learning is organised by centres (schools) for part-time education. In these programmes, learners follow general and technical courses at school two days a week and work in a company the three other days. The

second type of work-based learning concerns apprenticeships and entrepreneurial training programmes managed by Syntra Vlaanderen (Vlaams Agentschap voor ondernemersvorming) in BEFL, the iFAPME (institut wallon de formation en alternance et des indépendants et petites et moyennes entreprises) in Wallonia; the SFPME (Service formation pour les petites et moyennes entreprises) in Brussels and the iAWM (institut für Aus- und Weiterbildung im Mittelstand und in kleinen und mittleren Unternehmen) in BEdG. in these programmes, learners acquire general and occupation-related knowledge and practical skills at the training centre for one to one-and-a-half days and the rest of the week training in a company. The system is oriented towards becoming skilled workers and preparing for self-employed professions, over 18 years-old, learners have access to entrepreneurship programmes.

- From 18 years onwards, individuals have a wide range of programmes to choose from, offered by the education system and by public or private VET providers. To continue in higher professional, technical or academic education, it is, however, necessary to hold a higher secondary education diploma. People who have failed to obtain this diploma can follow adult education programmes which lead to secondary education qualifications, and in some cases also to higher professional qualifications (mostly bachelor level in BEFr or associate degree in BEFL).

Vocational training offered by public authorities leads to partial or full qualifications, or relates to specific subject areas, such as language learning. it is offered by the VdAB (Vlaamse dienst voor Arbeidsbemiddeling en beroepsopleiding) in Flanders and Brussels, the ForEM (office wallon de l'emploi et de la formation) in Wallonia, Bruxelles Formation (institut bruxellois de la formation professionnelle) in Brussels and the AdG (Arbeitsamt der dG) in BEdG. Training is organised by their own services or in cooperation with public or private VET centres, subsidised or not.

Denmark

Vocational education and training (VET) plays a key role in Danish strategy for lifelong learning and meeting the challenges of globalisation and technological change. An inclusive and flexible initial VET system helps ensure that all young people have an opportunity to obtain relevant competences for smooth transition to the labour market. Adult education and continuing training respond to structural and technological changes in the labour market and provide the workforce with new and updated skills.

In Denmark, upper secondary education programmes, also referred to as youth education programmes, can be divided into:

- General upper secondary education programmes, which primarily prepare students for higher education.
- Vocational upper secondary education and training programmes, which primarily prepare students for a career in a specific trade or industry.

VET

VET is under the Ministry of Education's jurisdiction, which maintains close dialogue with the social partners to respond to labour market needs. Initial VET is organised into 12 broad entry routes and includes technical, agricultural, commercial, social and healthcare programmes. Programmes are organised according to the dual principle, alternating between periods of college based learning and work-based learning (apprenticeship training) in enterprises. A typical iVET programme (EUd) lasts three-and-a-half years with a 2:1 split between workplace and college-based training, although there is

considerable variation between programmes. Individual study plans are compiled for all students, with VET colleges and the social partners sharing the responsibility for developing curricula to ensure responsiveness to local labour market needs. Qualifications at this level can provide access to relevant fields in academy profession (KVU) programmes or professional bachelor programmes at tertiary level.

Vocational education and training (VET) includes more than 100 main programmes leading to almost 300 different qualifications at level 3 to 5 in the Danish qualification framework. The duration varies from 2 to 5½ years, the most typical being 3½ to 4 years. VET programmes are combination ”sandwich-type” programmes in which theoretical and practical education at a vocational college (approximately 1/3 of the time) alternates with practical training in an approved company or organisation (approximately 2/3 of the time). The dual training principle building on apprenticeship contracts in companies ensures that the trainees acquire theoretical, practical, general and personal skills which are in demand in the labour market.

Furthermore, adults 25 years and older have access to VET programmes designed especially for adults on the basis of recognition of prior learning and relevant work experience, which lead to the same vocational qualifications. In order to complete the main programme, all VET students must have a training agreement with an approved company which offers training.

CVET

Denmark has a long-standing tradition of lifelong learning. In 2014, nearly one in three of the population in the 25–64 age bracket participated in formal and non-formal education and training including publicly or employer funded internal and private education programmes and courses in connection with employment or as leisure-time education.

Adult education and training programmes leading to formal qualifications for further education or for the labour market include:

- Preparatory adult education (FVU): Offered to improve basic literacy and numeracy skills of adults who do not have sufficient qualifications to follow education and training or cope with the demands of working life.
- General adult education (avu): General education at lower secondary level.
- Higher preparatory single-subject courses (hf-e): General education at upper secondary level.
- Adult vocational training (AMU): The main target group is unskilled and skilled workers in the labour market who need to update and/ or develop their competencies. The continuing training programmes are developed and adapted according to the needs of the labour market. Vocational education and training for adults (euv): Offers adults 25 years and older opportunities to acquire a VET qualification to become a skilled worker within the IVET system based on recognition of prior learning and work experience.
- Further adult education programmes (VVU): Corresponds to the level of ordinary academy profession programmes. – Diploma programmes: Corresponds to the level of bachelor’s programmes within the ordinary higher education system. – Master’s programmes within adult higher education: Corresponds to the level of master’s programmes within the ordinary higher education system.

Energy Efficiency Training

The Danish National Energy Efficiency Action Plan (NEEAP) (Centre for Energy Efficiency, 2017) provides that training and awareness-raising about energy efficiency are important elements in the Danish Energy Agency's work to improve energy efficiency. The BedreBolig scheme contains a large element of training. In connection with the scheme, a training course for tradesmen has been set up where tradesmen, construction engineers, engineers, architects, etc. can train to provide professional advice from the start of a renovation project through to completion (one-stop shop).

The BedreBolig course focuses on holistic energy renovation, including indoor climate, maintenance and comfort. BedreBolig advisers must have a special quality management system approved by a control body or an accredited certification body. At least one employee in an enterprise must undergo the training for the enterprise to be accredited by the Danish Energy Agency under the scheme.

Knowledge Centre for Energy Savings (Videncenter for Energibesparelser, VEB) VEB is a service for tradesmen and educational institutions concerning energy efficiency improvements. The centre has worked with industry organisation within the area of mediating knowledge to its members, and VEB holds regular courses to support the general further education campaign run by the labour market training centres.

France

IVET

VET at upper secondary level. on leaving lower secondary school (collège) at iSCEd-P 244, generally at the age of 15, students are steered either towards a general (iSCEd-P 344) and technological (iSCEd-P 354) upper secondary school (lycée), to prepare for a three-year general or technological baccalaureate, or towards a vocational lycée (iSCEd-P 353, 354), to prepare for a two-year professional skills certificate (CAP) or a three-year vocational baccalaureate. These qualifications are designed to provide direct access to employment and the training always includes in-company internship. However, access to tertiary level VET programmes in related fields is possible. Upper secondary education is governed and financed largely by the Ministry of Education and partly by other ministries (including agriculture and industry).

VET at tertiary level (iSCEd-P 554). The lycée based higher technician curricula provide a two-year programme leading to the higher technician certificate (BTS). Universities offer also a two-year technological university diploma (dUT); this is designed for entry into the labour market. Students can also decide, on completion, to go on to a vocational bachelor's programme, which enables them to acquire a vocational qualification at EQF level 6 and progress to master's level for a qualification at EQF level 7. Higher education (tertiary level) provides general courses and technical and vocational courses within universities and public or private higher colleges of excellence (grandes écoles).

Apprenticeship. This pathway can lead to all vocational certifications registered in the national directory of professional qualifications, which includes all secondary or higher education certifications as well as vocational qualification certificates (CQP), created by the professional branches. Young people on an apprenticeship contract (from one to three years) have the status and rights of other employees and receive a salary. The course takes place both in the workplace and in an apprentice training centre (CFA). The system is governed by the State (legislation), the regional councils (policy setting) and the social partners (management of the CFAs). Its funding comes from the State, which exempts enterprises from

employer contributions for the amount of each apprentice salary, the regional councils (bonuses on recruitment, apprenticeship subsidies) and companies (apprenticeship tax).

CVET

CVET applies to those entering the world of work or already in work, both the young and adults. The objectives of CVET include promoting professional integration or reintegration; maintaining people in work; encouraging the development of skills and access to different levels of professional qualification; and contributing to economic and cultural development and social progress. Access and funding procedures for courses vary according to individual status, either jobseekers or people in employment (private sector employees, public servants, self-employed workers). Training of jobseekers is managed by the regions, with central government intervening only for particular target groups (the illiterate, foreigners, and people with disabilities). Employers (private or public) and the social partners are responsible for training people in employment. The training market is open: in 2011, more than 58 650 training providers earned revenues of EUr 13 billion for 23.8 million training courses.

Ireland

VET

Most vocational education and training (VET) occurs within the State sector, although private providers also play a role. The country's education and training system is divided into four main sectors: primary, secondary, further (post-secondary non-tertiary) education and training (FET), and higher education. VET is provided primarily within the FET sector, with some in higher education.

The main VET providers are 16 education and training boards (ETBs) spread across the country. Responsibility for funding, planning and coordinating FET programmes at ETBs lies with SOLAS, Ireland's Further Education and Training Authority. Higher VET programmes are the responsibility of the Higher Education Authority (the statutory planning and policy body for higher education).

Ireland's 10-level national framework of qualifications (NFQ) is referenced to the European qualifications framework (EQF). VET pertains to NFQ levels 5 or 6 (EQF 4 or 5), with some programmes at NFQ 7 (EQF 6). Almost all awards made through the State-funded sector, and many in the private sector, have been placed on the NFQ. While it is possible to proceed to apprenticeship training following completion of lower secondary education (ISCED 2), most learners (around 90%) continue to complete upper secondary education, which in Ireland is general, rather than vocational, in nature.

Post-secondary non-tertiary programmes are aimed mostly at those who have completed upper secondary education. Training includes:

- Apprenticeships: people acquire craftsperson status by combining off-the-job training (in ETBs and institutes of technology) and on-the-job training (with an employer). Training leads to an NFQ level 6 (EQF5) craft certificate. Partial awards are also made;
- Post-leaving certificate courses (PLCs): delivered in ETB colleges or second-level schools; they comprise general or vocationally oriented education, or both. Typically, training is in areas such as technical knowledge, personal/core skills and work experience; PLCs lead to an nFQ level 5 or 6 award (EQF 4 or 5). Partial awards are also made;

- Training for other occupations: delivered by second-level schools, ETB colleges, private or sectoral providers (e.g. for tourism, agriculture or fishing). Awards, full or partial, are made, usually at nFQ level 5 or 6 (EQF 4 or 5).

VET at tertiary level (iSCEd-P 544, 554) is provided mostly by institutes of technology and, to a lesser extent, by universities and other higher education providers. Courses are mainly in business, science and technology and lead to an nFQ level 6 or level 7 award (EQF 5 or 6).

For second chance education and training for the unemployed, VET is also offered in the form of:

- VToS (vocational training for the unemployed); Youthreach (for early school leavers aged 15-20); and the back to education initiative (part-time for adults). Full and partial awards are made at nFQ levels 1-6 (EQF 1-5);
- Traineeships: training for the unemployed for a range of occupations (such as financial advisor assistant, pharmacy sales assistant). it leads to an nFQ level 5 or 6 (EQF 4 or 5) award (full or partial);
- Specific skills training: training for the unemployed in a vocational skill (such as computer hardware maintenance), delivered by ETBs (on average, 16 weeks). There is a range of awards, full and partial, at nFQ levels 3-5 (EQF 2-4).

Ireland

Education & Training in Ireland

According to the Progress Review of the Further Education and Training Strategy 2014-2019 the education sector in Ireland has undergone unprecedented structural reform in recent years. Within the Further Education and Training (FET) sector, these reforms have resulted in the establishment of SOLAS, 16 Education and Training Boards (ETBs) and Quality and Qualifications Ireland (QQI), as well as the expansion of the apprenticeship system. Reform is also underway within higher education (HE), supported by the Higher Education System Performance Framework 2014–2016. 92 A key objective of this reform process is to ensure that the system creates “the right opportunities for Irish adults”93 in the context of the skills required by Ireland’s economy. One of the unique aspects of the Skillnets model is that training networks are not tied to a fixed suite of courses, or to particular institutions or training providers. Training networks cross-cut both the HE and FET sectors and their offering constantly evolves because they are driven by the wide-ranging and ever-changing needs of enterprise (SOLAS, 2018).

In 2015 a report by the Skills and Labour Market Research Unit (SLMRU) in SOLAS for the Expert Group on Future Skills Needs reported education and training outputs for Ireland as:

- Over 216,000 awards spanning levels 1-10 on the NFQ in 2015.
- In further education and training (FET) there were 32,300 QQI awards (NFQ 1-6) in 2015, a 2% rise on 2010. There were increases across most fields of learning, except engineering & construction, science & computing and social science, business and law.
- In higher education, there were approximately 66,500 awards in 2014, an increase of 14% on 2010 with increases across all fields of learning, except engineering and construction.

The report further noted in relation to Engineering, manufacturing and construction that the sharp decline in the number of FET awards is almost entirely due to the impact of the recession on the

construction sector. They further state in relation to apprenticeship programmes over 3,000 new registrations took place in 2015. The downturn in the construction sector has also affected output from higher education in this discipline, with the number of HE awards at levels 7 and 8 particularly negatively impacted. Inflows into the higher education system at level 8 have been increasing in recent years, which should result in a reversal of recent declines at this level; until recently, all increases were driven by engineering courses, although construction is showing signs of recovery lately. Ireland's share of third level graduates in this discipline was lower than the EU average; at 10%, Ireland's share is less than half that of Austria, Finland and Germany, each at 20% or higher (SOLAS, 2016).

The skills shortages that Ireland is likely to experience up to the year 2025 were set out in the 2014 National Skills Strategy, this report identified the requirement for specific skill-sets within the construction sector: chartered surveyors; internationalisation and management capability; ICT, Building Information Modelling (BIM) systems and Green Economy skills.

Further Education and Training

ETBs, mentioned above, are statutory authorities (Education and Training Boards Act 2013) that have responsibility for education and training, youth work and a range of other statutory functions. ETBs establish, maintain, manage and operate second-level schools, further education colleges, multi-faith community national schools and a range of adult and further education centres delivering education and training programmes.

In their regionally-based, functional areas they are responsible for policy, planning, co-ordination, funding, review and monitoring of:

- The vocational schools offering second level education;
- Recognised schools or centres for education maintained by them;
- Education or training facilities maintained or resourced by them;
- Children detention schools;
- Prisons and facilities maintained by other public service bodies;

Provision of Further Education and Training. This sector covers all activity outside of primary and post primary schooling, and which is not part of higher education. This includes adult literacy, vocational education and training, second chance programmes for early school leavers and the unemployed, adult and community education. It covers awards at levels 1-6 of the national framework of qualifications (EQF Levels 1-5). Provision is mainly in vocational schools and other adult learning centres. Provision may also be contracted out to community or private sector providers.

Since 2013, policy, funding and co-ordination of the sixteen regional ETBs is undertaken by a new Further Education Authority, called SOLAS, (An tSeirbhís Oideachais Leanúnaigh agus Scileanna/Continuing Education and Skills Service). SOLAS also contracts out VET services to providers in private and community settings under a range of special initiatives, based on competitive tendering.

Further Education and Training (FET) refers to the provision of education and training at levels 1-6 on the National Framework of Qualifications (NFQ) outside the traditional post-primary and Higher Education Institute trajectory. Its remit includes the provision of courses for jobseekers, school-leavers, employees, those upskilling and/or retraining and those looking for 'second-chance' education, as well as the delivery of basic skills and education for adult learners.

Learners engage in the FET sector for a host of reasons from learning basic literacy skills, to completing state exams, to gaining vocational training, Continuing Professional Development or other lifelong learning activities. Historically, aspects of FET were provided either by FÁS (the previous Irish National Training and Employment Authority) Industrial Training or the Vocational and Educational Committees (VEC's) provided vocational education and community education. The previous 33 VEC's were replaced by the 16 Education and Training Boards (ETBs) under the Further Education and Training Act 2013. SOLAS was established in 2013, alongside the ETBs, as the 'State Organisation with responsibility for funding, planning and co-ordinating Further Education and Training (FET) in Ireland', ensuring that FET is funded and responsive to the needs of industry and learners (Mooney & O'Rourke, 2017).

FET encompasses ten main types of provision which include: Vocational Training Opportunities Scheme (VTOS); Post Leaving Certificate courses (PLCs); apprenticeships/work based learning; community education; statutory provision; traineeships; Youthreach; Specific Skills Training; Back to Education Initiative (BTEI); and literacy and numeracy courses (Mooney & O'Rourke, 2017).

Higher Education and Training

The Higher Education system is principally a binary system with universities and institutes of technology. The higher education sector offers awards at levels 6-10 of the national qualifications framework (EQF levels 5-8). A Higher Education Authority (HEA) is responsible for policy, funding and research in these institutions, while respecting academic autonomy. The HEA leads the strategic development of the Irish higher education and research system with the objective of creating a coherent system of diverse institutions with distinct missions. Since 2015 it is possible to offer apprenticeships in either further or higher education settings.

Apprenticeships - Ireland[6]

The review of the apprenticeship system marks a fundamental re-appraisal of the further education and training system in Ireland. Currently, Ireland has a very narrow-based apprenticeship system consisting of only 25 trades. Furthermore, these trades are traditional; they are mainly construction-related and they are overwhelmingly male-dominated. The only other form of a 'dual training' system (i.e. training which systematically involves a combination of on- and off-the job training modules) is 'traineeships'. These are typically initial vocational training courses which are of varying duration and which focus on providing skills for which there is a market demand. These are not formal apprenticeships and the participants are typically unemployed job-seekers, and, unlike apprentices, they are not considered to be employed (SOLAS, 2014).

The current model of apprenticeship training in Ireland for the traditional craft trades is called the Standards Based System (SBS) and has been in operation since 1991. A model of dual based training, the SBS divides an apprenticeship into phases of on the job and off the job training. This form of training, known as an employer-led model is the most common form of apprenticeship training in Europe and is the primary feature of a dual based training system due to its capacity to deliver blended learning (O Murchadha, Eoghan; Murphy, Roisin, 2018).

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6 Part of a set of articles prepared within CEDEFOP's ReferNet network (https://cumulus.CEDEFOP.europa.eu/files/vetelib/2015/ReferNet_IE_2014_WBL.pdf)

Current Craft Apprenticeships in Ireland:

1. Agricultural Mechanic
2. Aircraft Mechanic
3. Bricklayer / Stonelayer
4. Carpenter & Joiner
5. Construction Plant Fitter
6. Electrician
7. Electrical Instrumentation Craftsperson
8. Electronic Security Systems Craftsperson
9. Farrier
10. Heavy Vehicle Mechanic
11. Industrial Insulation Craftsperson
12. Instrumentation Craftsperson
13. Mechanical Automation and Maintenance - MAMF Fitter
14. Metal Fabrication Craftsperson
15. Motor Mechanic
16. Painter & Decorator
17. Pipefitter
18. Plasterer
19. Plumber
20. Refrigeration & Air Conditioning Craftsperson
21. Stonecutter & Stonemason
22. Sheet Metalworker
23. Toolmaker
24. Vehicle Body Repair Craftsperson
25. Wood Manufacturing and Finishing Craftsperson

A number of construction skills fall outside of the formal apprenticeship system. These include concrete workers, steel workers, roofers and glaziers. All of these workers are associated with the construction and renovation of building fabric and, in light of the new technologies and standards being applied to this field, should receive appropriate training in the future.

CURRENT TRENDS IN TRAINING[7]

In a survey undertaken within the Dublin Institute of Technology for the Construction Industry Federation and reported by Eoghan Ó Murchadha and Dr. Róisín Murphy in February 2018 the decrease in investment in training can clearly be seen from the current levels of new apprentices annually. From 2003 until the downturn in 2007, the Construction family of trades was responsible for more than half of all new registrations. By 2012, this group accounted for less than 15% of the intake of new apprentices.

7 https://cif.ie/wp-content/uploads/2018/05/CIF-DIT-REPORT-LOW-RES-2018.pdf

Today, the construction family of trades is recovering slowly and accounts for 26% of the annual intake of new apprentices (O Murchadha, Eoghan; Murphy, Roisin, 2018).

Within the Construction family of trades, the impact was felt worst by those referred to as 'wet trades'. The trade of Floor and Wall Tiling was so badly impacted that it has ceased to register any new apprentices since 2013 and as such has become a 'dead apprenticeship'. The trades of Painting and Decorating and Plastering have also recorded troubling declines. As can be seen from their intake figures, these trades declined to just single digit figures of new entrants at their lowest levels. The delayed reaction to construction growth is also felt in those trades referred to as 'wood trades'. The traditional backbone of the Construction trades, Carpentry and Joinery, is recording numbers for new entrants' equivalent to just 21% of its pre-recession peak. Worse still is the trend in the 'new' trade of Wood Manufacturing and Finishing. This trade is the result of a merger of the old trades of Cabinetmaking and Wood Machining and endeavoured to fortify the trades through amalgamation. However, registrations for 2017 were below the recorded registrations of 2008 for the old Cabinetmaking trade alone. This lag in construction trades is despite the fact that the national economy is in recovery and construction output is recording stable, positive growth. Naturally, stakeholders are concerned that the same fate awaits these trades as Floor and Wall Tiling (O Murchadha, Eoghan; Murphy, Roisin, 2018).

In Ireland, apprenticeship training is currently concentrated in the broad field of engineering, manufacturing and construction the number of new registrations for craft apprenticeships. The number of new apprentices declined significantly with the onset of the economic crisis in 2007 (falling to 1,200 in 2010); since then, numbers have begun to increase, although at 3,700 in 2016, they remain well below the peak of 8,300 observed in 2006 (Skills and Labour Market Research Unit (SLMRU), 2017)

Following a Department of Education and Skills review in 2013 it was decided to expand the apprenticeship system. An Apprenticeship Council was established in 2014, supported by SOLAS and the HEA, and a national Call for Proposals issued in January 2015. Following receipt of 86 proposals from industry-led groups, in July 2015 the Minister for Education and Skills announced development of an initial 25 of these proposals, and by quarter 2016, the first intake for these new apprenticeships had begun. At the time of writing, there were nine new non-craft apprenticeships, with a further 16 in development. The 2017 Call for Apprenticeship Proposals, which opened on 4th May and closed on 1st September, resulted in a range of proposals in different areas. These are currently being assessed and recommendations will be made to the Minster for Education and Skills for consideration and approval by November 2017 (Skills and Labour Market Research Unit (SLMRU), 2017).

Apprenticeship registrations for craft (pre-2016) apprenticeships in engineering etc. areas over the period 2006-2015 are provided in Figure 8. Although they remain much lower than the peak in 2006, the number of new registrations for these apprenticeships has been growing annually since the lowest levels in 2010 (Skills and Labour Market Research Unit (SLMRU), 2017).

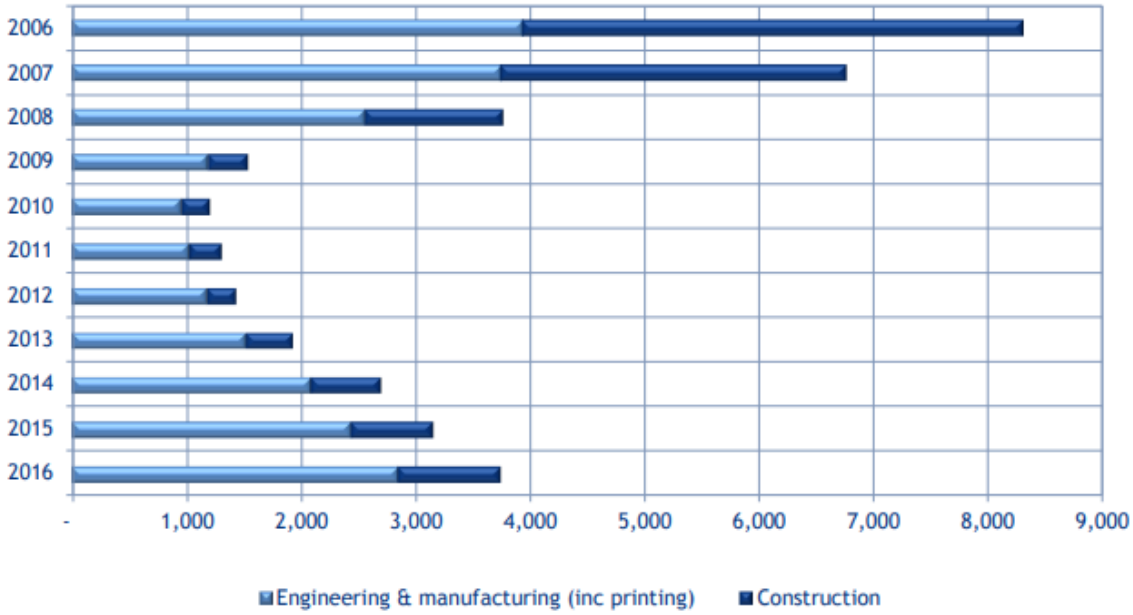

Figure 8 Craft (pre-2016 apprenticeship registrations for engineering etc. trades, 2006-2016 extracted from Solas Monitoring Ireland's Skill Supply

- Engineering & manufacturing: in 2016, more than three quarters of all new registrations were for apprenticeships in these trades; the highest number of new registrations were for electrical (over 1,300, up from 355 in 2011); motor mechanic (over 400) and metal fabricator (over 180) trades (Skills and Labour Market Research Unit (SLMRU), 2017).
- Construction: new registrations declined sharply as a result of the recession; since 2012. However, the number of new registrations for these trades has increased annually, although the total for 2016 (at just over 900) remains well below the 4,380 registrations observed in 2006; the trades with the highest number of registrations in 2016 were carpenter/joiner (almost 400 registrations) and plumber (345 registrations) (Skills and Labour Market Research Unit (SLMRU), 2017).

Electrician

A report by the SLMRU on Forecasts of apprentice intake into selected construction and non-construction trades to 2015 notes that with the exception of the trade of carpentry and joinery, the electrical trade provides the highest employment among the designated trades. While the majority of all employed electricians are working in the construction sector, there is a significant proportion working outside of that industry, particularly in areas such as utilities and manufacturing. The proportion working outside of construction is likely to increase as activity in the construction sector continues to contract further. The historical trends indicate this change in the distribution pattern of employment for this trade. In 1998, 62% of all employed electricians were working in construction and the share increased to 76% in 2007, reflecting the significant increase in construction activity during that period. However, as construction activity began to contract sharply since 2007, many electricians became unemployed and the proportion declined to 63% in 2010 — almost equivalent to the proportion which prevailed in 1998. It is assumed that this trend will continue as some of the sectors of employment for electricians, such as high technology manufacturing, are expected to exhibit a higher level of growth over the forecast period

compared to the construction industry.Employment of electricians almost doubled between 1998 and 2007, increasing from 16,400 to 30,400. Since 2007, the numbers employed declined dramatically, decreasing by just over 12,000 to 18,300 in 2010, reflecting the severe contraction in activity in the construction sector. These figures imply that the number of net job losses recorded over the last four years was not significantly below the number of net job gains experienced between 1998 and 2007 (Skills and Labour Market Research Unit (SLMRU), 2011).

Carpenter and Joiner

A report by the SLMRU on Forecasts of apprentice intake into selected construction and non-construction trades to 2015 notes that traditionally, the trade of carpentry and joinery accounted for the largest number of persons employed among the designated trades. Four fifths of those employed in this trade are working in the construction sector, particularly in the housing sub-sector. Employment in this trade increased from 22,200 in 1998 to reach a peak level of 43,400 in 2007; almost a two-fold increase in the numbers employed. Following a modest decline in 2008, employment began to contract sharply, declining to 18,700 in 2010. This represents almost a 60% reduction in employment when compared to the peak level (Skills and Labour Market Research Unit (SLMRU), 2011)..

Health and Safety Training[8]

In addition to specialist training for Managers, Engineers, Craftsmen and other workers there is a legal requirement for all workers at Construction sites to have completed Safe Pass Training and for operators of certain mobile plant to hold the relevant CSCS training accreditation.

Safe Pass

The Safe Pass Health and Safety Awareness Training Programme is to ensure that, over the course of time, all workers in construction will have a basic knowledge of health and safety, and be able to work on-site without being a risk to themselves or others who might be affected by their acts or omissions. From a health and safety perspective, construction workers are bound by law to hold a valid Safe Pass card. With this Background in mind the programme was developed in consultation with interested parties.

The Aims of the programme are focused mainly around health and safety awareness, while the Benefits include an improved safety culture. There are a number of different modules making up the Safe Pass Course Content. Part 1, Regulation 4 of the Safety Health and Welfare at Work (Construction) Regulations 2013 provides details on the categories of workers that recognise a Safety Awareness Registration Card. Construction apprentices registered under the Standards Based Apprenticeship Scheme, and trainees undergoing traineeships in the Construction Industry are also required to have a Safety Awareness Registration Card.

CSCS

The Construction Regulations require that certain construction workers carrying out safety critical tasks must complete Construction Skills Certification Scheme (CSCS) training. On successful completion of this training, persons are given a CSCS card. These cards demonstrate that the worker has received training in the relevant skills. A listing of tasks requiring CSCS Training are shown in Figure 9.

8 https://www.hsa.ie/eng/Your_Industry/Construction/Training_in_Construction/

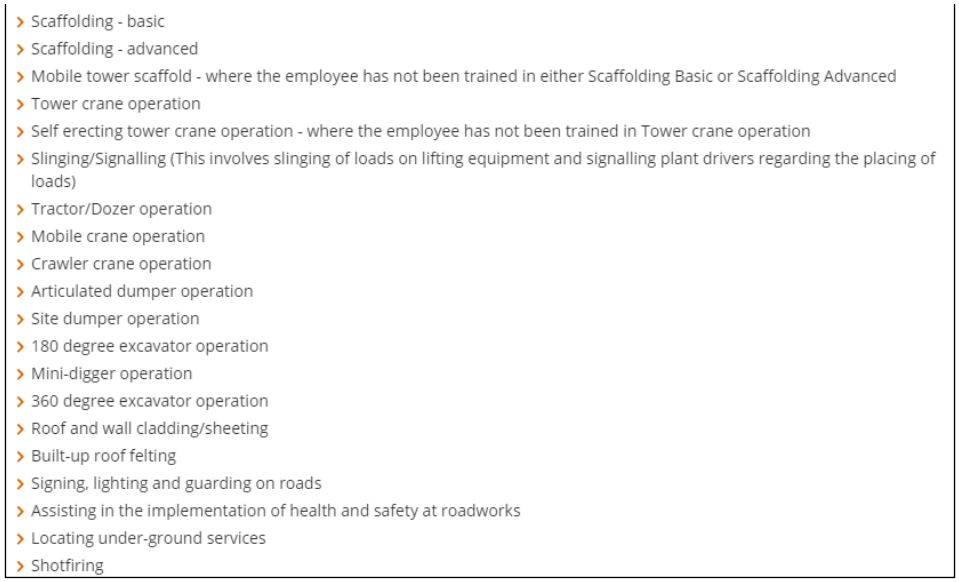

Figure 9 Listing of Tasks Requiring CSCS Training extracted from the Health & Safety Authority website[9]

United Kingdom

In a comprehensive survey of Northern Ireland construction firms carried out by the NI Survey Unit (McGuinness & Bennett, 2006) of the sample of 9,522 employees 4,368 were employed in skilled construction occupations (craft) giving to a total craft employment share of 46%. Firms were asked to give information on the qualification and/or experience levels of their workforce and it was found that in relation to the skill levels of these craft workers, approximately 67% were trained to NVQ level 3 and above. There are some variations in terms of the skills distribution of the various craft occupations (see Table 1 Distribution of current craft level employment (%) extracted from McGuinness & Bennett, 2006). Only 13 per cent of plumbers are skilled to NVQ level 2 compared to approximately 30 per cent of bricklayers, joiners and electricians. The traditional crafts of bricklaying, plumbing, joinery, plastering, electrical and, painting and decorating account for just 56% per cent of total craft employment with the remaining 44% classified as 'other'. On closer analysis of this 'other' category the authors found that the vast majority of these workers were employed in general building firms or civil/structural engineering firms suggesting that they tended to work in craft occupations such as, for instance, roofing within general building firms, and steel fabrication and scaffolding, etc. within engineering companies.

Table 1 Distribution of current craft level employment (%) extracted from McGuinness & Bennett, 2006).

9 https://www.hsa.ie/eng/Your_Industry/Construction/Training_in_Construction/

	New qualified NVQ 2	*Experienced NVQ 2*	*Qualified NVQ 3 or above*	*Employment share*
Bricklayers	4	27	68	6
Plumbers	6	7	87	6
Joiners	10	19	71	22
Plasterers	6	17	77	2
Electricians	11	25	64	17
Painters & decorators	6	5	89	3
Other trades	15	24	61	43
Total	12	22	66	100

Training in Prefabrication

Evidence from both the UK and NI suggests that there is clear evidence to support the view that prefabricated building processes are likely to become increasingly important and as such, the training needs of employers adopting such processes need to be taken into account. For instance, when a UK panel of industry employers were asked their views on the importance of various innovations within the sector, prefabrication received twice as many mentions than the next most significant technology (McGuinness & Bennett, 2006).

BUILD UP SKILLS (BUS)

Pillar 1 BUS Roadmaps by Country

The Build Up Skills – EU Overview Report (European Commision's Executive Agency for Competitiveness and Innovation (EACI), 2013, p. 39), identified as a 'staff working document' and dated October 2013, with a revision in June 2014, compiles the occupations with the most urgent training needs via the national status quo reports of 30 countries as follows:

Table 2 Occupations with the most urgent training needs extracted from the BUS EU Overview Report 2013.

Most often mentioned occupations requiring additional training (Annex 5)	**Most often mentioned occupations with the highest numbers of workers requiring additional training (Annex 6)**
• **Bricklayers and stonemasons**; • **Carpenters and joiners**; • Plumbers and pipe fitters; • Insulation workers; • **Building and related electricians**; and • Roofers. Some less often mentioned occupations include: • Glaziers: • Concrete placers; • Concrete finishers and related workers; • Plasterers; • Floor layers and tile setters; and • Electrical mechanics and fitters.	Most often mentioned were **carpenters and joiners** (incl. installers of windows/ doors/ facades). The following important occupations were mentioned similar number of times: • **bricklayers and stonemasons**; • **building and related electricians**; and • RES installers which were considered similarly important by countries. Other less often mentioned occupations were: • Plumbers; • Insulation workers; • HVAC technicians; • Plasterers; and • Roofers.

Source: National status quo reports and information separately provided by countries

Looking specifically at the national status quo reports of the 12 countries that are within the scope of this report, the following are those occupations most often mentioned as requiring additional training (see accompanying excel summary of the 3-5 occupations with the highest numbers of workers requiring up-skilling on EE and RES amongst building on-site workers and craftsmen as noted in the Appendix of Build Up Skills - EU Overview Report (European Commision's Executive Agency for Competitiveness and Innovation (EACI), 2013).

Austria

The Austrian BUS national status quo report predicts the need for 25,000 people within construction building services engineering by 2020, however, it states that this requirement is feasible due to the existing capacity of the educational institutions in Austria, with over 5000 people training per year in the areas of energy efficiency and renewable energy in the building sector.

Belgium

Within the Belgian BUS national status quo report the number of workers requiring training on EE and RES was estimated at 33,400, the occupations with the highest identified need for training included bricklayers and joiners (each at 19%) (Build Up Skills Belgium, 2012), see Table 3.

Table 3 Occupations with highest identified need for training - Belgium, 2012.

Occupation (group)	Est EE & RES Training Need for 2020	% of Total
Bricklayer	6,400	19%
Joinery	6,400	19%
Roofer	2,800	8%
Floor covering layer/Tiler/Plasterer	2,500	7%
Glazier	2,500	7%
Construction machinery	2,300	7%
CH fitter	2,250	7%
Plumbing installer	2,050	6%
Others	2,000	6%
Road worker	1,500	4%
Formworker/steel fixer	1,200	4%
Insulation worker	900	3%
Rendering/Pointing worker	600	2%
Total	**33,400**	**100%**

In the analysis of the national status quo in Belgium under P1 BUS (Build Up Skills Belgium, 2012) reported an increase in the following occupations from the years 2009 through to 2011 and noted that these were the occupations that have a major impact in the field of EE and RES:

- Roofer (+432)
- Weatherproofing roofer (+461)
- Joiner - Carpenter (+977)
- Industrial insulation worker (+1006)
- Central heating fitter (+660)
- Plumbing Installer (+555)
- Site plant operator (+984)

Denmark

The Danish Build Up Skills national status quo report (Build Up Skills Denmark, 2012) estimated on the basis of an optimistic scenario and a conservative scenario. In each scenario the number of skilled

construction sector craftsmen required for the energy saving initiatives to 2020 were outlined as shown in table

Table 4 Number of skilled construction sector craftsmen needed for energy saving initiatives from 2015 - 2020 by trade group (Build Up Skills Denmark, 2012).

Trade group	Initiatives	Scenario A	Scenario B
Bricklaying	Exterior wall insulation, floor structures, basement slabs	1.408	3.058
Carpenter/joiner	Insulate lofts, replace windows	3.973	8.352
Plumbing/heating/air conditioning (VVS)	Heating and ventilation systems	703	1.479
Electrical installations	Lighting installations and replacement of ventilators	112	224
Total		6.195	13.113

The highest requirement across both scenarios is within the Carpenter/Joiner trade group, followed by Bricklaying then plumbing/heating/air conditioning and finally electrical installations.

France

According to the overview of the national status quo reports in relation to France, the following occupations are described as those that requiring training: Bricklayers; Carpenters/Woodworkers; Roofers and Painters and plasterers.

Pillar 2 BUS Projects by Country

Austria – Crosscraft IEE (Build Up Skills Crosscraft Austria, 2016)

Summary

Within the project an interdisciplinary training programme was designed to highlight the importance of the approach: “the building as integrated system” and not a composition of elements, being put together. The focus of the developed course modules was mainly on the importance of the airtightness of the buildings’ envelope, the interaction between the crafts and the prevention of the most common construction mistakes and errors. Courses deployed via classrooms and also onsite.

Training Audience

The training audience were craftsmen, constructors and installers in the Austrian building sector including masons, HVAC technicians, carpenters, support services, electricians, roofers/glaziers, painters and others.

Construction Topic

Nearly zero-energy buildings.

Thermal renovation and energy efficient building solutions. These new training modules cover the additional expertise needed by craftsmen to achieve the Austrian 2020-targets for “nearly zero-energy buildings”.

Training Topics

6 modules

1. Basic CrossCraft module/off-site –2 days- Foremen and skilled workers

- Understanding of the importance of low-energy building standards
- Better Understanding of the interaction of crafts
- Avoiding poor workmanship and its impacts

2. Compact CrossCraft module/off-site – 4 days
   - Content of the Basic Craft module
   - + Techniques for renovation of old buildings
   - + Installation of renewable energy systems
3. Quality Coach Training module/off-site – 3days
   - Cross-craft understanding, quality assurance in terms of internal and legal aspects
4. Basic CrossCraft module/on-site- 4 hours
   - Based on frequently made mistakes ref implementation of a blower door test

Findings/Barriers

1. As SMEs have reduced their core staffing due to challenging economic conditions in recent years there was unwillingness to let their employees participate in longer courses, it was noted that short training (3-4hours) was better received.
2. Originally the "Quality Coach"-training focused on the older, experienced, but because of health issues no more in construction business active craftsmen as target group (e.g., foremen, masons,…). However, this target group could not be reached by the pilot courses. The Labour Market Service (AMS) which was targeted as a cooperation partner assessed the trainings as being too short. Should this target group be reached in the future, it would be necessary to extend these courses to be able to receive funding through the AMS. Basically, the need for such trainings has been demonstrated by the outcomes of the previous project BUILD UP Skills Austria.
3. The implementation of practical exercises such as blower door tests was very practical to show the effects of construction errors (e.g. the impact of deficient performed breakthroughs in the outer shell of the building). It was also possible for different trades (Installers, carpenters, masons, roofers ...) to discuss and coordinate their work with each other on the construction site.

Belgium – EnerPro IEE (start 2014)

Summary

Training Audience

Construction professionals, blue-collar workers and teachers

Construction Topic

RES & Construction

Training Topics

2 Training Programmes & online training module for trainers & 10 x short forms – presentations and materials

Italy - MEnS H2020 (start March 2015)

Summary

To enhance the Nearly Zero Energy Buildings (NZEB) skills of building managers such as engineers and architects through a series of accredited training activities developed by 9 universities and 3 market

players. Create the training program under the European Qualifications Framework provisions and based on desired and common learning outcomes of Level 7.

ECSO EUROPEAN CONSTRUCTION SECTOR OBSERVATORY COUNTRY FACT SHEETS

This section incorporates excerpts taken from the country fact sheets produced by ECSO specifically in relation to skills shortage and the category TO2 Skills by country.

Austria

(ECSO European Construction Sector Obervatory, 2018)

Skills shortage

The Austrian Fact Sheet provided by ECSO in 2018 reports that the Economic Chamber of Commerce in Austria (Wirtschaftskammer Österreich) has reported a lack of high-skilled labour and faces difficulties in attracting young people to work in the construction sector, mostly due to a poor image of the sector.

The total number of tertiary students in engineering, manufacturing and construction has increased by 48% between 2010 and 2015. Adult participation in education and training in the broad construction sector has been fluctuating since 2010. In the construction sub-sector, the participation rate declined to 1.7% between 2010 and 2016.

This report notes that renovation is going to grow, boosting demand for tinsmiths, construction site workers, roofers, plumbers and installation technicians. According to the Austrian Ministry for Agriculture, Forestry, Environment and Water Management, investments in energy efficient renovation and conversion of heating systems have the potential to create up to 35,000 additional jobs by 2020. Prospects of apprenticeships in these professions are therefore good.

The Austrian government has recognised a shortage of construction-related professions. The list of shortage occupations for 2018 includes technicians in mechanical engineering and power engineering technology, mechanical engineers, including installation engineers, air conditioning system engineers, building services engineers (heating, ventilation, sanitary), CAD design engineers and construction machinery engineers, but also includes

- Roofers: Roofer, foreman/forewoman (roofer), master roofer
- Construction joiners: stage joiner, construction joiner, floor layer (construction joinery), floorer, floor polisher, installation joiner, parquet layer, master joiner (construction joinery)
- Concrete constructors: Concrete worker, concrete constructor, concrete mixer, foreman/forewoman (concrete constructor), form worker, formwork setter, steel-reinforced concrete constructor, concrete repair worker
- Carpenters: Construction carpenter, assistant carpenter, shuttering carpenter, master carpenter, carpenter, foreman/forewoman carpenter, carpenter-polisher, prefabricated house builder, carpentry technician
- Floor and wall tilers, tilers, pavers, floor and wall tilers
- Pipe installers, pipe fitters: Master GWH installer, master heating installer, heating fitter, installer, installer foreman/forewoman, master installer, refrigeration system installer, air conditioning installer, pipe fitter, GWH installer, sanitary fitter, pipe fitter (pipe installations), gas and water mains installer, water mains installer, building fittings installer, heating and

sanitary fitter, pipeline engineering foreman/forewoman, sanitary and climate technician (gas/water mains installation), sanitary and climate technician (heating installation), sanitary and climate technician (ventilation installation), gas mains installer, central heating engineer, solar technician (solar operator), sanitary and climate technician (eco energy installation), installation and building services technician - gas/sanitary technology, installation and building service technician - heating technology, installation and building service technician - ventilation technology, engineering designer - installation and building service technology.

TO 2 – Skills

In Austria, the vocational education and training (VET) enjoys one of the highest rates of participation EU-wide, namely 70% in 2014, compared to the EU average of 48%. The good quality of the VET system is also a key contributor to low levels of unemployment for recent upper secondary graduates. In Austria, the share of young people (15-29) not in education, employment or training (NEET) is at 6.8%, one of the lowest across the EU.

A recent reform to the vocational training act (Berufsausbildungsgesetz) introduced quality objectives and quality-related measures in education. Furthermore, it makes the VET curriculum more flexible by allowing partial qualifications and easier access to the continuation of vocational education, especially focusing on integrating young refugees. This is part of the strategy “Education till 18” (“Ausbildung bis 18”), which aims at allowing young people to continue their educational path beyond compulsory education until the age of 18. Another goal of the vocational training reform is to simplify the introduction of pilot initiatives by educational institutions, thus fostering a more innovative approach to VET education. This 2015 education reform is funded and implemented by the Austrian government and came into force in 2016.

Importantly, as a means to incentivise apprenticeships, the Association of the Building Industry (Fachverbandes der Bauindustrie) gives a bonus of EUR 2,000 per year and per apprentice to their members that take on an apprentice. Moreover, the PORR Group, which is the biggest Austrian building contractor in the building industry, also offers commercial trainee programmes (ufBAU Business) for the university graduates to get the first hands-on experience in the construction sector.

There is also another incentive launched by the government to give EUR 2,000 to companies to hire apprentices. The aim of the bonus is to stabilise a number of apprentices entering the construction industry and counteract the decline. In addition, in the line of initiative, there is also regulation called “Bad Weather Regulation” (Schlechtwetter-Verordnung) for construction companies and employees to attract companies to employ young people. So if a company sends workers home due to a bad weather, they could apply and get 60% reimbursement from the government due to a bad weather. As from the last year, this regulation also applies to apprentices who could be reimbursed under this regulation, which became beneficial for both employer and employees.

Green Skills

Finally, Austria is investing in enhancing the green skills of its workforce through the programme klimaaktiv. The initiative focuses on providing advanced vocational training in the fields of renewables, energy efficiency and mobility by working in partnership with relevant professionals, such as plumbers,

architects, building masters, etc. Pilot training courses have been designed with the support of universities, technical colleges and the chamber of commerce. Ultimately, stakeholders are expected to benefit from increased knowledge and the application of higher quality standards135.

In order to implement Energy Performance of Buildings Directive and achieve the European and national climate protection targets for 2020, Austria participates in the project "NEWCOM" and seeks to increase the number of blue collar workers and building inspectors with special nZEB competence, who could gain knowledge and skills about quality renovations works with energy saving impact, and develop missing qualification and certification in the line of a Horizon 2020 project.

Belgium

(ECSO European Construction Sector Obervatory, 2018)

Skills shortage

The number of job vacancies in the construction sub-sector has decreased by 24.0% since 2012, from 8,788 to 6,678 vacant positions in 2015. The lack of demand for the jobs in the construction sector is linked to the strengthening of the competition between existing players as well as to increasing pressure from the posted workers from inside and outside EU with lower labour costs

Overall, the number of tertiary students in engineering, manufacturing and construction, and particularly in architecture and building, increased by 14.3% between 2010 and 2015, from 3,200 to 3,656. On the other hand, the number of tertiary students in manufacturing and processing dropped by 9.9%, from 485 to 437 over the period of 2010 and 2015. The adult participation rate in education and training in the construction sub-sector remained relatively stable on the average of 4.5% over 2010-2015, with a slight drop in 2016 that stood at 3.4%. In real estate activities, the participation rate was at 13.3% in 2011.

Construction is one of the sectors that presents the most bottleneck vacancies, particularly for professions such as engineers, technicians, designers, electricians. Employers often consider the lack of soft skills, in particular motivation and work attitude, as one of the reasons for the bottleneck vacancies. An average of 70% of companies find difficulties in filling up job positions related to construction. Moreover, the lack of skills had detrimental effects on the productivity of 2.2% of construction companies in 2012.

In addition, the construction sector needs plasterers, painters, plumbers, bricklayers, carpenters, scaffolders, roofers, tile layers, building site workers, electricians and mechanics. Belgium experiences labour shortage of about 20,000 construction workers every year, which will result especially in delaying the residential construction. Thus, in order to counteract the number of workers leaving the profession, the number of new recruitments will need to increase from a baseline of 24,150 in 2012 to 24,900 in 2030. This number may be as high as 32,000 if the workforce increases by 1%, whereas it could decrease to 19,000 in case the workforce is to decrease by 1%.

TO 2 – Skills

The Belgian vocational education and training (VET) system enjoys above average participation rates. The employment rate of VET graduates reached 75.6% in 2014, slightly above the EU average of 73 %. However, only a small fraction of the VET courses also cover work-based learning. Indeed, the regional governments are taking action to counteract this development. For instance, work placements were

made compulsory in more than 140 VET courses in Flanders as of 2014, while the Walloon region introduced the 'Pact for Employment and Training'.

Early school-leaving represents a challenge in the VET system. Furthermore, participation in lifelong learning is low in Belgium, in particular for people with low levels of skills. In fact, according to the Adult Education Survey, 46% of employed workers complete formal or non-formal education, below the EU average of 48.6%110. Adult participation in lifelong learning decreased in 2015 to 6.9%, well below the EU-28 average of 10.7% and neighbouring countries.

In terms of initiatives dedicated to construction skills, the Walloon region together with the Wallonia-Brussels Federation and the construction sector launched a framework for cooperation agreement in education, training and integration into employment in January 2016. The agreement aims at fostering stronger cooperation between sectorial and educational actors, which include a company and training/educational organisation, in order to develop common projects.

Furthermore, actions are dedicated to the promotion of the construction sector for young people. To this end, the pilot project of on-the-job education in construction companies was launched in 2014 by the Confédération Construction of the Brussels-Capital Region. The initiative consists mainly in a traineeship programme with the objective of improving the quality of the hands-on education in construction, as well as of facilitating the renewal of skilled workforce.

In addition to attracting young people, specific action has been taken to target women and attract them to the construction sector. The portal 'Femmes de metier' is dedicated to the recruitment of women, who are interested in a career in the construction sector. The portal offers information on specific trainings and includes testimonials of women working in construction.

Underscoring the importance of skills and career development in construction, the Confédération Construction dedicated its 2016 Construction Forum to discuss themes around the role of the construction sector as an attractive employer. The industry is witnessing the rise of new professional figures, such as the BIM Manager or the process manager. At the same time, the sector faces challenges from low cost labour, which can be considered social dumping. Moreover, collaboration has been set up between the PHARE Service and the Institut Bruxelles-Formation for the vocational education and training courses.

Socioprofessional insertion organizations, Organismes d'insertion socioprofessionnelle (OISP), operating under the Institut Bruxelles-Formation, offer adult learning courses for people who do not have a higher secondary education qualification (CESS) or equivalent qualification. These courses help to master reading and writing, to acquire basic skills and a professional qualification in many fields including the construction sector.

Similarly, the Schaerbeek Youth at Work, les Jeunes Schaerbeekois au Travail (JST) offers disabled people education and training for qualifying as gardeners and carpenters.

Entreprises de Formation par le Travail – E.F.T., work-based training companies (Wallonia) and work-based training workshops (Brussels) provide combined training and individual support in actual work situations, on site or in the workshops for people who are experiencing difficulties in integration117.

Similar to other EU Member States, Belgium introduced a social identity card in the construction sector. Specifically, the Social Security Fund of the Construction Industry, the fbz-fse Constructiv, is in charge of coordinating and organising the implementation of the ConstruBadge, i.e. an identification tool for construction sites. The data recorded on the badge is collected centrally and fbz-fse Constructiv performs checks on the data validity. As of the end of 2014, 160,000 badges were released, even though ConstruBadge is not mandatory. The main rationale for the launch of the initiative is to prevent social dumping by visually identifying construction workers. Nevertheless, the badges may also contain information on e.g. qualifications, safety, access to buildings, etc.

Denmark

(ECSO European Construction Sector Obervatory, 2018)

Skills shortage

Denmark is increasingly facing skills shortages in their economy, in particular in the construction sector. This is partly due to the fact that the labour market is experiencing a shift, whereby elderly workers are retiring, but they are not being replaced by younger ones with a vocational background.

In addition, the construction sector is predicted to experience the most significant future job growth until 2025. Indeed, more than one in five firms are reporting labour shortages and the number of average vacancies increased from 20,000 in 2013 to 30,000 in 2016.

Bottleneck vacancies are frequently reported in a number of professional occupations in the construction sector, specifically for road-construction workers and real estate agents. Furthermore, the construction sector suffers from a shortage of craftsmen, such as carpenters, bricklayers, plumbers and soil and concrete workers. Specific skills are needed to enhance energy-efficiency in buildings and improve insulation, heating systems, as well as replacement of windows. Electricians are considered short in supply, too. Furthermore, it is estimated that by 2020 there will be a shortage of both skilled and unskilled labour in construction, including high-skilled profession such as engineers and construction managers45.

Adult participation in education and training in the construction sub-sector is traditionally high and stood at close to 30% over the past decade. In 2016, it marked a decrease compared to the previous year, reaching 26.1% and well above the EU28 average of 9.2%. Similarly, adult participation in training for the real estate sub-sector stood well above 30% for most of the past decade, but saw a decrease from 33.6% in 2015 to 30.9% in 2016, though still well above the EU28 average of 15.8%. Furthermore, the number of students enrolled in tertiary education in engineering, manufacturing and construction, and specifically in architecture and building, grew by 10.6% since 2010, reaching 2,933 in 2015.

TO2 – Skills

Denmark is the EU country boasting the highest rate of vocational education and training (VET) students enrolled in work-based programmes (99.7%). Moreover, at 31.3% in 2015, adult participation in lifelong learning is also one of the highest in the EU, well above the average of 10.7%. Nevertheless, more apprenticeship places in companies are still required, and the enrolment of students in VET is only 19%. Therefore, the 2015 reform 'Better and more attractive vocational education and tpath from the current 19% to 25% in 2020 and 30% in 2025. In addition, the completion rate of VET should also be improved from 52% in 2012 to at least 60% in 2020 and 67% in 202592. Training programmes', enforced in the 2015/2016 school year, aims to increase the share of young students entering the VET.

An important aspect related to skills development revolves around raising the awareness and enhancing skills in the area of energy efficiency and renovation works in buildings. To this end, the scheme Bedre Bolig aiming to improve energy efficiency in housing, contains a training module to offer professional advice on energy renovation. Furthermore, the Knowledge centre for energy savings in buildings is dedicated to improving qualifications related to energy savings as well as providing advice and guidance94. However, more efforts are required to further improve the quality of trainings and ensuing skills, according to the Danish Association of Building Experts, Managers and Surveyors.

In order to attract young people to the construction sector, a series of initiatives were introduced. The Trade Union 3F and the Danish Construction Association launched Build the Future (Byg fremtiden), a website where young people can read about the 16 vocational education programmes in construction and the experiences of current apprentices, and therefore be inspired in their educational choices. The website also contains information about career opportunities and the possibilities of higher education within the sector.

Similarly, Build a House (Byg et hus) is a 4-year educational project for 3rd to 6th grade pupils (9-12 years) offered in collaboration between the Technical School of Esbjerg and Esbjerg Municipality. During the four school years, the students build a house in size 1:20, in cooperation with a partner vocational school. They therefore learn about different aspects of building a house, including electrical work, construction, roofing, architecture, décor, materials, crafts, house loans, etc. The goal of the initiative is to introduce the pupils to education and professions in the building sector and familiarise them with the vocational school96.

Finally, to simplify the recognition of skills, the competency card initiative (uddannelseskortet) was introduced by the Trade Union 3F and the Danish Construction Association97. However, the lack of EU-wide recognition of skills, as well as differing curricula in construction-related studies still pose a challenge for cross-border activity, according to Danish Association of Building Experts, Managers and Surveyors.

France

(ECSO European Construction Sector Obervatory, 2018)

Skills shortage

The number of tertiary students in engineering, manufacturing and construction increased by 6.5% between 2011 and 2015, growing from 104,746 to 111,603. Tertiary students in architecture and building experienced the highest growth, from 21,246 to 23,461, representing a 10.4% increase. Moreover, adult participation in education and training in the construction sub-sector went from 6.3% in 2010 to a record high of 15.8% in 2014, subsequently declining slightly to 15.5% in 2016. Similarly, adult participation in education and training in real estate activities experienced a generally increasing trend, growing from 6.0% in 2010 to 20.6% in 2016, after reaching a record high 23.1% in 2015.

Despite these figures, the French construction sector faces risks linked to the shortage of young workers with the new skills required by the evolving needs of the sector, namely with regard to energy efficient renovation and digital construction50. Indeed, estimates point towards the need to train up to 80,000 workers in Building Information Modelling (BIM) by 2020, i.e. about 27,000 per year51. According to a recent study from the National Institute of Statistics and Economic Studies (INSEE), 50% of companies in

the building sector cite lack of adequate skills as a barrier to hiring. More broadly, the French Building Federation voices concerns in all sub-sectors with regards to skills mismatches and would welcome new national initiatives, for example the upcoming reform on apprenticeships targeting the youth. This is the case, even though the number of posted workers in the construction sector in France is significant, amounting to 39.6% of the 177,674 posted workers France received in 201552.

TO2 Skills

The employment rate of vocational education and training (VET) graduates in France was 64.8% in 2016, well below the EU average of 75%, while participation of upper secondary students in VET was 41.5%, also below the EU average of 47.3%105. Nevertheless, the labour market performance and employment status of students having completed an apprenticeship is almost 20% greater than for school-based VET graduates (lycées professionnels). Both the VET and the apprenticeship systems have been criticised for their lack of adaptability to the needs of the labour market, as well as for their regional quality divergences. Moreover, access to continuous VET is difficult for the unemployed and lower skilled, as well as for employees of small companies. To this end, the government opened 500 additional VET paths in 2017 and will cooperate with local governments to improve synergies between the school-based VET and apprenticeship paths for greater flexibility106.

With regard to the construction sector, it is estimated that 1.3 million employees and craftsmen will require to be upskilled by 2020 in areas such as digital technologies and energy performance and, consequently, 12,000 trainers will need to be trained107. France has therefore put in place initiatives to support training on these aspects.

Under the framework of the Construction Revival Plan, the Action Programme for Construction Quality and Energy Transition (Programme d'Action pour la qualité de la Construction et la Transition Energétique - PACTE) was launched in 2015 by the Ministry of Housing with the aim of supporting innovation and training among construction companies. Namely, the PACTE seeks to foster the development of the energy efficiency skills of construction professionals so as to strengthen the overall quality of French constructions. With a total budget of EUR 30 million until 2018, the programme is structured around three main axes, namely supporting the development of skills, providing practical and modern tools adapted to the needs of professionals and strengthening cooperation among regions regarding the actions and measures to build the skills of construction professionals108.

Several other initiatives were also introduced to provide training on energy efficiency techniques. The FEE Bat initiative, set up through an agreement between various industry actors (Électricité de France, the Ministry of Housing, various trade associations, etc.) offers training courses on thermal renovation of existing buildings, covering both technical implementation aspects, as well as those related to the overall energy performance of buildings, so as to allow participants to provide relevant advice to customers in terms of energy savings. FEE Bat has trained over 162,000 professionals since 2008, and aims to train a further 170,000 between 2014-2017, through its allocated budget of EUR50 million109. Similarly, Qualit'EnR offers short training courses for construction professionals to provide them with the necessary skills for the installation of renewable energy systems (such as photovoltaic panels, solar-powered heating systems, biomass-powered heating systems, etc.)110.

In order to stimulate the adoption of digital technologies in the construction sector, the Building Digital Transition (PTNB) initiative (see Innovation in the construction sector) also seeks to improve the digital

skill-base of construction professionals. To this end, the PTNB coordinates several actions. These include the assessment of the offer for BIM trainings and benchmarking of international initiatives, aiming to provide construction professionals with a comprehensive picture of all training opportunities available and thus guiding them in their digital transition, but also to provide training centres with the opportunity to further align their courses with the needs of the industry111.

Under the PTNB, other initiatives include the setup of a call for projects with a budget of EUR 1 million to finance regional initiatives. BIM'Form, one of the project funded under the call for project, aimed to train 150 BIM instructors and developed free online courses (MOOC) on BIM. Furthermore, in order to offer trainings on BIM that are adapted to the various stakeholders, a competency dictionary. The objective is to offer better-targeted and individualised courses on BIM by better understanding the competences and learning needs of the learners112.

In 2014, stakeholders from the French construction industry agreed on the creation of Constructys as the accredited collection organism (Organisme paritaire collecteur agréé – OPCA) for the construction sector. The money collected is used to develop training programmes. Its action goes beyond the tax, developing training schemes to update the workers skills according to the new market requirements. It also provides companies with a support to train employees and manage their career development. In 2015, it counted over 209,200 companies among its members, and collected a total of EUR 364 million to train over 244,000 professionals113.

Finally, several initiatives were introduced to improve the image of the construction sector and attract young students to the industry. For instance, the Ministry of National Education and the National Federation of Public Works launched the Serious Games (Jeux sérieux) project, aiming to offer trainers and teachers a set of interactive training resources based on the construction of the high-speed train line Tours-Bordeaux. These are aimed at high school pupils, as well as students enrolled in VET. The project will develop five such games, each of which seeking to build the player's construction management, planning and strategic skills114.

Germany

(ECSO European Construction Sector Obervatory, 2018)

Skills shortage

The number of job vacancies in the construction sub-sector increased by 18.8% between 2011 and 2015, from 61,001 to 72,484. Vacancies in the real estate sub-sector grew even more strongly over the same period (+62.2%) albeit from a much lower level, namely from 2,947 to 4,780. As a result, the job vacancy rate increased for both sub-sector, indicating greater difficulties in filling vacant positions. In parallel, adult participation rate in education and training in the construction sub-sector slightly decreased, from 9.4% in 2010 to 8.9% in 2016. Conversely, in the real estate subsector, adult participation in training went up slightly from 11.0% in 2010 to 11.1% in 2016. The number of tertiary students in engineering, manufacturing and construction, and specifically in architecture and building, increased by 37.6% over 2010 to 2015, from 16,301to 22,437.

With increasing demand for construction works, the industry is faced with the need to find adequate skills on the market, particularly for high skilled professions such as engineering. Indeed, bottleneck vacancies for civil engineers, building electricians and similar professions are typically hard to fill due to

the lack of technical competencies in the workforce26. Furthermore, demographic changes constitute a particular threat for the German construction sector, creating difficulties in filling the increasing number of vacancies originating from the growing proportion of retiring construction workers. In 2016, 10,784 new construction apprenticeship contracts were signed, compared to the 13,500 workers that retired in the same year. The ratio of apprentices to skilled workers was 8.7 in 2014, below the critical value of 10, evidencing an unmet demand for skilled workers, particularly in enterprises with fewer than 100 employees27.

Indeed, the lack of qualified skills is hampering the sector with two-thirds of construction companies are experiencing issues in finding suitable staff28. While there has been a shortage of skilled workers and specialists in professions such as plumbing, plumbing, heating and air-conditioning technology as well as in the finishing trades for some time now, since summer 2017 there has also been a shortage in building construction and civil engineering29. The share of non-German nationals in the workforce of the construction industry has increased from 7.7% (2008) to 14.3% (2016)30. Given the important shortage of skilled professionals, foreign (non-EU) workers with relevant recognised vocational qualifications have been allowed to be employed in the German construction sector, as of July 201331.

In addition, the influx of migrants constitutes a further pool of potential labour for the construction sector. However, migrants often lack necessary language skills and need to be provided with the necessary education before being employable - in 2016, the share of workers with refugee status in the construction sector corresponded to only 0.2% of the workforce33.

Data on posted workers for 2015 shows that workers posted in the construction sector accounted 44.5% of all workers posted to Germany from the EU. For comparison purposes, 41.6% of all postings in the EU are in the construction sector.

TO2 Skills

Germany has a strong tradition of dual training, which is reflected in high participation rates to its dual vocational education and training (VET) system and overall employment rates for graduates.

Indeed, 86.4% of students are enrolled in VET programmes that include in-company and school-based learning. This significantly above the EU average of 27%89. In 2015 the employment rate for graduates with medium-level qualifications (ISCED 2-4) stood at 88% in contrast to the EU average of 77.2%.

Despite boasting a wide range of advanced dual training programmes, skills shortage is one of the biggest problems for the German construction industry, both in the short- and long-term.

In 2013, the construction industry in Germany launched the "*Berufsstart Bau*" pilot project, which financially supports measures for training in the construction industry. Under the project, regional measures are being set up in around 200 cross-company training centers throughout Germany in cooperation with local construction companies. The inter-company training centers bring in experience, know-how and existing contacts. For the period 2013-2015, 365 trainees completed the training successfully, with 70% taking on employment afterwards90. The funding period for the pilot project has been extended until 31.08.201891.

Some Länder set up campaigns aimed at raising interest in the construction sector among young students. An instance is the youth campaign "BAU – *Dein Ding*" (Construction – your thing), initially

launched in Baden-Württemberg in 2012 and operated by the local construction industry association92. The initiative aims to inspire local students to explore construction-related professions through a variety of materials, including the "Construction Bus" (BauBus), visiting students directly at school. The programme was then adopted by other regions such as North Rhine-Westphalia, which started it in December 201593.

At regional level, Berlin-Brandenburg launched the initiative *'Ready for Apprenticeship*' (Startklar für Ausbildung) to offset the lack young talent. The programme started in 2013 and runs until 2018 with an approximate annual budget of EUR 365,000. The main goal of the initiative is to reduce the skills mismatch by helping young unemployed to discover a range of construction-related professions. It is designed as a 6-month training scheme that facilitates the transition into a construction profession. The programme has supported 55 trainees in obtaining an apprenticeship since its start.

To stimulate interest for the construction sector by young people, the Construction Federation of Nordrhine (Baugewerbeverband Westfalen) launched the so-called *Azubi Portal*, which provides key information on apprenticeships in the construction industry. It allows interested candidates to submit their application directly through the portal96.

Finally, the recent influx of migrants provides an opportunity to recruit workers and to facilitate their integration. In this respect, the pilot project "Arrivo Bauwirtschaft" run by the City of Berlin aims at coaching asylum seekers to be fit for regular professional training97

Ireland

(ECSO European Construction Sector Obervatory, 2018)

Skills shortage

The Irish construction sector is experiencing a shortage of workers, which will become even more marked as the sector grows over the next years. Indeed, the expansion of the industry is predicted to require an additional 76,000 new workers until 2020. Moreover, there will be significant demand to replace workers who leave the labour market due to illness and retirement, which is estimated at about 36,000 skilled workers (including 3,840 apprentices) over 2016-2020. Thus, the total labour requirement until 2020 amounts to an additional 112,000 workers. Specifically, in order to sustain the ambitious planned housing construction targets and infrastructural investments, skilled trades will be the most requested. Indeed, by 2020 there will be the need for 88,900 skilled craftsmen, including 30,800 carpenters and joiners, 15,200 electricians, 7,900 bricklayers and masons, 13,900 plasterers and tilers and 11,800 plumbers and heating/ventilating engineers65.

Ireland's construction workforce needs to upskill, particularly in response to the growing need for renovation and building performance professionals. The drive towards international markets also further changes the necessary skills66. Further upskilling to gain experience in areas such as Building Information Modelling (BIM) and Information Technology will enable the industry to develop more efficient administrative processes. To be able to address these needs, several actions are in place in Ireland (see TO 2 - Skills).

TO 2 – Skills

Ireland reports a relatively low employability for VET graduates, standing at only 59.4% in 2015 compared to the EU average of 73.0%. The government is therefore aiming to develop ways for employers and

providers of education and training to cooperate better so as to build a skill supply aligned with the needs of the labour market114.

In this context, the National Skills Strategy 2025, introduced in early 2016, aims to provide an education and training system with the flexibility to respond to a rapidly changing environment and the ability to provide the skills needed over the next ten years.

Namely, the strategy seeks to create 50,000 modern apprenticeship and traineeship places by 2020, establish a new National Skills Council to oversee research, forecasting and prioritisation of skills needs in the economy and increase participation in lifelong learning to 15% by 2025 (from 6.7% in 2014).

In the construction sector, the significant shortage of skilled workers threatens the ambitious government plans to deliver the required housing units and infrastructural projects. This is acknowledged in the Construction 2020 Strategy, which stresses the importance of facilitating the moving of redundant construction workers back into the job market. Indeed, about 60,000 people with construction experience are estimated to be on the Live Register, according to the Construction Industry Federation (CIF). Several initiatives are therefore being launched by public and private actors to tackle this issue.

The Department of Education and Skills was already providing funding through SOLAS, the new Further Education and Training Authority, and the Higher Education Authority for various training and education interventions to support the skilling and reskilling of unemployed people across sectors with growing employment prospects. An instance is MOMENTUM, rolled out in 2013, which provides free education and training projects to up to 12,000 long term jobseekers118. Moreover, the Springboard initiative, launched in 2011, is a training programme that provides immediate opportunities for firms from the construction sector to partner with education and training providers and offers a broad choice of courses across areas such as management and non-wet trades, ICT, Building Information Modelling (BIM), 'green' construction and chartered surveying119. As of July 2016, 80% of participants since 2011 are no longer on the Live Register.

The Construction Industry Federation is also playing an active role in this respect. It is actively engaging with Solas to develop innovative ways to upskill unemployed construction workers, increase their employability and attract the younger generation to the sector. For instance, the Shared Apprentice Scheme allows apprentices to work with a number of companies, learn a trade and develop critical skills on-site. A pilot was rolled out with four participating construction companies, which share apprentices between them over the four-year duration of their apprenticeships, allowing the companies to share the costs associated with apprenticeships and the participants to gain a wider range of skills that will increase their employability in the industry. The scheme aims to increase the number and quality of new apprentices, especially in trades such as plastering and concrete work.

The CIF also launched a website targeting Irish construction workers living overseas and aiming to attract them back to Ireland to take up a job in the sector. The website, Cifjobs.ie, presents the jobs available in CIF member companies and allows potential candidates to engage directly with Irish construction companies122. CIF also launched the website apprentices.ie, aiming to match employers and job seekers to suitable apprenticeships across the country123. Furthermore, the JobsPlus Scheme was recently extended to the wet trades124. The scheme is an incentive from the Department of Social Protection to encourage and reward enterprises to employ a person that has been unemployed for over 12 months.

Under the scheme, employers can claim grants between EUR 7,500 and EUR 10,000 for each position filled.

The Action Plan for Jobs 2017 aims to create 200,000 net additional jobs by 2020 and get 45,000 additional people into employment by the end of 2017, among other priorities.

With regard to the construction sector, the Action Plan identifies specific actions126. These include the completion of the Traditional Building Skills Training Scheme, a pilot initiative part of the previous Action Plans for Jobs 2013 and 2014, which aims to enhance the skills in built heritage conservation by providing capital funds to allow certain repair projects to include a skills training element.

Finally, Construction Industry Register Ireland (CIRI) is an official online register of contractors carrying out construction works that aims to increase the quality level of the construction sector by vetting all companies who register to a set standard with regard to using competent and certified professionals, good governance of energy efficiency and health and safety regulations, amongst other criteria. CIRI provides details on competent builders, contractors, specialist sub-contractors and traders. Its objective is 'to be recognised as the primary online resource used by consumers in the public and private procurement of construction services'. CIRI is operated by the CIF on a voluntary basis and is seen as a valuable consumer protection measure, giving access to competent and qualified construction professionals. Under the Building Control (Amendment) Regulations 2014, all commencement notices, notice of assignment of builder, undertakings by builders and certificates of compliance on completion by builder seek the CIRI registration number.

Spain

(ECSO European Construction Sector Obervatory, 2018)

Skills shortage

The number of job vacancies in the construction sub-sector decreased by 71.7% from 9,102 to 2,572 in 2010-2015. In line with this trend, the number of vacancies in the real estate sub-sector decreased by 21.4%, during the same period, from 518 in 2010 to 409 in 2015. However, such a decrease had a different impact on the amount of occupied jobs. If the amount of occupied jobs in narrow construction has shrined by 41.0% in 2010-2015, the occupied jobs for real estate have increased by 14.1%, suggesting faster recovery of the latter sub-sector.

Adult participation in education and training in the narrow construction sub-sector has been fluctuating in the last years. After the initial increase in 2010-2013, the overall adult participation in trainings for narrow construction has decreased by 17.8% between 2010-2016. On the contrary, the real estate sub-sector has experienced some fluctuations; it grew from 6.5% in 2010 to 14.2% in 2013, and then decreased to 10.3% in 2016. Tertiary education students in engineering, manufacturing and construction has increased by 32.8% since 2010. It reached 71,720 students in 2015, highlighting the increasing interest during this period of students in construction and engineering (+41.8%) and manufacturing and processing (+64.1%) activities.

Experts believe that it is necessary to promote the value of the formation in the construction sector with respect to other trainings. The focus in vocational education should be put emphasise quality of the training, attractiveness of the sector and opportunities for supplication in the sector.

According to the Spanish Labour Foundation for Construction (Fundación Laboral de la Construcción – FLC), only 30% of Spanish construction workers received appropriate training, compared to the average of 60% across other industries63. Indeed, the construction sector had traditionally been one of the main employers of relatively low-skilled workers, particularly the youngest aged 15-24 educated below upper secondary education64. Many of these, currently unemployed, will need to be retrained.

Developments in national and EU legislation are pushing for the creation of new skills to meet energy efficiency and sustainability requirements. Namely, priority skills identified in this respect include joint sealant operators, PVC and aluminium metalwork assemblers and environmental/quality control technicians, but also builders, plumbers, electricians, and heating/air conditioning/gas/insulation installers65. The development of such skills within the workforce requires a gradual adaptation of the current Vocational Education Training (VET) system. To this end, the national Organic Law 4/2011 amends previously existing laws that regulate VET in Spain, aiming to improve the adaptability of vocational training to the changing needs of the labour market. The Law is further supported by the Royal Decree 1147/2011,which sets the framework for a more flexible and better-integrated VET. In addition, in 2015 28.1% of the total posted workers received in Spain were from the construction sector.

TO2 Skills

The trends of the recent years consider decrease in early school leaving in Spain, reaching 20.0% in 2016, according to CEDEFOP. In 2017 it decreased to 19.0%, but this indicator remains well above the EU-average (11.1%) being the second largest among the EU-28135, and above the national target for 2020 (15%), However, important disparities exist among regions. In the north, regions such as the Basque Country present an early school-leaving rate below the EU average, whereas other regions, particularly in the south, such as Ceuta, present an early school-leaving rate of 25%136. In order to tackle this issue, the Europe 2020 report for Spain137 emphasises three main actions to improve the skills level:

- Introduction of a skill-based training in secondary schools to improve the global level of students;
- Focus on job-relevant skills for tertiary students to participate in the growth of emerging sectors, since employability of tertiary students is the lowest in Europe, at 68.6%138;
- Upgrade the competencies of low-skilled adults with specific trainings.

In the broad construction sector, the average level of training is the second lowest among all industries, only above agriculture. In 2013, 45% of the workers in the sector stopped studying after compulsory school and only 17.5% went to university.

The construction sector ranks second in terms of hours of formation, with an average of 27.6 hours per worker and gathers 49.5% of the participants in training related to Professional Risk.

However, there is still need for training among construction workers. This is stronger for production professionals that lack green construction skills, contrary to the design professionals, who tend to have more relevant skills on this aspect.

A project to reach the 2020 EU energy objectives in the construction sector was launched called BUILD UP SKILLS Construye 2020. The project aims to promote the qualification of workers in the construction

sector, mainly in the building sector, creating courses to increase the professional competencies on Energy Efficiency (EE) and Renewable Energies installation (EERR) in buildings.

The Spanish Construction Labour Foundation (Fundación Laboral de la Construcción –FLC) a bipartite non-for profit body, created by social partners in construction sector, introduced a skill training on innovative techniques and tools for energy efficiency building. Furthermore, the FLC is in charge of issuing and monitoring the Construction Professional Card (Tarjeta Profesional de la Construcción -TPC), which contains information on the worker's experience in the sector, his professional qualifications and the training received. This tool contributes to the standardisation of training among construction professionals.

In addition, the Spanish Construction Labour Foundation offers several courses (online and/or presential) for a high variety of construction jobs such as plumbing, machinery use, or working in risky conditions courses. This Foundation, during the 6th General Agreement from the construction sector highlighted the importance of promoting, developing, adapting and completing the professional qualifications of the workers in the sector.

Moreover, in 2010 an employment portal for construction sector was created by the Spanish Construction Labour Foundation. In 2016, it published around 100 new jobs every month, with 1400 companies registered and 70,000 applicants. It has increased heavily during the past years. The job positions mainly target builders, plumbers, masonry officers, supervisors, and machinery drivers. It is interesting to highlight that 30% of the companies registered have between 1 and 5 workers, and 25% between 10 and 50. In addition, the most common user is between 30 and 40 years old, unemployed, and with the minimum mandatory education level.

In 2014, the European Investment Bank granted a EUR 200 million loan to tackle education investment needs and limit the skill shortage in Spain. This support is aimed at students in higher education, young people looking for their first job, young entrepreneurs and education facilities and research projects. Another EUR 75 million loan was granted to Cantabria in order to finance investment in education in the region. Namely, the loan supports the refurbishment, enlargement and construction of educational establishments.

The European Commission granted EUR 840,000 to the Valencia region in 2013, through the European Globalisation Adjustment Fund (EGF), to support 300 workers made redundant in the manufacturing of building materials in finding new jobs. The funds aim to provide the redundant workforce with guidance, skills assessments, general training and retraining, individual vocational education training, promotion of entrepreneurship and incentives for setting up a business.

Future Training Needs in the Construction Sector

In its 2018 report, the World Economic Forum notes that today's infrastructure and urban development industry does not have enough people with the necessary skills for the future, and processes to help workers acquire suitable capabilities are not in place. Almost three-quarters (74%) of leading IU company CEOs at the World Economic Forum Annual Meeting 2018 recognized this issue as important, and rated attracting new talent and building up required skills as one of three top transformation imperatives for the industry (World Economic Forum, 2018).

An ECSO analytical report 'Improving the human capital basis' shows that adult participation in education and training in narrow construction increased from 8.3% in 2008 to 9.2% in 2015. It further states that 48% of highly qualified employees in the EU construction sector hold a STEM (Science, Technology, Engineering and Mathematics) degree. There is a need to review the training structures currently in place and the content of courses to reflect changes taking place within the sector (European Construction Sector Observatory, 2017).

Up-skilling the existing workforce to meet the sector's future needs, including planning and management skills, the adoption and ability to use new technologies and sustainable construction processes. In Austria, for example, there is reported demand for key technical skills such as CAD and construction planning. In Denmark, the demands of energy-efficient construction have led to increased emphasis on innovation and management skills, partly to ensure the optimisation of work processes5. Interdisciplinary competences appear increasingly important along with an increased focus on 'building physics' and 'materials' to provide a better foundation for energy-efficient construction. The general focus on energy and environmental awareness skills in construction is evident in many countries. In Finland, this is combined with a focus on teamwork skills in multi-professional settings, client service skills and managing sector-specific automation (CEDEFOP, 2014).

The recent World Economic Forum, Shaping the future of construction Final Report, 2016, recommends that Occupational safety and health (OSH) training should be a key element of training in relation to the construction sector. Break down functional silos by, for instance, complementing technological knowhow with commercial capabilities, or broadening the skill set through job rotation along the value chain. Pay adequate attention to soft skills (notably, leadership or cultural interests) and hard content (such as lean construction or project management). One of the top priorities of many E&C companies over the next few years will be the upgrading of digital skills.

In a CEDEFOP 2012 synthesis report 'Green skills and environmental awareness in vocational education and training' trends in employment, skill needs and training provision for a selected group of occupations likely to be affected by the development of a low-carbon and resource-efficient economy was examined. This report focused on 9 occupations (mix of sectors and skills levels). Data was analysed from 9 Member States including Germany, Greece, Italy, Hungary, the Netherlands, Slovakia, Finland and the UK. Of interest to this report is the medium skilled occupations that were included: energy auditor, insulation worker, electrician and solar photovoltaic installer. The demand for skills in the occupations selected for this study is influenced primarily by the regulatory and incentive schemes introduced under energy and environmental policies, for example in the construction sector (CEDEFOP, 2012).

One of the main gaps in learning provision is for insulation workers and SPV installers. This is of concern for employers of insulation workers in particular because demand for labour is predicted to expand in the near future. Learning provision for SPV installers is relatively fragmented in some countries (Germany, the Netherlands and the UK) and employers may experience lack of transparency in the content and quality of training (the UK), while in other countries the amount of provision appears limited (Slovakia and Hungary). The quality of learning provision appears relatively high in Finland, the Netherlands and Germany (CEDEFOP, 2012).

Ireland

In a research study carried out for the Construction Industry Federation, led by O Murchadha and Murphy only 29% of respondent companies currently employ apprentices. Most commonly employed apprentices are Carpentry & Joinery followed by Electrician and Plumbing. However, the most common apprentice by number employed remains Electrician followed by Plumbing then Carpentry and Joinery (O Murchadha, Eoghan; Murphy, Roisin, 2018).

Current trends in training and the decrease in investment in training is evident from the current levels of new apprentices annually. From 2003 until the downturn in 2007, the Construction family of trades was responsible for more than half of all new registrations. By 2012, this group accounted for less than 15% of the intake of new apprentices. Today, the construction family of trades is recovering slowly and accounts for 26% of the annual intake of new apprentices.

Within the Construction family of trades, the impact was felt worst by those referred to as 'wet trades'. The trade of Floor and Wall Tiling was so badly impacted that it has ceased to register any new apprentices since 2013 and as such has become a 'dead apprenticeship'. The trades of Painting and Decorating and Plastering have also recorded troubling declines. As can be seen from their intake figures, these trades declined to just single digit figures of new entrants at their lowest levels

The delayed reaction to construction growth is also felt in those trades referred to as 'wood trades'. The traditional backbone of the Construction trades, Carpentry and Joinery, is recording numbers for new entrants equivalent to just 21% of its pre-recession peak. Worse still is the trend in the 'new' trade of Wood Manufacturing and Finishing. This trade is the result of a merger of the old trades of Cabinetmaking and Wood Machining and endeavoured to fortify the trades through amalgamation. However, registrations for 2017 were below the recorded registrations of 2008 for the old Cabinetmaking trade alone. This lag in construction trades is despite the fact that the national economy is in recovery and construction output is recording stable, positive growth. Naturally, stakeholders are concerned that the same fate awaits these trades as Floor and Wall Tiling

Occupations

The Governments strategy outlined in the Pathways to Work 2016-2020 report[10] reflects a shift in focus from 'activation in time of recession' to activation in time of recovery and growth'. This report provides that job losses during the recession were heavily concentrated in the construction, manufacturing and retailing sectors. Together, these industries accounted for 260,000 of the overall fall in employment of 330,000 between 2008 and 2012. A relatively narrow group of sectors – agriculture, accommodation and food service activities, and professional services, initially led the employment recovery. During 2014 and 2015, employment growth extended more widely in sectoral terms, most notably into construction and manufacturing. In terms of occupations, the largest employment decrease during the downturn was for workers in craft and "elementary" occupations, which was to be expected given that a large number of such persons were employed in the construction sector. The occupational pattern of the recovery in employment since 2012 reflects the sectoral trends already referred to. Of the overall increase of about

10 https://www.welfare.ie/en/downloads/PathwaysToWork2016-2020.pdf

140,000 in employment between 2012 and 2015, about 50,000 related to skilled manual trade occupations, and a further 20,000 were in elementary manual jobs.

In a CSO statistical release in November 2017[11] the results of the fifth survey of continuing vocational training in private sector enterprises in Ireland were presented in relation to the year 2015. Customer handling was identified by enterprises as the most important skill to develop in 2015. Over half of enterprises considered customer handling to be the most important skill for the development of the enterprise, with 45% considering Technical, practical or job specific skills and team working skills to be most important (see Table 5).

Table 5 the most important skills for the development of the enterprise in the coming years

	General IT skills	Professional IT skills	Management skills	Team working skills	Customer handling skills	Problem solving skills	Office administration skills	Foreign language skills	Technical, practical or job-specific skills	Oral or written communication skills	Numeracy and/or literacy skills	Other skills
Economic Sector												
	%	%	%	%	%	%	%	%	%	%	%	%
B-E Mining, quarrying, manufacturing and electricity, gas and water supply	21.2	6.6	47.0	41.2	26.3	28.7	11.4	2.4	65.3	5.2	3.3	9.7
F Construction	21.3	8.6	46.4	43.6	20.9	23.7	15.0	.	68.4	5.0	3.0	9.9
G Wholesale and retail trade	24.7	6.3	29.7	46.4	71.5	12.8	11.0	1.3	41.0	5.2	4.9	6.4
I Accommodation and food service activities	7.6	0.5	33.2	62.5	77.4	9.2	2.4	1.6	22.7	12.0	3.8	3.1
H,J Transport and storage, information and communications	26.0	25.8	32.8	27.9	42.8	21.5	14.1	3.5	47.1	8.6	5.3	10.6
K Financial and insurance activities	26.7	17.9	41.7	26.8	45.6	12.1	15.6	2.7	60.1	12.0	19.5	6.6
L,M,N,R,S Real estate, professional, administrative, arts and other service activities	27.4	19.3	29.3	42.3	35.7	11.9	24.8	0.8	47.3	19.9	0.9	16.3
Total	22.0	10.6	34.0	44.9	52.5	15.4	13.3	1.6	45.1	10.1	4.1	9.0
Size class (by number of employees)												
10 to 49 employees	23.2	10.2	30.1	46.0	53.1	14.7	14.6	1.2	43.2	9.8	3.9	8.8
50 to 249 employees	16.5	12.5	51.6	40.7	50.8	17.5	7.2	3.0	53.0	11.7	5.1	9.8
250+ employees	12.3	14.3	63.1	34.7	43.2	24.4	5.3	3.8	63.7	9.7	4.7	11.4
Total	22.0	10.6	34.0	44.9	52.5	15.4	13.3	1.6	45.1	10.1	4.1	9.0

[1]Enterprises were asked to return their three most important skills
. Reason not chosen by non training enterprise

New Constructions Methods

In a review of the employment and skills needs of the construction industry in Ireland SLMRU reports that new methods of construction, when they become more extensively deployed in Ireland, will result in a significant change in the skills profile. Broadly speaking, they will result in a relative decline in the demand for craft workers in the 'wet trades'; an increase in demand for glaziers and those involved in erection of panels (including timber frame) and in an increase in demand for a range of professionals including logistics managers and designers (Skills and Labour Market Research Unit (SLMRU), 2008).

nZEB by Countries

France

Lack of qualification and skills of professionals for renovation + the actual professional building training available are theoretical and do not present enough the operability of renovation work + urgent need for building professionals to have access to appropriate training for renovations

11 https://pdf.cso.ie/www/pdf/20171115120806_Continuing_Vocational_Training_2015_full.pdf

Ireland

Among other concerns, off-site training for envelope retrofits was highlighted by three interviewees and they regarded licensing of practitioners in retrofits as important (Zuhaib, Manton, Hajdukiewicz, Keane, & Goggins, 2017).

Lithuania

Lack of NZEB knowledge amongst construction companies and workers + unprepared education institutions

Spain

In describing the barriers to uptake of NZEB in Spain the Zebra2020 Deliverable D5.2 Report finds that "there is a shortage of educational and training offers targeting the market of energy efficient measures and the overall construction labour in Spain still lack qualifications for installing most innovative energy saving solutions and technological devices available."

EU Resources

CEDEFOP Occupational Skills Profile

The occupational skills profiles (OSP) developed by CEDEFOP can be used to summarise the most essential characteristics of a given occupation: not only the level and field of education and training required, but also requirements in terms of knowledge, skills, abilities and attitudes. They allow deeper analysis of skills requirements by sector and occupation across countries and over time. Their area of application extends to skill needs forecasting and the investigation of skill mismatch between qualifications and job requirements (CEDEFOP, 2013).

An OSP summarises essential characteristics required for a given job: the level of education and training required (and hence the complexity of the occupation); the field of education and training required; and other requirements in terms of knowledge, skills, competence, occupational interests, and work values (CEDEFOP, 2013).

The European Construction Sector Observatory (ECSO)

The European Construction Sector Observatory (ECSO)[12] is an EU imitative under COSME, Europe's programme for small and medium enterprises. ECSO carries out regular analysis and comparative assessments on the construction sector in all 28 EU countries. The aim of this initiative is to inform European policy makers and industry stakeholders on the market conditions and policy developments in the European construction sector. The key outputs of the Observatory include Country Fact Sheets that profile and analyse the construction sector in each Member State, Policy Fact Sheets on key sector-related policies in each Member State, and a series of Analytical Reports on the implementation of Construction 2020 Strategy objectives.

Following the 2008 economic crisis the construction sector has been adversely affected by labour shortages, particularly for both low and medium skilled jobs in Germany and Luxembourg. The construction sector in Europe has one of the highest levels of over qualifications, with approximately a third of workers overqualified for the work that they do. A 2017 ECSO report highlights that a misalignment between the supply of VET Training and the skills demand within the construction labour

12 https://ec.europa.eu/growth/sectors/construction/observatory_en

market and that this is reducing the development of the sector (European Construction Sector Observatory, 2017).

Eurostat

Eurostat[13] is the statistical office of the European Union situated in Luxembourg. Its mission is to provide high quality statistics for Europe.

- Classification of Economic Activities/Industrial Activity
- Central Statistics Office IE/ Ireland uses NACE Rev 2
- Instituto Nacional De Estadistica ES /Spain uses NACE Rev 2
- Classification of Occupations
- National Catalogue of Professional Qualifications

European Skills Index (ESI)

The European Skills Index (ESI)[14] is CEDEFOP's composite indicator measuring the performance of EU skills systems. The ESI measures countries' "distance to the ideal" performance. This ideal performance is chosen as the highest achieved by any country over a period of 7 years. The ideal performance is scaled to be 100 and the scores of all countries are then computed and compared to that.

The ESI consists of three pillars: skills development, activation and matching, each of which measures a different aspect of a skills system. The basis of the ESI are 15 individual indicators from various international datasets. The scores are calculated across countries at the indicators' level. The scores are then averaged at the various layers and finally the Index score is formed. To illustrate, an Index (or pillar, sub-pillar etc.) score of 65 suggests that the country has reached 65% of the ideal performance. Thus, there is still 35% (100-65) room for improvement. A score of 100 corresponds to achieving the 'frontier', that is an aspirational target performance for that indicator. A score of 0 corresponds to a lowest-case performance. The shaded part in the graphs below shows how far (in %) a country has scored in comparison to the ideal, while the dotted line shows what is the remaining distance to cover until the best performance is reached

References

Bloom, D., Canning, D., & Fink, G. (2010). *Implications of population ageing for economic growth.* Oxford: Oxford University Press.

Build Up Skills Belgium. (2012). *Build Up Skills - Belgium - Analysis of the national status quo.*

Build Up Skills Crosscraft Austria. (2016). *Training modules for the optimal implementation of energy efficiency and renewable energy sources in building and construction industry - Final Report.*

Build Up Skills Denmark. (2012). *Build Up Skills Denmark Status Quo Report.*

CEDEFOP. (2009). *Skillsnet Sector Flash Green Economy.*

CEDEFOP. (2012). *Green skills and environmental awareness in vocational education and training.* Luxembourg: European Union.

13 https://ec.europa.eu/eurostat

14 http://www.CEDEFOP.europa.eu/en/events-and-projects/projects/european-skills-index-esi

CEDEFOP. (2013). *Quantifying skills needs in Europe: Occupational skills profiles.* Luxembourg: Publications Office of the European Uion.

CEDEFOP. (2014). *EU Skills Panorama Construction Analytical Highlght.*

CEDEFOP. (2015). *Skills forecasts country report - Belgium.*

CEDEFOP. (2015). *Skills forecasts country report - Ireland.*

CEDEFOP. (2015). *Skills forecasts country report - Spain.*

CEDEFOP. (2015). *Skills, qualifications and jobs in the EU: the making of a perfect match?* Luxembourg: Office of the European Union.

CEDEFOP. (2015). *The role of modularisation anduitisation in vocational education and training.* Luxebourg: Publications Office. Retrieved from http://dx.doi.org/10.2801/38475

CEDEFOP. (2016). *Future skill needs in Europe: critical labour force trends.* Luxembourg: Publications Office.

Centre for Energy Efficiency. (2017). *Denmark's National Energy Efficiency Action Plan (NEEAP).*

ECSO European Construction Sector Obervatory. (2018). *Country Profile - Belgium.*

ECSO European Construction Sector Obervatory. (2018). *Country Profile - Denmark.*

ECSO European Construction Sector Obervatory. (2018). *Country Profile - France.*

ECSO European Construction Sector Obervatory. (2018). *Country Profile - Germany.*

ECSO European Construction Sector Obervatory. (2018). *Country Profile - Ireland.*

ECSO European Construction Sector Obervatory. (2018). *Country Profile - Spain.*

ECSO European Construction Sector Obervatory. (2018). *Country Profile Austria.*

Eurofound. (2017). *Sixth European Working Conditions Survey Overview Report (2017 update).* Luxembourg: Publications Office of the European Union.

Eurofound. (2017). *Sixth European Working Condtions Survey - Overview report (2017 update).* Luxembourg: Publications Office of the European Union.

European Builders Federation. (2017). *What the construction sector needs to ensure more and better apprenticeships.*

European Commision's Executive Agency for Competitiveness and Innovation (EACI). (2013, October). *Build Up Skills - EU Overview Report.* Retrieved from EASME: https://ec.europa.eu/easme/sites/easme-site/files/overview-report_buildup_skills.pdf

European Commission. (2010). *The Bruges Communique on enhanced European Cooperation in Vocational Education and Traiing for the period 2011-2020.* Retrieved from http://ec.europa.eu/dgs/education_culture/repository/education/policy/vocational-policy/doc/brugescom_en.pdf

European Commission. (2012). *Strategy for the sustainable competitiveness of the construction sector and its enterprises.* Strategy, Brussels.

European Commission. (2016). *New Skills Agenda for Europe.*

European Commission. (2018). *A Blueprint for Sectoral Cooperation on Skills (Wave II).* Luxembourg: European Union.

European Construction Sector Observatory. (2017). *Analytical Report - Improving the human capital basis.*

European Construction Sector Observatory. (2017). *Analytical Report Improving the human capital basis.*

European Construction Sector Observatory. (2017). *Analytical Report Improving the Human Capital Basis.*

International Labour Office (ILO). (2011). *Study of occupational and skill needs in green building final report.* Geneva: ILO.

Jones, A. (2018, August 3). *Vocational education for the twenty first century.* Melbourne: University of Melbourne.

Mavromaras, K. G., McGuinness, S., O'Leary, N. C., Sloane, P. J., & Fok, Y. K. (2010). *The Problem of Overskilling in Australia and Britain.*

McGuinness, S., & Bennett, J. (2006). Examining the link between skill shortages, training composition and productivity levels in teh construction industry. *The International Journal of Human Resource Managment*, 265-279.

Mooney, R., & O'Rourke, C. (2017). *Barriers to Further Education and Training with particular Reference to Long Term Unemployed Persons and Other Vulnerable Individuals.* Dublin: SOLAS.

National Skills Council. (2018). *National Skills Bulletin.*

O Murchadha, Eoghan; Murphy, Roisin. (2018). *Trades & Apprenticeships Skills Survey.* Dublin.

Ryan, C., & Sinning, M. (2011). *Differing skill requirements across countires and over time.* NCVER.

Skills and Labour Market Research Unit (SLMRU). (2008). *A review of the employment and skills needs of the construction industry in Ireland.*

Skills and Labour Market Research Unit (SLMRU). (2008). *A Review of the Employment and Skills Needs of the Construction Industry in Ireland.*

Skills and Labour Market Research Unit (SLMRU). (2011). *Forecasts of Apprentice Intake into Selected Construction and Non-Construction Trades to 2015.* Dublin: FAS.

Skills and Labour Market Research Unit (SLMRU). (2017). *Monitoring Ireland's Skills Supply.*

SOLAS. (2014). *Apprenticeship-type schemes and structured work-based learning programmes - Ireland.*

Solas. (2014). *Further Education and Training Strategy 2014-2019.*

SOLAS. (2016). *Monitoring Ireland's Skills Supply - Trends in Education and Training Outputs.*

SOLAS. (2018). *Progress review of the further education and training strategy 2014-2019.* Department of Education and Skills.

UK Commission for Employment and Skills. (2012). *Sector Skills Insights: Construction.*

UK Commission for Employment and Skills. (2012). *Sector Skills Insights: Construction.*

UNESCO & Commonwealth of Learning. (2017). *Using ICTs and Blended Learning in Transforming TVET.* (C. Latchem, Ed.) Paris: UNESCO & Commonwealth of Learning.

Wheelahan, L., Buchanan, J., & Yu, S. (2015). *Linking qualifications and the labour market through capabilities and vocational streams.* Adelaide: NCVER.

World Economic Forum. (2016). *Shaping the Future of Construction.*

World Economic Forum. (2018). *Shaping the Future of Construction - Future Scenarios and Implications for the Industry.*

Zuhaib, S., Manton, R., Hajdukiewicz, M., Keane, M. M., & Goggins, J. (2017). Attitudes and approaches of Irish retrofit industry professionals towards achieving nearly zero-energy buildings. *International Journal of Building Pathology and Adaptation*, 16-40.

Annex 2 – Interview Script

The company

- Could you tell us about your role and your organisation background and current activities?
    - When was it set up,
    - Services provided,
    - Types of training undertaken and clients)
- What's the extent of your experience in construction training?
    - How did you get involved in the sector?
    - Can you tell us about your current courses?
    - Who are the clients?
- Can you tell us about your current activities? (Numbers,
        - Women,
        - Migrants,
        - Training/qualification level,
        - Status of apprentices).

Questions for training providers

- Can you tell us about your organisation, and your role?
    - Are you directly involved in the development/provision of training programmes?
- What type of training does your organisation provide in the construction sector?
    - Can you give details of what course/modules, their level, duration, and a breakdown of each in terms of knowledge, competence and skill components?
- Do you run courses specifically for experienced workers? (CVET)
- Is there variety in terms of the mode and time of study?
    - Is there enough flexibility in the provision to facilitate participation by those in employment?
- What is take up like?
    - Who are the participants?
    - Young people, experienced skilled workers?
    - Women, migrants and those from ethnic minority groups?
- Are there other training providers that you collaborate with? (national/EU)

Annex 3 – List of Interviewees

List of the respondents appealed to for interviews

Rossella Martino, Condirettore, Formedil, Italy

Jan Steiger, Research Associate, Passive House Institute, Germany

Dragomir Tzanev, Deputy Executive Director, Center for Energy Efficiency EnEffect, Bulgaria

Elisabeth O'Brien, Project Support Officer, Limerick Institute of Technology, Ireland

Horia Petran, Senior researcher, National Institute for Research and Development in Urban-INCERC Construction, Romania

Ileana Iannone, Construction Engineer-Architect, ZEPHIR - Zero Energy and Passivhaus Institute,Italy.

Stefan Pallantzas, Hellenic Passive House Institute, Greece

Bojan Milovanović, University of Zagreb, Croatia

Jiri Karaseki, Senior Consultant, The Energy Efficiency Center, Czech Republic

Tomas OLeary, Managing Director, MosArt, Ireland

Seamus Hoyne, Development and Public Engagement Manager,Limerick Institute of Technology, Ireland

Jim Bradley, Lecturer Civil Engineering, University of Limerick, Ireland

John.Spillane, Lecturer Architecture, University of Limerick, Ireland

Richard Bayliss, Sustainability and Innovation Strategy Lead, Construction Industry Training Board, United Kingdom

Peter Smulders, Education Program Specialists, OTIB Education and Development Fund, Netherlands

Ms Marjana Šijanec Zavrl, Building and Civil Engineering Institue ZRMK, Slovenia

Charles Buhagiar, Chairman/Ceo, Building Industry Consultative Council, Malta

Sabrina Veral Borja, Market Observatory of the Institute of Ceramic Technology, Spain

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Delphi Panel Detecta

Welcome!

In the scope of the Detecta project, UL conducted some interviews with construction companies related to the main evolutions the construction sector is facing. The four evolutions are digitalisation, Circular Economy, Standardisation Automation and Prefabrication (S.A.P.), and Health and Safety. The organisations indicated some impacts these trends are having on the occupations, skills and knowledge in the construction sector. Now we would like to confirm those trends to your expertise.

1) Profile

* Organisation's name

* Field

* Name (interviewee)

* Function in the organisation (interviewee)

How would you agree with these statements on a scale from 1 to 10 (1 = I completely disagree and 10 = I strongly agree).

Regarding the impacts of DIGITALISATION on the occupations:

2) The relationship with the customer is changing because digitalisation also changes the customer's role in purchasing both information and the product, the workers need to give digital services to the customers too

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

3) The way the construction workers manage the suppliers' relationship, the pricing and the commercial approach is changing.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

4) Workers and new workers must show interests in digitalisation as the use of digital devices/software is inevitable as well as the social media or even new online marketing platforms.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

5) Digitalisation is revolutionising the traditional work's organisation.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

6) All workers need to adapt to the fast evolution of the systems/programs and production processes (automation of most processes, automatic data gathering, production control system), this means that they need to learn fast because of the fast evolution of digital tools.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

7) Would you like to add other impacts on the occupations or to comment your answers?

How would you agree with these statements on a scale from 1 to 10 (1 = I completely disagree and 10 = I strongly agree).

Regarding the impacts of DIGITALISATION on the skills:

A skill is the ability to do something while a knowledge is the theoretical and/or practical understanding (information) needed to do something.

8) IT skills (administrative management, e-marketing and production)

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

9) Communication skills

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

10) Project management skills

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

11) Marketing and selling skills

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

12) Would you like to add other skills or to comment your answers?

How would you agree with these statements on a scale from 1 to 10 (1 = I completely disagree and 10 = I strongly agree).

Regarding the impacts of DIGITALISATION on the knowledge:

A skill is the ability to do something while a knowledge is the theoretical and/or practical understanding (information) needed to do something.

13) IT knowledge to use digital tools (software and hardware devices) for administration management (e.g. e-mail, MS Office, ERP system), production (e.g. BIM models), e-marketing (e.g. internet, social media)

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

14) More specific/technical knowledge of the products

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

15) Online communication with the customers (e.g. social media, e-mails)

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

16) Digital marketing techniques (use of 3D visualisation system, e-marketing)

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

17) Management

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

18) Accountability

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

19) Engineering

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

20) Would you like to add other knowledges or to comment your answers?

How would you agree with these statements on a scale from 1 to 10 (1 = I completely disagree and 10 = I strongly agree).

Regarding the impacts of CIRCULAR ECONOMY on the occupations:

21) The relationship with the customers is evolving because of their growing interest in Circular Economy, they are more curious and the construction workers need to be able to answer their questions.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

22) Circular Economy is impacting the production chain and logistics, especially the packaging, (new) workers need to adapt to new production processes.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

23) The life-cycle of the materials is evolving, and the construction workers need both to know more about it and to adapt to new procedures.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

24) Workers need to enlarge their knowledge related to the Circular Economy of the products as well as the normative regulations they are confronted to.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

25) Would you like to add other impacts on the occupations or to comment your answers?

How would you agree with these statements on a scale from 1 to 10 (1 = I completely disagree and 10 = I strongly agree).

Regarding the impacts of CIRCULAR ECONOMY on the skills:

A skill is the ability to do something while a knowledge is the theoretical and/or practical understanding (information) needed to do something.

26) Construction and demolition waste management skills

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

27) Would you like to add other skills or to comment your answers?

How would you agree with these statements on a scale from 1 to 10 (1 = I completely disagree and 10 = I strongly agree).

Regarding the impacts of CIRCULAR ECONOMY on the knowledge:

A skill is the ability to do something while a knowledge is the theoretical and/or practical understanding (information) needed to do something.

28) Recognising different types of packaging waste

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

29) Recycling / reuse / life-cycle of materials/products

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

30) European/national/local regulations

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

31) Would you like to add other knowledges or to comment your answers?

How would you agree with these statements on a scale from 1 to 10 (1 = I completely disagree and 10 = I strongly agree).

Regarding the impacts of STANDARDISATION, AUTOMATION AND PREFABRICATION (SAP) on the occupations:

32) All S.A.P. aspects are already impacting the work chain in depth: production, logistics, process of design and construction, monitoring after completion of building (regarding energy & water consumption, sustainability) and recycling after demolition.

1 2 3 4 5 6 7 8 9 10

33) The use of the BIM model will impact the occupations.

1 2 3 4 5 6 7 8 9 10

34) S.A.P. can impact the speed of construction work as well as it can impact the demand's growth and therefore impact on the occupation's demand.

1 2 3 4 5 6 7 8 9 10

35) The focus on prefabrication solution will induce a work sphere less dependent on the workers.

1 2 3 4 5 6 7 8 9 10

36) Would you like to add other impacts on the occupations or to comment your answers?

How would you agree with these statements on a scale from 1 to 10 (1 = I completely disagree and 10 = I strongly agree).

Regarding the impacts of SAP on the skills:

A skill is the ability to do something while a knowledge is the theoretical and/or practical understanding (information) needed to do something.

37) Digital skills

1 2 3 4 5 6 7 8 9 10

38) Project management skills

1 2 3 4 5 6 7 8 9 10

39) Prefabricated construction skills

1 2 3 4 5 6 7 8 9 10

40) Would you like to add other skills or to comment your answers?

How would you agree with these statements on a scale from 1 to 10 (1 = I completely disagree and 10 = I strongly agree).

Regarding the impacts of SAP on the knowledge:

A skill is the ability to do something while acknowledge is the theoretical and/or practical understanding (information) needed to do something.

41) Robotics and smart technologies

1 2 3 4 5 6 7 8 9 10

42) IT programs/software and hardware devices

1 2 3 4 5 6 7 8 9 10

43) Project management

1 2 3 4 5 6 7 8 9 10

44) Health & safety regulations related to the use of new technologies

1 2 3 4 5 6 7 8 9 10

45) Use of prefabricated products and techniques (concrete beams and vaults, steel construction, wooden roof and wall elements for timber frame construction)

1 2 3 4 5 6 7 8 9 10

47) Would you like to add other knowledges or to comment your answers?

How would you agree with these statements on a scale from 1 to 10 (1 = I completely disagree and 10 = I strongly agree).

Regarding the evolution of HEALTH AND SAFETY standards, the construction organisation are taking actions. With your expertise how would you agree with these:

48) Implementation of an internal legal framework for employees and construction sites including medical checks, safety

clothes/equipment, external safety coordinator, elaboration of safety plans with risk analysis, ...

1 2 3 4 5 6 7 8 9 10

49) H&S trainings with ISOH certification and bonus scheme for the trainings followed

1 2 3 4 5 6 7 8 9 10

50) Offering H&S management services to members: H&S guides/advisors

1 2 3 4 5 6 7 8 9 10

51) Production of H&S business guides

1 2 3 4 5 6 7 8 9 10

52) The questionnaire is now finished. Is there any comment you would like to share with us related to the questions and/or the answers you have given?

100 % completed

Annex 5 – Delphi Panel Results

This document shows the interim results regarding the Delphi Panel created in the scope of the DETECTA project. The organisations identified impacts of the four main evolutions of the construction sector on the occupations, skills and knowledge. These impacts were translated into statements and submitted to experts in order to confirm (or not) these impacts by evaluating the statement on a scale from 1 to 10. We can say that each statement that received a mean score equal or above 5 out of 10 is confirmed by the experts. From that we can see in the table below that each topic received a mean score superior to 7/10. Therefore, we can say that the topics were confirmed by the experts of the Delphi Panel.

THEME	MEAN
DIGITALISATION - OCCUPATIONS	7,8
DIGITALISATION - SKILLS	8,7
DITIALISATION - KNOWLEDGE	8,3
CIRCULAR ECONOMY - OCCUPATIONS	8,7
CIRCULAR ECONOMY - SKILLS	9,0
CIRCULAR ECONOMY - KNOWLEDGE	8,6
S.A.P. - OCCUPATIONS	8,0
S.A.P. - SKILLS	8,3
S.A.P. - KNOWLEDGE	8,2
HEALTH & SAFETY	8,0

The following information give the list of each statement and the mean score that it received. From those results, we can say that all statements obtained a mean score above 6/10. We can then conclude that all the statements were confirmed by the experts appealed to participate to this Delphi Panel.

1 DIGITALISATION

1.1 Occupations

The relationship with the customer is changing because digitalisation also changes the customer's role in purchasing both information and the product, the workers need to give digital services to the customers too

Mean: 6.0

The way the construction workers manage the suppliers' relationship, the pricing and the commercial approach is changing.

Mean: 6.0

Workers and new workers must show interests in digitalisation as the use of digital devices/software is inevitable as well as the social media or even new online marketing platforms.

Mean: 9.0

Digitalisation is revolutionising the traditional work's organisation.

Mean: 9.0

All workers need to adapt to the fast evolution of the systems/programs and production processes (automation of most processes, automatic data gathering, production control system), this means that they need to learn fast because of the fast evolution of digital tools.

Mean: 9.0

Would you like to add other impacts on the occupations or to comment your answers?

.

1.2 Skills

IT skills (administrative management, e-marketing and production)

Mean: 9,0

Communication skills

Mean: 9,0

Project management skills

Mean: 9,0

Marketing and selling skills

Mean: 8,0

Would you like to add other skills or to comment your answers?

Digitalisation is also relevant to the construction skills especially with the advent of new products and installations.

1.3 Knowledge

IT knowledge to use digital tools (software and hardware devices) for administration management (e.g. e-mail, MS Office, ERP system), production (e.g. BIM models), e-marketing (e.g. internet, social media)

Mean: 9,0

More specific/technical knowledge of the products

Mean: 8,0

Online communication with the customers (e.g. social media, e-mails)

Mean: 8,0

Digital marketing techniques (use of 3D visualisation system, e-marketing)

Mean: 8,0

✓ Management

Mean: 8,0

✓ Accountability

Mean: 9,0

Engineering

Mean: 8,0

2 CIRCULAR ECONOMY

2.1 Occupations

The relationship with the customers is evolving because of their growing interest in Circular Economy, they are more curious, and the construction workers need to be able to answer their questions.

Mean: 9,0

Circular Economy is impacting the production chain and logistics, especially the packaging, (new) workers need to adapt to new production processes.

Mean: 8,0

The life-cycle of the materials is evolving, and the construction workers need both to know more about it and to adapt to new procedures.

Mean: 9,0

Workers need to enlarge their knowledge related to the Circular Economy of the products as well as the normative regulations they are confronted to.

Mean: 9,0

2.2 Skills

Construction and demolition waste management skills

Mean: 9,0

2.3 Knowledge

Recognising different types of packaging waste

Mean: 9,0

Recycling / reuse / life-cycle of materials/products

Mean: 9,0

European/national/local regulations

Mean: 8,0

Would you like to add other knowledges or to comment your answers?

3 STANDARDISATION, AUTOMATION AND PREFABRICATION (S.A.P.)

3.1 Occupations

All S.A.P. aspects are already impacting the work chain in depth: production, logistics, process of design and construction, monitoring after completion of building (regarding energy & water consumption, sustainability) and recycling after demolition.

Mean: 9,0

The use of the BIM model will impact the occupations.

Mean: 8,0

S.A.P. can impact the speed of construction work as well as it can impact the demand's growth and therefore impact on the occupation's demand.

Mean: 8,0

The focus on prefabrication solution will induce a work sphere less dependent on the workers.

Mean: 7,0

Would you like to add other impacts on the occupations or to comment your answers?

33 Depends what you mean by BIM, does this include all digital modes such as VCR/A, data processes etc.,
35 workforce omn site, as prefabrication will need workforce in factory

3.2 Skills

Digital skills

Mean: 9,0

Project management skills

Mean: 9,0

✓ Prefabricated construction skills

Mean: 7,0

Would you like to add other skills or to comment your answers?

The focus on prefabrication solution will induce disappearance of skills and emergence of less qualified trades as assemblers

3.3 Knowledge

Robotics and smart technologies

Mean: 9,0

IT programs/software and hardware devices

Mean: 9,0

Project management

Mean: 8,0

Health & safety regulations related to the use of new technologies

Mean: 7,0

Use of prefabricated products and techniques (concrete beams and vaults, steel construction, wooden roof and wall elements for timber frame construction)

Mean: 7,0

4 HEALTH & SAFETY

Implementation of an internal legal framework for employees and construction sites including medical checks, safety clothes/equipment, external safety coordinator, elaboration of safety plans with risk analysis, ...

Mean: 9,0

H&S trainings with ISOH certification and bonus scheme for the trainings followed

Mean: 8,0

Offering H&S management services to members: H&S guides/advisors

Mean: 8,0

Production of H&S business guides

Mean: 7,0

Annex 6 – List of Training Experts

List of the experts appealed to the Delphi Panel

Professor Wolfgang Feist, Innsbruck University, Austria

Sue Higginson, Principal, Wirral Metropolitan College United kingdom

John Cassidy, Area Training Manager, Waterford Wexford Training Services, Ireland

Rosalind Thorpe, Assoc Dir. Education & Standards, Chartered Institute of Buildings, United Kingdom

Rossella Martino, Condirettore, Formedil, Italy

Dragomir Tzanev, Deputy Executive Director, Center for Energy Efficiency EnEffect, Bulgaria

Elisabeth O'Brien, Project Support Officer, Limerick Institute of Technology, Ireland

Horia Petran, Senior researcher, National Institute for Research and Development in Urban-INCERC Construction, Romania

Tomas OLeary, Managing Director, MosArt, Ireland