

Secondary Sources Report

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1. Construction sector

■ Construction sector description

The construction sector profile¹ (2014) written by the European Foundation for the Improvement of Living and Working Conditions is one in a series and gives an overview of structural characteristics, work organisation practices, human resources management, employee participation and social dialogue in the construction sector compared to the EU28. It is based on the third European Company Survey (2013) and uses the construction sector terminology including all activities related to construction.

The report shows figures related to the European sector and allows us to emphasise some trends but no linked are made to employment needs, evolutions in the sector, differences between countries and subsectors, etc. The main trends were in 2013:

- most establishments (87%) in the construction sector are single establishments;
- a slightly higher than average proportion of establishments in the construction sector (70%) has been in operation from 10 to 49 years;
- regarding the sector's population variety (education, woman rate, innovation),
 - o less than 20% of workers have a degree in 78% of construction establishments, compared to 58% in the EU28 overall,
 - o in 75% of construction establishments, less than 20% of the workforce is female,
 - o the construction sector is less innovative than the EU28 average;
- there are large differences regarding innovative activities in terms of size;
- work is more likely to be organised in teams in the construction sector than on average. In 42% of establishments, most employees work in a single team, compared to 32% in the EU28;
- as compared to the EU28 average, the planning and execution of daily tasks in the construction sector is more frequently decided by managers or supervisors (70% compared to 54% for the EU28);
- in 30% of construction firms, the number of employees decreased between 2010 and 2013, compared to 24% in EU28 establishments. The group is characterised by an extremely high proportion of establishments that had difficulties in finding skilled employees (88%);
- in the construction sector, 75% of establishments offer time off for training – at least to some of their employees (EU28 71%);
- flexibility in starting and finishing time is not offered in 44% of establishments, compared to 35% across the EU;
- differences between the sector and the EU overall average are marginal about variable pay schemes;
- an official structure of employee representation is present in 29% of establishments in the construction sector, a little lower than in the EU28.

■ European strategy for a sustainable competitiveness

According to the European Union², the construction industry plays a key role in the European economy, in numbers and in impacts on the life of the EU-citizens. Therefore, the competitiveness of the enterprises is an important issue. The construction sector plays an important role in the delivery of the Europe 2020 Strategy on smart, sustainable and inclusive growth: renovation of the buildings and infrastructure. Furthermore, higher energy efficiency in new and existing buildings is key for the transformation of the EU's energy system.

□ Construction market diagnosis

The markets of the EU construction sector and the sector itself are highly fragmented, with many micro-enterprises, large differences between Member States in the performance of the sector and considerable

¹ Establishment characteristics and work practices: Construction sector
<https://www.eurofound.europa.eu/nl/publications/information-sheet/2016/working-conditions-industrial-relations/establishment-characteristics-and-work-practices-construction-sector>

² Strategy for the sustainable competitiveness of the construction sector and its enterprises
<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2012:0433:FIN>

difficulty in spreading good practices. Better value-chain integration would significantly increase the scope for spill-over innovation effects from collaboration.

□ **Main challenges to 2020**

The sector faces today and up to 2020 many challenges in terms of investment, human capital, environmental requirements, regulation and access to markets. The main challenges are:

- the shortfall of skilled workers,
- the low attractiveness to young people,
- the limited capacity for innovation,
- the undeclared work,
- the recovery from the hard hit by the financial and economic crisis,
- the increased competition from non-European operators inside and outside the EU-borders,
- the achieving the EU's climate, energy and environmental objectives.

It will require significant changes that will be difficult for the sector to tackle without appropriate policy support.

▪ **Sustainability**

As announced in the recast of the Energy Performance of Buildings Directive, the introduction of Nearly Zero Energy Buildings (NZEB) is going to be a major challenge for the construction sector. The transition to a resource-efficient and low-carbon economy will also bring important structural changes in the construction sector, which will have to adapt and anticipate the needs for skills and competences in these areas.

▪ **Circular economy**

The industry is developing more and more materials that are easier to collect and reuse and systems or 'building solutions' that facilitate the 'deconstruction' of the works and the re-use of materials.

It is necessary to better anticipate future skills and qualification needs, to attract a sufficient number of students to relevant construction professions and to create the conditions for a better working environment and career management, for a greater mobility of construction workers and for wider provision of cross-border services.

□ **European Strategy**

As Europe shapes the future of the European construction sector in terms of circular economy, zero emission houses, investment in infrastructure, lack of low skilled workers and anticipation in trainings, this strategy focuses on five key objectives:

- (a) stimulating favourable investment conditions;
- (b) improving the human-capital basis of the construction sector;
- (c) improving resource efficiency, environmental performance and business opportunities;
- (d) strengthening the Internal Market for construction;
- (e) fostering the global competitive position of EU construction enterprises.

■ **Innovation in Belgian companies**

A study of Belgian construction companies³ focuses on innovating in the construction sector and the consequences for the employee's occupations.

The expected transformations of the construction sector are that the number of white-collar workers is rising rapidly, while the number of workers is constantly falling. This has consequences for the provision of additional training courses. The main evolutions of the sector in Belgium are:

- an increase in involved actors,
- stricter (legal) requirements,
- changing financing models,
- shrinking margins,
- demanding customers,
- stricter technical standards.

³ Trends en innovatie in bouwsector

<https://www.cevora.be/Portals/0/Documents/Sectoren/Studie%20-%20Trends%20en%20innovaties%20in%20de%20bouwsector.pdf>

- **Technology**

The evolution of the sector will require more cooperation between all building partners (architects, engineers, building companies, project leaders, blue and white-collar workers, ...) and technology is the great facilitator by digitisation and ICTevolutions (e.g. Building Information Modelling (BIM) and lean building). Through technology it becomes possible to produce much more accurately and efficiently and this is no longer at the expense of customisation. Robots, drones or 3D printers are highly flexible devices that can be used in the construction industry but there is no guarantee of success. Technological innovation requires social innovation.

Safety, weight, strength and functionality are important factors in the development of new products. However, the main role is reserved for the sustainability of materials and techniques.

- **Employment**

It is very likely that the standardisation of processes and products will continue in the future. But also, in terms of organisation, a certain degree of standardisation in the processes can be realised through sustainable partnerships.

The number of purely executive employees will steadily decline as technology becomes smarter and faster. This is compensated by an increase in the number of employees in the construction sector due to an increasing need for management, maintenance and control functions. But there is a threat of creating a dual labour market with, on the one hand, the well-paid and highly trained coordinators and managers, and on the other hand, the – often foreign – executive and low-paid staff, who are also getting more and more competition from technological alternatives.

The construction sector is extremely fragmented and is involved in a tough competition. The availability of cheap, foreign workers is another brake on innovation: if the costs for labour remain so low, companies have little pressure to innovate.

The sector has a role to play in the economic, socio-cultural, political and technological evolutions that take place. In fact, the construction sector is socialising more and more. The added value is to be found in the way one produces, the customer focus, the speed of building, the materials used to build, or the technologies used. Too many suppliers of production capacity are with a one-sided focus on cost reduction and this prevents innovation.

To conclude, the transition that the construction sector will undergo can best be described as the evolution from a fragmented production market to a process-based, integrated services market in function of social added value. However, interviews and literature all point in the direction of chain cooperation as process innovation, but it is now still in the start-up phase. Under the influence of lean (where executive personnel have more autonomy), BIM and standardisation (offsite prefabrication instead of onsite), many functions in the construction sector will change, disappear or see the light. In terms of health and safety this has positive consequences, but in terms of employment and autonomy, the expectations are unclear.

2. Digital trends in Europe

- **World's top contractors and technologies**

According to Ernst & Young⁴, all the top 30 contractors from a technology perspective have been quite actively deploying technologies, such as green concrete, lean construction, BIM and drones, to increase operational efficiency and cost effectiveness. However, perhaps owing to the already thin margins in the construction industry, technology investments remain well below 1% of total revenues. In fact, the review of the top 30 global contractors shows that US and European contractors spend close to 0.1%, in contrast to Asian contractors, which spend well above 1%.

Employee productivity also remained low compared with other sectors, confirming that the engineering and construction sector still lags on productivity. The construction sector does not invest largely in technology. Yet the world's biggest contractors do invest (green concrete, lean construction, BIM and drones) to increase productivity. Compared to other sectors the productivity remains low in the construction sector.

⁴ How the world's top contractors are preparing for a new era of growth (EY)
https://www.ey.com/en_gl/real-estate-hospitality-construction/how-the-world-s-top-contractors-are-preparing-for-a-new-era-of-g

■ Digital technologies in European countries

□ BIM

A report from the Build Up portal⁵ shows that in Europe, the construction sector labour-productivity growth doesn't match the labour productivity growth achieved in the overall economy. However, the World Economic Forum described the digital tool BIM as one of the 10 most promising technologies that can act as a force for lowering the barriers for change and reversing this trend.

BIM is much more than a digital technology and should be considered as a strategic and complete methodology to increase construction productivity by delivering cost savings, improved construction and exploitation management, better environmental performance and quality, enhanced transparency and collaboration across the industry.

According to the CSTC⁶ (Scientific and Technical Centre in Construction, in Belgium), the BIM is one of the main innovations in digitalisation. It plays an important role in the conception of smart cities and smart buildings by the conception of a digital twin. The use of the BIM is a strategic priority as the Belgian governments do not apply a top-down strategy compared to other European countries where government invest millions in digitalisation of the sector.

However, BIM is still distant from reaching its potential in Europe; and, is progressing at different speeds in European countries.

Several studies have underlined the main barriers for BIM adoption: low demand, absence of national standards, initial investment or lack of knowledge and experience of stakeholders involved in the AEC industry.

□ European digitalisation⁷

An overview of the digitalisation process in Western Europe (France, The Netherlands with a detailed analysis of Belgium) shows that the digital technologies are not very known in the construction sector. The main obstacles are that these technologies are identified as useless (41,1%), are not essential (33,5%), too expensive (10,5%), demand too much time and qualified workforce (4,6% and 3,2%), etc. However, a large list of different digital tools already exists. An index has been established as the Digital Economy and Society Index (DESI) using indicators like connectivity, human capital, internet use, digital technology integration and digital public services.

▪ In the United Kingdom

The United Kingdom is since 2011 engaged in a deep modernisation of its construction sector through digitalisation. The purpose is reducing by 20% the construction costs, the timing and the heritage management costs.

▪ In the Netherlands

The Netherlands (and other countries like Finland) have already made the BIM utilisation mandatory since 2011. It is estimated that almost 20% of the partners are already using BIM.

Public forces have started integrating the BIM since 2011, they made the e-invoice compulsory since 2017. Bouwend Nederland (Dutch Construction Enterprises Federation) plays a key role in the transition. BN says that the digital transition is already happening in the Netherlands: robotization, 3D-printing, drones, e-tools. According to BN, 20% of Dutch enterprises use the BIM in 2017. They created a survey on BIM use and it showed that the BIM barriers are: lack of knowledge about the BIM utilisation, existence, lack of standardisation in information exchange procedures, lack of demand from the workers.

▪ In France

France has been developing a digitalisation transition plan for more than two years. The government is willing to help enterprises to achieve the digitalisation transition.

⁵ Benefits of BIM and its Level of Adaptation in European Countries
<http://www.buildup.eu/es/node/56441>

⁶Confédération construction – La construction numérique. Balises pour une transition réussie
https://www.confederatiebouw.be/Portals/0/documenten/documenten%20-%20enkel%20leden/jaaverslag/Rapport%20Annuel_Confederation%20Construction_2016_2017_FR_WEB-190617.pdf

⁷Confédération construction – La construction numérique. Balises pour une transition réussie
https://www.confederatiebouw.be/Portals/0/documenten/documenten%20-%20enkel%20leden/jaaverslag/Rapport%20Annuel_Confederation%20Construction_2016_2017_FR_WEB-190617.pdf

PNTB (Digital Transition Plan in Construction) is financed by the government and aims at accelerating the digital transition in France by convincing the enterprises, allowing trainings, good communication strategy.

- **In Belgium**

Belgium is located quite behind in the line of digitalisation transition. The Confederation Construction Report shows that more than 15% of Belgian enterprises already know how to use the numeric tools in administrative management but very few of them know or use the BIM.

- **In Sweden**

Skanska⁸ is working on many opportunities including drones, robotics and 3D printing. By using new technology, they can deliver projects faster, safer, at lower costs and using fewer resources. These are positive impacts on both productivity and the environment.

- **Drones**

Instead of contracting a pilot to do a photo shoot of a jobsite, drones, or Unmanned Aerial Systems (UASs), are being piloted by certified employees at Skanska to monitor site progress and to complete aerial survey photography. The drones provide detailed information, are quicker and often less expensive. For inspections, drones are used in place of sending workers to hard-to-reach locations or other hazardous areas. This promotes worker safety and mitigating jobsite risks. Other benefits of drones/UAS in construction includes smarter planning and construction delivery.

- **Robotics**

Automated construction

Together with industry and academia partners, Skanska has established a new industrial research school in Sweden called Automation Region Research Academy (ARRAY), exclusively focusing on future technologies in automation and automated construction. ARRAY has been jointly founded by Skanska, ABB, Volvo CE, Sandvik and Robotdalen, among others.

Rebar robotics

Robots will be a part of the future building process. Together with ABB and Robotdalen, they have developed an automated rebar robot that can manufacture steel reinforcement cages onsite. Through working smarter with the digital input solution, they can speed up the production process, eliminate cumbersome work and reduce transport emissions.

3D printing

3D printing has huge potential for the construction industry creating substantial sustainability and productivity gains. They are already using it on the 6 Bevis Market in London where the roof's supporting structure was formed using 3D material. The printing technique provided a considerable cost and time saving alternative to a traditional method using case steel nodes.

- **Exoskeletons for Industrial Application⁹**

An exoskeleton can be defined as a wearable, external mechanical structure that enhances the power of a person. Exoskeletons can be classified as 'active' or 'passive'. The main application area of exoskeletons has been for medical /rehabilitation purposes, but also for military applications. There is still a need to further develop lightweight exoskeletons compatible with operators.

The industrial use of passive and active exoskeletons requires consideration of several specific safety issues. Varying risk scenarios can be defined for the worker wearing an actuated exoskeleton in the occupational field, for example on the shop floors in production industry, in warehouses, in hospitals, or outdoors in agriculture or construction.

- **Health and safety**

Exoskeleton could be a solution for the aging of the population, facilitating physical work in the construction sector. Some have specifically been developed for industrial purposes and to assess the potential effect of these exoskeletons on reduction of physical loading on the body. The main use is in the medical sector, or even in the military. As the structure has been tested, it is still a project for industrial uses.

⁸Skanska is one of the world's leading construction and project development companies, focused on selected home markets in the Nordic region, Europe and USA.

<https://group.skanska.com/about-us/research-and-innovation/innovation-projects/>

⁹Exoskeletons for Industrial Application and their Potential Effects on Physical Work Load

https://pdfs.semanticscholar.org/b38c/5795d943ae8d36f0c1296d63c5f7e7822bf7.pdf?_ga=2.63511919.1313414861.1542096524-514920681.1542096524

All passive exoskeletons retrieved were aimed to support the low back. A reduction of 10 to 40% in back muscle activity during dynamic lifting and static holding has been reported. Both lower body, trunk and upper body regions could benefit from active exoskeletons. Muscle activity reductions up to 80% have been reported with an effect of active exoskeletons. Exoskeletons have the potential to considerably reduce the underlying factors associated with work-related musculoskeletal injury.

- **Barriers**

Specific issues include discomfort (for passive and active exoskeletons), weight of device, alignment with human anatomy and kinematics, and detection of human intention to enable smooth movement (for active exoskeletons). Many workers are still exposed to physical workloads due to material handling (over 30 % of the work population in the EU), repetitive movements (63%), and awkward body postures (46 %). In the European Union, yearly more than 40 % of the workers suffer from low back pain or neck and shoulder pain.

Full-automation could be a solution to these issues. Plus, there is a growing movement in modern industry towards human robot collaboration to improve use of robotics while retaining the flexibility of humans. The main benefit is that, specifically in dynamic environments, one will fully profit from the human's creativity and flexibility, while he is the one in charge, and there is thus no need for robot programming or teaching of

Digital Tools Identification in the Construction Sector		
Administrative management	E-marketing use	Production
<ul style="list-style-type: none"> • e-mail • Electronic archiving • Excel sheet • Accounting programs • Electronic invoice • Track and trace (GPS) • ERP (Enterprise Resource Planning) • Documents management • Cloud computing (access to apps, data and material through the internet) • Notifications (presence checklist, ONSS e-box, work declaration, subcontractor control, social risks declaration) 	<ul style="list-style-type: none"> • Website • Social networks (e-reputation) • E-procurement 	<ul style="list-style-type: none"> • Project portal (online workspace for info sharing) • Virtual reality casks • BIM • Drones • 3D pilotage (GPS pilotage) • 3D scan and print • Robots • E-objects • Exoskeletons

robots.

3. Circular economy trends in Europe

- **Circular economy and construction industry**

The CSTC¹⁰ produced a document explaining the concept of circular economy and gives examples of its application through Europe.

- **Challenges in the construction sector**

The construction sector plays a key role in the resources management as resources consumer and waste producer.

According to the European Commission, the construction and buildings exploitation in the European Union represent half of the material extraction and a third of water consumption. Even if huge progress has been

¹⁰ Vers une économie circulaire dans la construction. Introduction aux principes de l'économie circulaire dans le secteur de la construction.
<https://www.cstc.be/homepage/download.cfm?lang=fr&dtype=publ&doc=Vers une economie circulaire dans la construction.pdf>

made in energy saving measures, the construction sector stays a big energy consumer: 40% of the demand in Europe and produces 36% of its CO₂ emissions.

□ **5 principles in European circular economy**

The circular economy is based on 3 pillars which are conception and construction, new economic models and urban mining (considering buildings as the source of materials); and has 5 principles: adaptability, stratification, environmental friendly materials, assembling methods and waste management. Here are some examples of each principle in Europe

▪ **Adaptability in the Netherlands**

Buildings adaptation is important to convert them to other uses or functions in the future as also to adapt them to the evolution of the user's needs. The Martini Hospital in the Netherlands is one example. The building structure is entirely modulable, flexible and can be dismantled to transform it into an office building or even in housings. However, this process has a cost and the inconveniences for the users are multiple.

▪ **Stratification of buildings in Germany**

The different stratum in a same building have sometimes different lifetimes. Building in stratum allows then to transform a stratum without modifying the others. An example of this stratification process is the Smart Price House in Germany. The supporting structure, the vertical circulation and the technical connexions are furnished during the initial phase of the building process and are provided to the future users of the building, so they can modulate it according to their needs.

▪ **Material selection in Denmark**

This principle focuses on the selection of environmental friendly materials as recycled materials or reused materials. In Denmark, the Biological House has been built with the use of agroindustry wastes (grass, seaweed, straw, etc.). Materials considered as waste are here transformed to become building materials.

▪ **Flexible assembling methods in Germany**

To reuse construction materials without ruining it, it is important to adapt the assembling methods. In Germany, the F87 (Efficiency House Plus) project is the construction of an emission free building that does not produce nor consume energy and should be entirely re(up)cyclable. But the building has not been dismantled yet, so it is still too soon to know if the assembling method worked.

▪ **Waste minimising in Belgium**

Prevent, minimise and manage construction wastes are more and more important in a circular economy model. In Belgium, a construction site guardian position has been created. These guardians are accountable for the waste management and the construction site cleanliness prevention.

□ **Developing circular solutions**

▪ **Standardisation**

Standardisation of products and process in construction is one of the strategies minimising waste. Standardisation is negatively seen but it is important to realise that the construction industry has already largely been standardised.

▪ **Lean management**

The lean management consists in creating sustainable value for clients suppressing waste costs in the company's process and avoiding everything that does not create added value for the client (this means reducing the costs and optimise the flows). The lean process leads to reduce delivery costs and time and improves quality and security.

▪ **Materials passports**

The building can be imagined as the first second-hand material storage this could reduce the importation of new materials (and therefore reduce the carbon emissions). Some tools can facilitate the quantification and qualification of these resources as the BIM and passports for materials. Indeed, materials must be documented and identified in the building to proceed to the operational recuperation. These documents would follow the materials during their lifetime and would reflect the degradation conditions of the materials.

▪ **Urban mining**

The urban mining process sees the city as the main furnisher of construction materials. The process starts by defining strategies to preserve the existing and create an inventory of "pre-deconstruction". Then starts the selective deconstruction (for a better waste selection on construction site and for the reuse from

deconstruction), the remanufacturing phase, the reuse and the preparation for the reuse and finally comes the recycling.

- **Circular economy and employment**

If the reuse of construction materials will generate employment needing a high rate of low qualified workers for the deconstruction phase, other occupations will be created with medium qualifications profiles for the manutention, storage, documentation, etc. As the selling of reused materials implies an increase in the workforce demand including a wide range of profiles as logistics, technical, commercial, etc. The circular economy generates employment in a product-service economy.

- **Circular Economy in Europe**

Regarding the political framework, a paper produced by the University of Gloucestershire¹¹ states that the circular economy has been encouraged by the European Commission since 2015. The circular economy in Europe grows in an environmentally challenged context and exists through different circular business models that can be used at different stages of the lifecycle of an asset. An analysis of the circular economy by the University of Gloucestershire in the European construction industry provides examples from the UK, the Netherlands, Sweden, Spain, France, Ireland and Germany.

- **In the Netherlands**

In the Netherlands, the Bam group employed circular design while building a new town hall extension for the municipality of Brummen. Here the local authority commissioned a 20-year lifetime building therefore Bam designed a building for disassembly. The extension's modular design will not only enable easy disassembly and some 90% of the materials in the newly added space can be dismantled and reused at the end of the extension's service life.

- **In Spain**

Ferrovial, the Spanish based construction company, for example, created a circular economy working group in 2016 'to identify and promote opportunities for transforming waste produced and managed' by its two divisions 'into raw materials or secondary fuels, which can subsequently be used in other works and infrastructures designed, built and operated by Ferrovial'.

- **In the United Kingdom**

The Construction Products Association (2016) has identified several mechanisms by which construction products and materials can be reused.

Salvo, for example, trades in France, Germany, Netherlands, Ireland and the UK, and offers a reclamation service for architectural antiques, doors, fireplaces, ironwork, lighting, radiators, windows and stained glass.

Toyne (2016) has provided some illustrations of how Balfour Beatty employed a circular design approach in using King Sheet Piling on the M25 widening project and the A421 improvement project in the UK and claimed significant savings in the steel used and reductions in carbon dioxide emissions.

- **In Sweden**

Skanska¹² recognised that significant opportunities exist in construction to prevent waste from occurring' and reported that they 'operate in line with the waste hierarchy and are working on several initiatives which aim to eliminate waste to landfill and promote the circular economy.

Skanska developed a Deep Green Cooling Solution, which uses ground boreholes to cool buildings, has near-zero impact on the environment – far beyond compliance with existing codes, standards and voluntary certification schemes. It has been used throughout Skanska projects since 2013.

BoKlok, the affordable housing concept owned by Skanska and IKEA, is the first residential developer in Sweden to commit to equipping all apartment buildings with photovoltaic solar panels. Beginning in 2019, BoKlok will equip all apartment buildings it builds in Sweden with photovoltaic solar panels on the roofs. That's about 1,000 homes annually

¹¹ The Construction Industry and the Circular Economy.

<http://eprints.glos.ac.uk/5562/1/5562%20Jones%20%282018%29%20The%20construction%20industry%20and%20the%20circular%20economy.pdf>

¹²The Swedish based multinational construction company.

<https://group.skanska.com/about-us/research-and-innovation-projects/>

4. Occupation needs in Europe

■ Bottleneck Vacancies in EU Labour Markets

The European Commission published a study¹³ identifying the top-20 bottleneck occupations on the EU labour markets (in all Member States and including Iceland, Norway and Liechtenstein). Bottleneck occupations should in this context be understood as occupations where there is evidence of recruitment difficulties, i.e. employers have problems finding and hiring staff to meet their needs.

□ Results

- Building and related trades workers, excluding electricians, are the second biggest group of skilled manual occupations, where bottlenecks have been identified.
- All in all, 41 bottlenecks exist in 18 of the 29 studied countries in this report.
- The division between the specific occupations is rather clear-cut (see table 25 of the report): in particular “carpenters and joiners” (11 bottlenecks) and “plumbers and pipe fitters” (8 bottlenecks) are in high demand, whereas one or two bottlenecks exist for most of the other specific occupations within this occupational group.
- Top 20 bottleneck vacancies at ISCO 4-digit level European level (per occupation): #10 carpenters and joiners (in 11 countries), #17 Plumbers and pipe fitters (in 8 countries), #19 Building and related electricians (in 6 countries)
- Top 20 bottleneck vacancies at ISCO 2-digit level European level (per sector): #5 Building and related trades workers, excluding electricians (18 countries reporting 41 bottleneck vacancies)

The table below shows the bottleneck occupations in the construction sector for the countries implied in the Detecta Desk Research. The rank of the specific occupation among the top-20 bottleneck occupations in the country in question is indicated in parentheses behind each occupation. The national ranking per each occupation is included only when available. If further specification of the 3- or 4- digit level occupational category was provided in the national ranking, this is included in parentheses, specifying its rank.

Country	Bottleneck vacancies
Austria	<ul style="list-style-type: none"> ○ Carpenters and joiners (specifically: Carpenter (7); Joiner (13); Construction- and furniture joiner (16)) ○ Roofers (4) ○ Plumbers and pipe fitters (12)
Croatia	<ul style="list-style-type: none"> ○ Bricklayers and related workers (13) ○ Carpenters and joiners (14) ○ Plumbers and pipe fitters (15)
Denmark	<ul style="list-style-type: none"> ○ Carpenters and joiners (specifically: Carpenter (7); Joiner (13); Construction- and furniture joiner (16))
France	<ul style="list-style-type: none"> ○ Roofers (6) ○ Plumbers and pipe fitters (specifically: Pipe fitters (20))
Italy	<ul style="list-style-type: none"> ○ Plumbers and pipe fitters (specifically: Plumbers (5)) ○ Air conditioning and refrigeration mechanics (specifically: Heating system mechanic (2))
Poland	<ul style="list-style-type: none"> ○ Building and related trades workers, excluding electricians (1) <p>Meaning almost all job vacancies in the sector (it includes building and related trades workers, excluding electricians; building finishers and related trades workers; and painters, building structure cleaners and related trades workers)</p>
Portugal	<ul style="list-style-type: none"> ○ Building frame and related trades workers not elsewhere classified (2) ○ Painters and related workers (20)

Building and related trades workers, excluding electricians, are mainly needed in the European construction industry, where almost all bottlenecks within this occupation group were identified. More specifically,

¹³ Mapping and Analysis of the Bottleneck Vacancies in EU Labour Markets
<https://ec.europa.eu/eures/downloadSectionFile.do?fileId=8010>

construction of buildings and specialised construction activities need qualified employees representing this occupational group. In the construction sector the lack of labour force is in many countries related to labour mobility. The main reasons for bottleneck problems are one of the two reasons below, or both:

- the lack of applicants meeting the skills requirements for the job,
- the applicants with necessary skills are available, but not willing to take the job due to different reasons.

This can be explained by several reasons:

- an overall unfavourable perception of manual construction work persists;
- few young people are interested in the occupations;
- the pay is considered low in some countries;
- the status of the occupations is low;
- workers mobility as part of the workforce leaves the country results in both a labour and a skills shortage, as those remaining lack adequate qualifications.

In Austria, the lack is also attributed to a decrease in the training offer.

□ **Solutions**

In this context, awareness-raising campaigns to attract employees to building and related trades workers and to the industry in general, can be considered a viable strategy to alleviate the lack of interest towards those professions. Labour mobility is also to be mentioned as causing bottlenecks in some of the European countries, where qualified workers left to work in the construction sector in other European countries. The economic crisis, however, has partly diminished the needs in the construction sectors of some of the receiving countries, as for instance Spain, making return schemes relevant.

■ **Evolutions in France**

France Strategy and the Researches, Studies and Statistics Management (DARES)¹⁴ identify the changes in manpower and labour per occupation in France. The main evolution of employment in the construction sector by 2022 is that employment will increase. However, it results that this increase will be a consequence of a high retirement rate among workers leaving the sector “at the end of their career”.

□ **Three scenarios**

Three scenarios are established to shape the evolution of the skills in France: the central tends to be neutral about the unexpected behaviours of the economy, the target scenario is ambitious, and the crisis scenario is the most pessimist.

- The central scenario takes in account two facts: first, the recovery capacities of the economy of the different sectors and second, the structural modifications already engaged influencing the productivity and the employment evolution.
- The crisis scenario imagines a lower economic growth due to irrecoverable loss because of the crisis (investment, innovation, human capital) and a decrease in the global demand.
- The target scenario imagines a productivity rebound of the French economy based on a strategy of investment and innovation within a normative and fiscal context that facilitates the outbreak of new activities linked to environment and the articulation of services and industry.

□ **Employment evolution**

The need of qualified labourers in the construction sector (in the three scenarios) would continue increasing and this would be the result of the population growth in the country, of the refurbishment of buildings and adaptation of building lots to an aging population and to dependency, of the development of regulatory and environmental norms. However, the job creation would be lower than the last decade. The qualified labourers in the “second structural work” (electricians, painters, plumbers, carpenters...) would relatively be affected by the retirement of workers (mainly self-employed) creating needs for the coming years.

▪ **Employment need**

According to the central scenario, the creation of employment would mainly affect the technicians, supervisors and managers. Also, the low-qualified labourers but they could represent a high entry potential for higher occupations through training. In the “second structural work” field, one out of four low-qualified

¹⁴ Les métiers en 2022.

https://www.strategie.gouv.fr/sites/strategie.gouv.fr/files/atoms/files/fs_rapport_metiers_en_2022_27042015_final.pdf

workers is a trainee. If the employment creation varies according to the three different scenarios, it shows positive rates in all three cases.

- **Retirements**

Regarding the leaves “at the end of career”, they will be higher among qualified labourers (40% of self-employed) than among the low-qualified labourers where there is a turn-over phenomenon. However, we can see in all professional fields in the construction sector that workers stop early their career as a “at the end of career” leave due to uncomfortable working conditions, physical conditions, higher risks, etc.

- **Turn-over effect**

The turn-over effect will play a key role in the employment creation when the leave of workers is linked to hard working conditions and to the transition of workers to a more qualified occupation. The employment creation would affect mostly low-qualified workers and especially workers in structural work, public works and concrete.

- **Qualifications needs**

The evolution of the sector will need a higher qualification from workless labourers due to environmental laws, the increasing use of ICT and the adaptation of the relational competencies. The qualifications at the beginning of the employment will increase and underlies a big challenge in training opportunities for the next decade. Plus, the workers profile in the sector remains mainly men-only. Even though there is an increase in the female rate in the very qualified occupations such as architects and managers, they remain very few among the labourers. The rates of foreign manpower working in the construction sector is still very high being three times higher than in the total employed population.

- **Evolutions in Ireland**

DKM Economic Consultants¹⁵ reports on the evolution of the demand for skills in construction to 2020 in Ireland. It gives a review and prospects on the Irish economy and focuses on the construction industry. It establishes medium-term prospects for construction, the situation of the public sector then leads to overall construction prospects to 2020. It follows with the key risks, the implications for construction enterprises and skills and finishes with recommendations – enhancing skills capacity.

- **Perspectives to 2020**

What comes out of the implications for construction enterprises and skills is that:

- the industry will remain a fragmented sector with a large majority of self-employed firms and among the employing enterprises 98% will be less than 10 employees enterprises;
- direct employment in construction is expected to increase;
- there will be significant replacement demand for workers required to do the jobs of individuals who leave the labour market because of illness, retirement or death;
- a strong skills shortage could be a threat to the aging of the workers, the need of new entrants with required skills and experience will be significant. The analysis gives some numbers in needed manpower prospection and insist on implementing a strong apprentice training system to form new entrants that could replace the leaves expected in 2020.

There is a particularly pressing issue with specialised tradespersons and the availability of apprenticeships. The combination of technical education and practical experience obtained via the apprenticeship system leaves apprentices well placed to contribute the knowledge, skills and competencies needed to work as a craftsperson in the workplace.

- **Recommendations to enhance skills capacity**

These recommendations are by means of a collaboration between the Irish Government and industry to:

- establish a Construction Skills Forum that would report annually to work as a feedback mechanism between industry and the education and training system allowing issues to be resolved in partnership;
- use the report as a benchmark to constantly monitor progress and year-on-year changes, to ensure the education and training system;

¹⁵ Demand for Skills in Construction to 2020.

[https://www.ey.com/Publication/vwLUAssets/ey-demand-for-skills-in-construction-to-2020/\\$FILE/ey-demand-for-skills-in-construction-to-2020.pdf](https://www.ey.com/Publication/vwLUAssets/ey-demand-for-skills-in-construction-to-2020/$FILE/ey-demand-for-skills-in-construction-to-2020.pdf)

- improve the image of the industry by inspiring young people through extensive communications;
- deliver an international recruitment drive to target the Irish diaspora, to attract skilled construction personnel back to Ireland;
- refine apprenticeships and seek to introduce innovative methods of apprenticeship delivery
- engage with Solas and the Education and Training Board (ETB) network to deliver skills courses nationally;
- adapt initiatives such as “Leadership for Growth” and deliver to a wider cadre of management functions within construction companies in all size cohorts of the sector;
- refocuses CIF Training and its Construction SME Skillnet on driving new skills around modern building techniques, green construction and professionalism across the industry.

■ Evolutions in the United Kingdom

The UK Commission for Employment and Skills¹⁶ is a social partnership led by Commissioners from large and small employers, trade unions and the voluntary sector. The study is the most detailed and comprehensive set of UK labour market forecasts available (released in April 2016) and is part of a series of studies *Working Futures* (2003-2004, 2004-2014, 2007-2017, 2010-2020, 2012-2022, 2014-2024). The results provide a picture of employment prospects by industry, occupation, qualification level, gender and employment status for the UK and for nations and English regions up to 2024.

Construction is expected to see the fastest rate of growth of the sixth sectors, in both output and employment terms, resulting from an anticipated increase in public and private investment. To 2024 an employment growth is expected as the productivity growth will show positive rates.

□ Key factors

The key factors influencing the sector are:

- construction growth will depend on the recovery of lending to the private sector and public infrastructure spending
- rising population levels in the UK are expected to increase demand for construction of housing and infrastructure

Long-term, major public infrastructure projects

- overall, regulatory policies are likely to encourage construction growth particularly as firms seek innovative processes and technologies to adapt to environmental concerns
- new types of demand will encourage technological innovations and stimulate growth

□ Occupational profile

Occupational profile in construction and building trades to 2024 are mainly skilled trades employment including: steel erectors, bricklayers and masons, roofers, roof tilers and slaters, plumbers and heating and ventilating engineers, carpenters and joiners, glaziers, window fabricators and fitters.

All these occupations imply a high level of physical duties that normally require a degree of initiative, manual dexterity and other practical skills. This underlines the importance of traineeship. Also, this occupational group will see changes in task and skill requirements, resulting from technological innovation and new business and delivery models.

5. Build Up Skills Projects in Europe (2012)

The Build Up Skills Projects¹⁷ were aimed at European countries to identify the training needs of craftsmen and other on-site construction workers and systems installers in the building sector. Its final aim is to increase the number of qualified workers across Europe to deliver building renovations which offer high-energy performance as well as new, nearly zero-energy buildings. The initiative addresses skills in relation to energy efficiency and renewable energy systems and measures in buildings.

¹⁶ Working Futures 2014-2024

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/513801/Working_Futures_final_evidence_report.pdf

¹⁷ Build Up Skills Projects

<http://www.buildup.eu/en/skills/about-build-skills>

■ **In Belgium**

The analysis of the National Status Quo (NSQ) shows that an overwhelming majority of the annual intake of construction workers consists of young people without formal qualifications. This means in other words that there is a substantial intake of unqualified personnel. Consequently, raising the competency level of the workforce up to standard will constitute a challenge for the current workers.

The analysis features the construction sector, the national policy and strategies to contribute to the EU 2020 energy targets in buildings, the statistics on buildings and energy sectors, the existing vocational education and training (VET) facilities, the gap between the current situation and the needs for 2020 in terms of skills and its barriers.

□ **Vocational competences**

The vocational competencies relating to renewable energy and energy efficiency were also updated. Reworked vocational profiles were validated in 2012 for the following occupations:

- Roofer
- Weatherproofing roofer
- Plumbing installer
- CH fitter
- Ventilation systems installer

Other occupations will be updated at a subsequent stage. Work is currently in progress on the following occupations:

- Roofing carpenter
- Timber frame construction
- Exterior joinery worker
- Interior joinery worker
- Interior fitter

Different barriers that impede the expansion of the technical collaborators' skills in the working field have been mapped:

- a shortage of qualified workers (irrespective of training);
- a shortage of trained workers;
- a high-quality execution of contracts does not offer any economic added value;
- the existing training courses are too theoretical;
- the existing manpower allocation does not offer any opportunity to enter into any results or performance commitments;
- technical progress is not being followed up on soon enough;
- the way in which the work is organised does not allow workers to be sent for training;
- the cost of training is too high to send workers for training;
- there are no results or performance commitments included in the scope of contract execution.

■ **In Denmark**

The NSQ concluded that there would be a shortfall of up to 13,100 skilled construction craftsmen if the sector is to meet its share of the 2020 goals. The current competence level is thus insufficient and is a barrier to meeting these goals. The roadmap presents concrete initiatives aimed at overcoming this barrier. There are several approaches to this: the workforce supply can be increased; the current workforce can have its skills in energy efficiency and the use of renewable energy upgraded through continuing and further education and training; and the loss of skilled workforce to other sectors can be minimised.

The construction sector has shown an almost continuous negative trend since 2000, which makes labour productivity one of the sector's major challenges. At the same time, there has been a growth in labour productivity in manufacturing, which could indicate the need for increased industrialisation in construction processes. Two scenarios are identified to predict the sector evolution in the coming years:

Scenario A	Scenario B
The optimistic, which includes positive factors Energy consumption for heating is reduced by 0.5%	The conservative, which includes negative factors Unchanged energy consumption for heating from

per year from 2011 – 2014	2011 – 2015
Around 10% of the overall energy savings is attributed to “do-it-yourself” work	The effect of “do-it-yourself” work is not included
Energy consumption for heating is reduced by 80 GWh/year	Unchanged conditions corresponding to the historical development
Other initiatives account for 10% of the total energy savings	Other initiatives are not included
The effect of energy saving initiatives is not reduced (temperature)	The effect of energy saving initiatives is reduced by 10% (1 °C higher indoor)

□ **Shortage in occupations**

Skilled construction sector craftsmen needed for the energy saving initiatives from 2015 to 2020:

- bricklaying,
- carpenter/joiner,
- plumbing/heating/air conditioning (VVS),
- electrical installations.

□ **Barriers**

Barriers for reaching the 2020 goals have been identified at a workshop held by the consortium with the participation of representatives from the stakeholder group. The lack of interdisciplinarity in the construction sector is seen as the greatest challenge, presenting itself in several ways:

- there is a general lack of interdisciplinary insight and understanding between craftsmen’s trades;
- the construction workforce most often does not have the necessary competences to be able to conceive of a building holistically, and is too narrowly focused on own areas of expertise;
- there is a lack of understanding between consultants and craftsmen, and there are often communication breakdowns that can hinder energy savings.

There are also specific fields within the vocational education programmes that need to be strengthened, for example competences relevant to new renewable energy sources such as solar panels and heat pumps, and greater insight in sealing and the proper positioning of vapour barriers.

□ **Other barriers**

The identified barriers indicate that there is currently a range of additional gaps that are not directly related to education content, but which are structural or more overarching, such as:

- there will be a lack of well-educated manpower to carry out energy improvement initiatives if demand increases in the future.
- there are several barriers in the current vocational and continuing education systems for skilled workers. Some are structural, some are economic, and some are based on familiarity and image.
- many members of the construction workforce are semi-skilled, and need their skills upgraded.
- there is a lack of an incentive structure that can stimulate interest in continuing education and training.

■ **In Italy**

The green economy has led to the creation of specific jobs such as installers of photovoltaic panels and other clean technologies. These new jobs, according to the research by Ires Cgil, require new skills to be developed through training and the adoption of training programmes.

The study has identified 16 new professions for thermal and photovoltaic solar energy; 14 new professions for wind energy; 13 new professions for biomass sources and 11 general figures.

The new employment would be distributed in the following sectors: electric (19%), metal products (4%), building (8%), wholesale trade (4%), professional activities (18%) and other activities (47%).

The main occupations identified with a shortage are:

- Masons,
- Carpenters,
- Workers installing insulation, windows and fittings,

- Painters,
- Other building workers,
- Floor layers, layers of lining and plasterers,
- Electricians,
- Plumbers and heating experts,
- Others.

6. EC SO Country Profiles

The country profiles emitted by the European Construction Sector Observatory (EC SO)¹⁸ provide information of the construction sector for the 28 countries of the European Union on its economic-business framework, the skills shortage, the regulation on construction and demolition (C&D) waste management but as well on the vocational education and training system. It is a three-year action (2015-2017) and EC SO is also identifying and analyzing specific policy measures that are being implemented in each member state to stimulate construction sector employment, growth and opportunities, and to help overcome societal challenges.

■ Skills shortage

The Country profile of six countries were analyzed to identify the skills shortage in those countries. The table below shows the main occupations where skills shortage was identified:

Country	Skills shortage
Poland	<ul style="list-style-type: none"> ○ Bricklayers ○ Plasterers ○ All building and related trades occupations (excluding electricians)
France ¹⁹	<i>Risks linked to new skills required by the evolving needs (energy efficient renovation and digital construction)</i>
Germany	<ul style="list-style-type: none"> ○ Plumbers ○ Heating and air-conditioning technology occupations ○ Finishing trades occupations
Austria	<ul style="list-style-type: none"> ○ Roofers and master roofers ○ Tinsmiths ○ Construction site workers ○ Plumbers ○ Installation technicians
Sweden	<ul style="list-style-type: none"> ○ Bricklayers ○ Roofers ○ Floorers ○ Scaffolders ○ Painters ○ Concrete workers
Luxembourg	<ul style="list-style-type: none"> ○ Mason ○ Bricklayers ○ Façade specialists

■ In Poland

□ Context

The main reasons explaining this shortage are:

¹⁸ European Construction Sector Observatory
http://ec.europa.eu/growth/sectors/construction/observatory/index_en.htm

¹⁹ Bottleneck vacancies in Poland (2013)
<http://ec.europa.eu/social/BlobServlet?docId=12666&langId=en>

- significant migration of young construction professionals to Northern and Western EU countries, mostly the United Kingdom and Germany;
- life-long learning is still undeveloped, with adult participation in education and training standing only at 2.9%.

The Polish context justifies the need for a formal and pan-European certification of the qualifications relevant to the construction industry related to two trends:

- 1) Polish migrant workers are mostly educated at the vocational level (60% of employees in the sector display medium-level skills) but the Polish system is not recognised abroad forcing migrants to work below their qualifications (it is the same as migrants acquire new skills abroad and come back to Poland);
- 2) Polish construction sector is dominated by small companies and self-employed people (there is a high competition and a certification of certain services would enhance the credibility of such companies).

□ **Polish VET system**

Polish VET suffers from low quality and limited alignment of curricula with labour market needs, which in turn leads to low levels of participation and lack of needed skills, however the participation proportion of students increased in 2016. The employment rate of VET graduates stood at EU average. Even though skills mismatch is high in the construction sector, there is currently no dedicated policy measure for vocational education in construction

□ **Waste management**

Poland has no specific legal provisions dedicated to construction & demolition waste. Instead, the Act on Waste adopted in 2012 implements the EU Waste Framework Directive as well as other EU legislation related to waste management. The Act stipulates that plans should be implemented at national and regional level to meet the objectives. Currently all C&D waste is managed individually by Municipalities and City Councils.

■ **In France**

□ **Skills shortage**

Adult participation in education and training in the construction sub-sector doubled in 2014 compared to 2010. Despite this, the skills shortage in French construction sector is important considering the rapid evolution to energy efficient renovation and digital construction. A further study shows that skills shortage is identified as a barrier to hiring. As there is a need for training the workers to update their skills, it is also needed to form trainers.

□ **French VET system**

The employment rate of VET graduates in France was in 2016 well below the EU average, while participation of upper secondary students in VET was also below the EU average. Moreover, access to continuous VET is difficult for the unemployed and lower skilled, as well as for employees of small companies.

□ **Waste management**

The Energy Transition Law sets a recycling target of 70% for C&D waste by 2020. Moreover, it stipulates that, as of January 2017, distributors of construction materials, products and equipment shall take back the waste arising from the same type of materials, products and equipment they sell.

■ **In Germany**

□ **Context**

The amount of foreign workforce has increased due to the lack of skilled professionals. foreign (non-EU) workers with relevant recognised vocational qualifications have been allowed. Migrants often lack necessary language skills and need to be provided with the necessary education before being employable.

□ **Waste management**

The recovery rate of C&D waste in 2015 was well above the target for 2020. However, some regions are experiencing a shortage of landfill capacity for contaminated C&D waste which cannot be recycled. This process may take up to 10 years and there are considerable variations among Germany's 16 regions.

■ In Austria

□ Austria VET system

Austria is enhancing the green skills of its workforce through the klima:aktiv initiative which focuses, among others, on providing advanced vocational training in the fields of renewables, energy efficiency and mobility.

□ Skills shortages

Austria lacks 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. Adult participation in education and training in the broad construction sector has been fluctuating since 2010. The good quality of the VET system is a key contributor to low levels of unemployment for recent upper secondary graduates. The share of young people (15-29) not in education, employment or training is one of the lowest. It focuses on integrating also young refugees (high immigration rate).

□ Waste management

Austria is already a leader among European countries in terms of the management of construction and demolition waste (CDW). Austria is considered a leader in ecological construction and particularly with respect to passive house building.

■ In Sweden

□ Skills shortage

Sweden is experiencing a slight skills shortage in the narrow construction sector. The skills shortage is expected to increase in the coming years, due to growing investments in construction, coupled with high retirement rates in the sector. The ID06 Skills Database (Kompetensdatabasen) is an electronic card that stores and centralises all the professional qualifications of workers on the building site, enabling the site manager to quickly check that all employees have the necessary skills to perform their respective tasks. This system constitutes a means to limit undeclared illegal work, to ensure the appropriate level of skills and consequently to enhance the safety of the workplace and the quality of the construction output.

□ Swedish VET system

The employment rate of VET graduates is high compared to the EU average. Nevertheless, participation of upper secondary students in VET is decreasing, and the transition between the different training pathways remains challenging. The Swedish VET system is well developed, with dual education programmes combining practical work experience with theoretical teaching having been introduced and boasting good participation among employers.

□ Waste management

The Waste management plan for 2012-2017 published by the Swedish Environmental Protection Agency emphasises the need for improved waste statistics and improved Construction and Demolition waste management, namely recycling.

■ In Luxembourg

□ Luxembourgish VET system

Adult participation in education and training in the construction sub-sector increased between 2010 and 2016 above the EU average. Despite high enrolment rates, completion rates of VET education are below average. Furthermore, the Luxembourgish system offers training paths based on the dual principle, but also ones that are mostly school-based, thus lacking consistency in its VET approach. To improve the VET system, a reform process was initiated in 2015 aimed at increasing the overall matching of skills with labour market needs. Plus, LuxBuild 2020 is website that focuses on the centralisation of all the information on the trainings offered. several trainings and certifications are available on the market, offered by the public sector or trades association.

□ Waste management

In terms of legal framework for the management of C&D waste, two main pieces of legislation are applicable in Luxembourg, namely the Law of 21 March 2012 on management of waste and the Grand-Ducal Regulation of 24 February 2003 on landfilling of waste, as amended. In addition, Luxembourg introduced a General Waste Management Plan in 2010, which also covers C&D waste.



7. Skills needs in the construction sector

■ ESCO skills mapping pilot

The ESCO skills mapping pilot²⁰ tried to test the ESCO classification comparing the skills classifications of curriculum vitae (CV) and job vacancies (JV) from Austria and Sweden to the ESCO skills classifications to check the relevance of its classifications. They used both blue- and white-collar profiles (but not from the construction sector).

It results that the Public Employment Services of the European countries should detail as much as it can the different skills both in CVs and in JVs. The more listed skills there are easier is the matching with the ESCO skills. Sweden shows a 60% accuracy rate due to the lack of detailed skills when Austria shows a 77% accuracy rate.

The importance of “Noise” is underlined. “Noise” are skills which are introduced during the transformation but are not part of the correct skills in the target system. The noise represents more than 80% of the skills which means that only one/two out of every ten skills represented are correctly transferred skill. These can be useful for a career guidance meaning that the jobseeker sees a wider list of job opportunities.

■ Skills, knowledge and abilities shortage and surplus across Europe

The OECD report²¹ published in 2017 identifies the skills that are in shortage or surplus in European economies. The main goal is to furnish a database for every country willing to identify the skills needs and therefore the training priorities. Many factors are expected to challenge the European economies such as the new technologies, the ageing population and the increase of female workers in the labour market. This analysis can help restructure the economy to ease the transition of workers showing skills in surplus through a field showing a skill shortage.

□ Shortage and surplus in construction

The average age of the employed population is rising and with them the number of workers with low cognitive skills. Countries in which the skills gap between older and younger workers is the biggest have stronger shortages of key information-processing skills. The main trends showed in the OECD report are that:

- the skills shortage (all sectors) are most pronounced in Luxembourg, the Netherlands, Spain or Germany but less pronounced in Hungary;
- the probability of being mismatched is strongly influenced by socio-economic characteristics but also by job characteristics (e.g. working hours);
- there is a high need of adaptability for teaching professionals;
- adult training and lifelong learning are fundamental.

	Shortage	Surplus
Skills	<ul style="list-style-type: none"> • Content skills (reading comprehension, writing, speaking and active listening) • Process skills (critical thinking and active learning) • Complex problem-solving skills and social skills (instructing, social perceptiveness) <p>More pronounced in Finland, Luxembourg, Netherlands, Spain and Germany.</p>	<ul style="list-style-type: none"> • Content skills (reading comprehension, writing, speaking and active listening) • Process skills (critical thinking and active learning) • Complex problem-solving skills and social skills (instructing, social perceptiveness) <p>More pronounced in Switzerland, Hungary, Cyprus and South Africa.</p>
Knowledges	<ul style="list-style-type: none"> • Computers and electronics 	<ul style="list-style-type: none"> • Transportation, manufacturing and

²⁰ Final report of the ESCO skills mapping pilot https://ec.europa.eu/esco/resources/escopedia/20181010_150824/657260c3-3f9d-4b0a-b093-bb3589808676Skills_mapping_pilot_report.pdf

²¹ Getting Skills Right: Skills for Jobs Indicators https://read.oecd-ilibrary.org/employment/getting-skills-right-skills-for-jobs-indicators_9789264277878-en#page1

	<ul style="list-style-type: none"> • Education and training • Mathematics and science fields • Healthcare field <p>More pronounced in Finland, the Netherlands, Ireland and Belgium.</p>	<ul style="list-style-type: none"> • production • Building and construction <p>More pronounced in Estonia, Bulgaria, Romania, the Netherlands, Ireland and Belgium.</p>
Abilities	<ul style="list-style-type: none"> • Verbal and reasoning abilities • Perceptual and quantitative abilities <p>More pronounced in Finland and Iceland.</p>	<ul style="list-style-type: none"> • Manual and routine abilities: physical strength, flexibility, balance and co-ordination, endurance or control movement and fine manipulative abilities <p>More pronounced in Finland, Luxembourg, Ireland and Estonia.</p>

□ **Sector transition**

Construction and building shows a surplus in the knowledge domain across most countries and particularly in Bulgaria, the Netherlands, Ireland and Belgium. It also shows a surplus in manual and routine abilities such as physical strength, flexibility, balance and co-ordination, endurance or control movement and fine manipulative abilities.

Results show that for the average country, “building and related trades workers” are in surplus, but have a very similar skills profile to “metal, machinery and related trades workers” which are in shortage. The two occupations differ, however, in that workers in the latter occupation have more technical skills than those in the former. Additional training, designed to reinforce specific technical skills of building and related trades workers could be useful for them to move into metal and machinery trades jobs that have better labour market outcomes.

□ **New technologies**

There are substantial shortages in a variety of cognitive skills. It is likely related to the automation processes that are making routine skills redundant and cognitive ones increasingly more important. Results confirm the existence of surplus in routine manual and physical skills and abilities. Control precision abilities (e.g. the ability to quickly and repeatedly adjust the controls of a machine or a vehicle to exact positions) are shown to be in considerable surplus in many of the countries examined. Similarly, evidence shows a negative correlation between the increase in robots per hours and the shortages of control precision abilities and physical strength needs across countries.

□ **Organisational restructuring**

The transition to the digital economy implies an organisational restructuring in the workplace as they cannot replace soft skills. There will then be a rise of soft skill needs as well as skills such as co-ordination with others and ability to lead others. Results show that countries that underwent substantial restructuring in the workplace (Sweden, Denmark) are also showing stronger shortages in administration and management knowledge as well as in other key skill dimensions requiring workers to develop autonomy in making decisions and independence in the organisation of tasks.

■ **Skills needs in mentoring occupations**

This study²² identifies the evolution of competences needs per framing occupation (works conductor, construction site manager, team manager) in France. It underlines the creation of new occupations in the sector implying new qualification needs. This will lead to the emergence of new competences for developing tasks: technical, organisational, social and relational, adaptation competences. The report gives a descriptive analysis of the trainings for framing occupations (continuous vocational education and training (CVET), initial vocational education and training (IVET) and skills and competences).

□ **Adaptation of CVET and IVET**

The table below resumes the adaptation of the competences needed for CVET and IVET for each framing occupation (team manager, construction site manager, works conductor) and transversal trainings.

²² Étude sur les fonctions d'encadrement de chantier du BTP
https://www.metiers-btp.fr/images/documents/publications-et-etudes/encadrement_de_chantier/exe_etude_encadrement_chantier_HD.pdf

The technical competences	The relational and social competences
<ul style="list-style-type: none"> • Identifying technical and financial options • Anticipation and planification of construction site steps respecting budget and norms • Anticipation and analysis of inherent risks in each construction site step • Securing the construction site • Mastering informatic tools • ... 	<ul style="list-style-type: none"> • Negotiations including technical aspects on construction site • Oral and written expression • Commandment capacity • Team animator capacity • Adaptability to different communication modes depending on context and interlocutor • ...
The adaptation competences	The organisational competences
<ul style="list-style-type: none"> • Capacity to transfer know-how to team members • Capacity to adapt the offer depending on the clients demands • Polyvalence • Mobility to supervise and move to geographically distant construction site 	<ul style="list-style-type: none"> • Works and subcontractors' coordination • Contractual management • Waste management • Financial reporting • Priorities and emergencies management • ...

■ **In Spain**

A new reform in Spain²³ on the setting up of a Professional Training System for the Employment aims to overcome some needs and priorities of both companies and workers in a competitive context with increased needs of qualifications. These needs are due to the aging of the active population, the coexistence of high rates of unemployment and the lack of qualified labour supply in some sectors or in emerging occupations demanding high innovative skills, and the increase of long-term collective unemployment. According to the report, the reform should be able to improve the companies competitiveness, the workers employment and to treat efficiently the incompatibility between qualified supply and work demand. As it has four strategic goals:

- the guarantee that the workers (employed and unemployed) keep their right to access these trainings,
- the effective contribution of the trainings to the companies competitiveness,
- the collective negotiation enforcement with a qualified labour supply consistent with the productive system requirements and
- the transparency and efficiency in managing public finances.

□ **Spanish economic-business framework**

In 2016 in Spain there has been an increase in employment (compared to 2015) showing a consecutive period of increase for the last four years since 2006. The construction sector is one of the four sectors showing this increase and includes the bricklayers as one of the occupations with the most recruitments rates. Therefore, the construction sector in Spain shows the best rate of negative interannual variation of unemployment in 2016. However, the construction sector has not yet recovered from the pre-crisis situation, last sector showing recruitment rate lower than those in 2009.

The activity with the best behaviour is the specialised construction, mostly because of the renovation, even if the construction of buildings has been reactivated in some geographical areas with the increase of new buildings.

The sector is characterised by a high volume of workers as self-employed, mostly in the specialised construction even if the volume is decreasing. The self-employed workers in the construction of buildings represent almost a third of the professional workers in this activity and show a positive evolution.

²³ Detección de necesidades formativas
https://www.sepe.es/contenidos/que_es_el_sepe/observatorio/pdf/DETECCION_NECESIDADES_FORMATIVAS_2017.pdf

□ **Skills shortage**

The report gives an overview of the formative needs²⁴ in the construction sector (edification and civil works).

Technical professional skills	Transversal skills	General skills
<ul style="list-style-type: none"> • Auxiliary techniques • Machinery • Structure • Brick layering • Finishing touch • Others 	<ul style="list-style-type: none"> • Languages • IST and informatics • Knowledge in finance • Juridical and normative knowledge • Functioning of public administrations 	<ul style="list-style-type: none"> • Soft skills • Team management • Literacy • Organisation and planification • Social skills

□ **The future of the construction sector**

What will help the rebound of the construction sector is the implementation of the technical code in the construction with criteria related to the environment, energetical efficiency, sustainable energies. Some experts state that the future of the construction sector is in prefabricated construction and engineering of buildings, this will create a need in trainings for skills linked to new materials or for safety as they will change the working organisation. The young workers play then a key role in the replacement of the workers close to retirement. The construction sector shows a high rate of workers aged more than 60 years old affiliated to a social security.

■ **In Germany, Hungary and Slovenia**

According to the Skillco project reports²⁵ (based on an analysis of German, Hungary and Slovenian economies in the construction sector), the construction industry in Europe has suffered from the economic crisis explaining fewer investments in digital construction, which has been identified as the main trend for this geographical area. However, the construction industry is now recovering from the crisis and begins to adapt and invest in new technologies. The major goal underlined in Europe is the creation of new jobs such as in green energy and in smart infrastructure. This reinforces the need to invest in technologies and innovation and underlines the implementation's evolution of VET in Europe.

The evolution of the new technologies in the construction industry in Europe will lead to an increasing need in the workers skills related to energy efficiency and renewable energy by 2020. This shows the importance of developing a qualified workforce, the main challenge in Europe being digital construction.

□ **Skills shortage**

The ESCO report identifies four skills categories (table below): green skills, occupational safety and health, literacy and numeracy to which it adds soft skills including: communication/vocabulary, time management, ability to lead others and written skills. It also identified two valuable vanishing skills as wooden construction (in Germany and Slovenia) and thatched construction (in Hungary). These skills are linked to the natural environment of the country.

Green skills	Health and safety	Literacy	Numeracy
<ul style="list-style-type: none"> • reuse of industrial/construction waste material • recycling with the safe use of potentially harmful materials 	<ul style="list-style-type: none"> • measures of prevention of musculoskeletal disorders and basics of ergonomics 	<ul style="list-style-type: none"> • understanding of construction schedule and sequence of construction works • reading/understanding of project documentation • preparing time plans with the use of ICT on construction site/use of ICT technology for construction works 	<ul style="list-style-type: none"> • cost calculation expenditure forecasts in construction for group of work or small objects

²⁴ List of the formative needs in the construction sector pp. 68-72. Plus, an annex to the report gives the list of formative needs, the list of the most representative economic activities per occupation and gives information about the job market per occupation and its territorial distribution.

²⁵ Status Report on Finding of Skill Gaps, Skillco WP2 General document of research results <https://www.skillco.eu/en/content/outputs/>

■ **Inclusive Vocational Education and Training for Low Energy Construction (VET4LEC)**

The VET4LEC²⁶ project aims to identify the implementation of VET for low energy construction (LEC) in 10 European countries which are Belgium, Germany, Finland, Spain, Italy, Bulgaria, Hungary, Poland, Slovenia and Ireland.

The project contextualises the low energy concerns in the construction sector insisting on the need of a trained workforce, the different set of knowledge, skills and competences that it implies. As well as the interdisciplinarity that it requires through communications between all different actors implied in the process.

□ **Similarities between the different countries**

The 10 countries can be grouped by traditional industrial relations:

- Germany and Belgium represent the Germanic system with strong social partnership and a strong dual system with common curricula;
- Italy, Spain and perhaps Slovenia represent a “Mediterranean” model with regional variation;
- Finland represents the Scandinavian school-based approach;
- Hungary and Poland represent an Eastern European model;
- Ireland belongs to the Anglo-Saxon liberal market economy model.

Other similarities can be observed between some countries:

- mainstreaming of VET for LEC: Belgium and Germany;
- concerted attempts to embrace nZEB and develop VET for LEC: Ireland and Finland;
- many regional and local initiatives in terms of CVET: Italy, Spain, Slovenia and Poland;
- more limited and sporadic efforts observable: Bulgaria and Hungary.

The report underlines the importance of the Build Up Skills projects to introduce LEC into VET. In fact, reforms have been implemented in the 7 countries implied in the BUS project which are:

- a review of the national qualifications framework to align it with EQF (Bulgaria, Hungary, Slovenia);
- the development of national (Italy) and sectoral (Poland) qualification frameworks;
- initiatives to strengthen work-based learning (Bulgaria, Hungary, Slovenia, Spain);
- the introduction of apprenticeships (Slovenia and Hungary);
- the introduction of mandatory work-placement schemes (Hungary);
- restructuring of the regulatory framework and governance arrangements (Ireland, Poland, Slovenia);
- increased autonomy for schools and teachers (Slovenia);
- the introduction of a competence-based system (Slovenia).

□ **Observations**

The report gives an analysis of the implementation of VET in the 10 countries. This lead to the listing of challenges that were observed in the 10 countries. Those are:

²⁶ VET4LEC – Inclusive Vocational Education and Training for Low Energy Construction
<http://www.fiec.eu/en/fiec/projects/current-5460/vet4lec.aspx>

- structural features
- unregulated and undeclared activity
- varying qualification levels
- workforce diversity or lack of it
- skill shortages
- rapid technological innovation

Some factors enabling and supporting effective training have been identified as follows:

- social partnership and consultative structures
- levy style funding arrangements for VET
- a relatively highly qualified workforce
- broadly based IVET
- the development of new qualifications and upgrading of existing ones
- the development of CVET for LEC

The experiences of these projects in the 10 countries allowed to underline some important trends: an increase in the number of profiles for new LEC related occupations, an increase in the number of existing profiles incorporate LEC elements, more awareness of relevant inter-occupational interfaces, more emphasis on transversal abilities and that CVET is critical to equip the existing workforce for LEC/NZEB.

The integration of LEC into Construction VET can be imagined by different models as a common syllabus, a common curriculum, a sector framework, etc.

What works best for IVET:	What works best for CVET
<ul style="list-style-type: none"> - Knowledge, know-how and attitudes are spelled out in a way that can be used by curriculum designers. - Identify occupational overlaps and build them in where this is deemed to be desirable to achieve better inter-occupational co-ordination. Extending or updating the scope of existing occupations with SQF. For those countries that do not have centralised VET curricula, a more flexible approach is desirable. - The appropriate national, regional or sectoral bodies responsible for drawing up profiles use the Belgian profiles, the <i>Qualibuild</i> framework and the Leeds guidelines as a basis for reviewing existing profiles. 	<ul style="list-style-type: none"> - LEC is concerned with innovation and the rationale for LEC CVET is to introduce construction workers to these innovations and incorporate them into their practice. APEL procedures on their own are unlikely to guarantee that candidates have acquired the latest knowledge and practices since they are unlikely to have encountered these in their work. APEL can at best only be a component of a LEC CVET qualification.

■ Public Works jobs' greening

Constructys (the accredited collection organism for construction in France) published a study²⁷ in 2013 analysing the greening of Public Works occupations identifying some training needs to achieve the green objectives as the global performance of buildings.

Six main evolution in the integration of green economy in Public Works in France:

²⁷Le verdissement des métiers des travaux publics
<https://www.constructys.fr/wp-content/uploads/2017/03/Le-verdissement-metiers-TP.pdf>

- Biodiversity preservation
- Construction site acceptability
- Waste management
- Primary materials saving and recycling
- Global performance of buildings
- Energy and SEG reduction saving

Training offer to eco-prestacion address to execution workers

- Commercialisation of new offers: ecological alternatives, sustainable roads, canalisation renovation...
- Resources saving and recycled materials optimisation
- Developing intelligent networks and systems

Training offer to eco-responsibility

- Understanding and reducing buildings impact on biodiversity
- Construction site acceptability: organising concertation

8. Health and Safety

Construction sites are dynamic and complex environments which makes them difficult to control. Indeed, safety and performance efficiency are often inadequate. Construction industries are relying on new equipment and machinery to keep up with the dense and complex design projects. To cope with the development, new techniques and technologies are being adopted to deal with the rising safety risks.

■ **Improving construction safety using BIM**

A paper written for the Second Congress of BIM²⁸ states that automated recognition of construction risks using BIM is being developed and looks promising to manage and minimise accidents.

Currently, BIM is just being introduced to be a part of safety and health planning in the construction industry. BIM is being used for visualisation and analysis procedures to improve health and safety programs during the project lifecycle. Prevention planning using BIM can be 4D visualisation and transferred to all project levels and stakeholders. In addition, to the work space conflicts could be analysed and prevented in earlier stages and avoid collisions according to construction schedules

- **Major areas where Safety and Health professionals can use BIM:**

²⁸ Improving construction safety using BIM-based sensor technologies.
<https://repositorio-aberto.up.pt/bitstream/10216/111987/2/266242.pdf>



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- Safety training,
- safety planning,
- pre-task planning,
- job hazard analysis,
- site equipment planning,
- design for safety and
- accident investigations.

Monitoring the site using sensors could decrease the manual monitoring, a centralised data base could be used to store data and retrieve them whenever needed, that will help to take necessary actions and planning.

□ **BIM limitations:**

- BIM being an immeasurable tool,
- benefits that are related to any phase other than the design phase are hard to assess,
- project managers also consider BIM as money and time.

□ **BIM requirements:**

- model familiarity and good modelling skills,
- understanding the model and relate schedules and components,
- the person developing the model should also be familiar with the safety regulations and requirements,
- the models need to be detailed and having all necessary safety information for safety planning and checking, lacking these details will prevent identifying risks,
- BIM is considered hard to use and for subcontractors, site workers and foremen they might be uncomfortable using it and they rather stick to the traditional 2D drawings instead,
- as for health and safety professionals, access to BIM models could be limited and the technical skills and tools to use the model are not yet in place. BIM is still not able to fully simulate the construction process, and still rely on manual assistance, as an example changes in the construction site were hazards arise might suddenly occur for workers, BIM do not simulate the rapid changes,
- some accidents are still not able to be fully covered with BIM, for example operating from heights, machinery operation, personnel safety management,
- BIM technology requires a high level of inter-organisational coordination. This coordination must be flexible in technological structure, secure, easy system to use and cost-effective. This is more effective and beneficial if and only if both parties adopt 3D CAD system, also either they use the same software, or any software which follows same standards.

Assisting BIM system by sensing tools improved the safety status but still most of the location tracking system do not gather accurate indoor data. As well as some sensors loose connection in underground or tunnel works where Wi-Fi is not available. The sensing technologies still rely on heavy infrastructure. In addition, the implemented system creates additional efforts to safety manager such as attaching Tags, analysing data and training individuals. Results of the research also shows that sensor data may provoke false alarms and may cause inaccurate reading of sensing subsystem. Most of the sensing devices that relies on batteries have energy deficiency and cannot be continuously used for monitoring.

■ **Green jobs and occupational safety and health**

The 'Foresight of new and emerging risks to occupational safety and health associated with new technologies in green jobs by 2020'²⁹ summarises impacts that new technologies in green jobs would have on occupational health and safety by imagining three scenarios of greening.

Key technology innovations directly linked to construction are:

- green construction technologies with energy-efficiency measures (examples: new build and retrofit, renewable energy, new techniques, increasing use of ICT and robotics and automation);
- green manufacturing technologies and processes, including robotics and automation with advanced manufacturing techniques, distributed manufacture, lean methods, biotechnologies, green chemistry, nanomaterials;
- nanotechnologies and nanomaterials with a very wide range of potential applications including materials used in construction (for instance, pavements/bricks/asphalts 'capturing' environmental

²⁹Green jobs and occupational safety and health: Foresight on new and emerging risks associated with new technologies by 2020 <https://osha.europa.eu/fr/tools-and-publications/publications/reports/summary-green-jobs-and-occupational-safety-and-health-foresight-on-new-and-emerging-risks-associated-with-new-technologies-by-2020/view>

pollutants, nanocoating/nanopaint transforming solar energy into electricity, 'green' anti-fouling nanocoating).

The use of these rapidly evolving technologies reinforces the high need of training systems to work with qualified workers. The risk of skill shortages due to these rapid changes is high. In fact, the high demand in (qualified) workers will have two impacts which are the employment of unqualified workers unaware of the new risks and a greater polarisation of the workforce by a highly competitive highly qualified workforce leading low-skilled workers to work in poor working conditions. Plus, there is a high need of monitoring these new technologies over their lifecycle to understand and prevent unknown health and safety risks.

□ **Scenarios and workers' health and safety impacts**

▪ **Win-Win scenario**

The win-win scenario includes high economic growth, strong green values and high innovation in green technologies. In more details, this means that:

- new buildings are zero carbon and external insulation of existing buildings to reduce the carbon footprint,
- photovoltaics are integrated into buildings or painted
- hyper-insulating materials are in use,
- buildings can be disassembled and recycled,
- modular prefabricated buildings are the norm,
- buildings interact amongst themselves and the smart grid.

According to these changes, the impacts on workers' health and safety are:

- exposition to hazards from old building demolition;
- + improved onsite safety by automated construction of modular buildings offsite;
- workers are exposed to novel substances increasingly used in construction material;
- issues linked to the mixing of automated activities with manual ones;
- risks during connection of services (water and electricity) with the pre-fabricated modules;
- electrical risks as old and new buildings must be integrated into the smart grid;
- increasing underground congestion with the increase of basements construction;
- new hazards and unexpected accidents linked to the use of new energy sources;
- risks of falls or exposure to lead and asbestos by the increasing roof work linked to old buildings retrofitting.

▪ **Bonus world scenario**

The bonus world scenario includes high economic growth, weak green values and medium - innovation in green technologies. In more details, this means that:

- most new buildings are prefabricated modular designs with increased automation in assembling and retrofitting,
- most old buildings are demolished, and demolition waste are not recycled,
- high levels of insulation are the norm,
- photovoltaics are integrated into buildings,
- buildings are not designed for recycling,
- subcontracting is used to drive down costs.

According to these changes, the impacts on workers' health and safety are:

- exposition to hazards from old building demolition;
- + improved onsite safety by automated construction of modular buildings offsite;
- workers are exposed to novel substances increasingly used in construction material;
- increasing underground congestion with the increase of basements construction;
- risks of falls or exposure to lead and asbestos by the increasing roof work linked to old buildings retrofitting;
- attraction of unqualified workers for indoor ventilation as the demand in insulation retrofitting is high.

▪ **Deep green scenario**

The deep green scenario includes low economic growth, strong green values and medium + innovation in green technologies. In more details, this means that:

- limited construction of new buildings and high proportion of recycled materials,
- retrofitting homes to new standards is the norm,
- governmental regulations and controls limit buildings' energy consumption.

According to these changes, the impacts on workers' health and safety are:



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- exposition to hazards from old building refurbishment,
- height risks, electrical risks, dust and hazardous chemicals exposition linked to retrofitting of renewable energy technologies;
- attraction of unqualified workers for indoor ventilation as the demand in insulation retrofitting is high.

■ Innovative solutions in the construction

The European Agency for Safety and Health at Work³⁰ identified in 2011 four risk categories at work. A report on innovative solutions identifies the main risk factors for each category in three sectors: construction, healthcare and HORECA. The table below summarises the identified main risk factors per category (psychosocial load, physical load, slips, trips and falls and dangerous substances) for the construction sector with their solutions.

³⁰ Innovative solutions to safety and health risks in the construction, healthcare and HORECA sectors.
<https://osha.europa.eu/en/tools-and-publications/publications/reports/innovative-solutions-OSHrisks>



Risk categories	Main risk factors	Solutions
Physical load	<ul style="list-style-type: none"> • Accidents • Manual handling of (heavy) loads • Work environment (e.g. not enough room, uneven or slippery floor, cold) • Awkward postures (e.g. stretched arms, bent postures, kneeling and squatting) • Working above shoulder/head level • Repetitive work 'e.g. hammering, drilling, driving screws, sawing, painting with brushes, plastering, cutting sheet metal with scissors, loading and unloading small pieces like tiles or bricks) • High force applications • Vibration • Local compression of tools and surfaces • Psychosocial factors 	<ul style="list-style-type: none"> • The risk management framework for work-related stress • Increasing construction workers' use of hearing protection devices • A job safety programme using tool box training sessions and computer-assisted biofeedback stress management techniques • Improving lifestyle among male construction workers at risk for cardiovascular disease • Reducing the level of sickness absence by organising healthier work • Working well together campaign to improve health and safety • Worker engagement decision tool • Achieving behavioural change by the TASK card and other means • Better health under construction through a supportive national framework • Organisational health management interventions to improve work life balance
Slips, trips and falls*	<p>Falling from heights</p> <ul style="list-style-type: none"> • Working on scaffold or platform without guard rails, or without a safety harness correctly attached • Working on fragile roofs and ladders that are badly maintained, positioned and secured 	<ul style="list-style-type: none"> • Information for training/toolbox talks on the use of Mobile Elevating Work Platforms
Dangerous substances	<p>(varies with size, exposure)</p> <ul style="list-style-type: none"> • Tunnel construction • Demolition • Renovation 	<ul style="list-style-type: none"> • Dibasic esters can replace dichloromethane in paint strippers • OSH preventing solutions for fire accidents • OSH preventing solutions during the painting processes • OSH preventing solutions during the welding processes • OSH preventing solutions during work with spray polyurethane systems • Dust-free construction materials reduce inhalable dust concentrations • Dust free sanding of wood • Innovative application solution to prevent skin contact with epoxy resin • Use of warm mixed asphalt to reduce exposition to fumes and aerosols
Psychosocial load	<ul style="list-style-type: none"> • Time pressure and deadlines • Undeclared work • Low control • High demands (physical workload) • Training (or lack thereof) • Job certainty • Safety climate • Skill under-utilisation • Responsibility for safety of others • Safety compliance • Hours of exposure • Tenure • Harassment/discrimination • Lack of communication • Posture • High turnover • Unsafe work practices 	<ul style="list-style-type: none"> • Ergonomic interventions and mechanisation aides for bricklayers • Implementation strategy and training on new working methods for floor layers • Use of a hydraulic ladder rack for all maintenance workers • Mechanical aids for plasterers • Use of prefabricated steel and self-compacting concrete • Mechanisation aids for road workers and floor layers • Use of alternative methods for pile cropping <p>*Tasks carried out in specific construction jobs: plasterers, including plaster spraying; pointers, when filling joints between bricks; screeders making floors level (and exposed to vibration, pulling mechanic tools, manual spreading); scaffold erectors; tilers; carpenters, when working above shoulder level; glaziers, manual handling, kit cutting, applying kit; bricklayers, especially when handling large blocks; insulation workers, when applying mineral wool or polystyrene; plumbers; architects' staff, undertaking Computer Aided Design (CAD); paviours, carrying out repetitive movements, handling heavy materials, and using vibrating equipment.</p>



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