



European
Commission

Digital construction skills: enabling the energy transition in Europe's building stock

Proceedings of the BUILD UP Skills workshop at Construmat'19



BUILD UP

The European Portal For
Energy Efficiency In Buildings

**Digital construction skills:
enabling the energy transition
in Europe's building stock**

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Introduction

This report sets out the results of a workshop, organised as part of the European Commission's BUILD UP Skills initiative, which took place on 16 May 2019 as a side event of the Construmat 2019 trade fair in Barcelona, Spain.

A total of 75 participants attended the event including two representatives from the European Commission DG GROW and DG ENER respectively; two representatives from EASME.

The event was prepared and facilitated by EVERIS, EURAC and ESN.

The Exchange Meeting consisted of one plenary presentation, two breakout sessions with 2 specific sessions each, one panel discussion and one closing session.

This report summarises the presentations and speeches given throughout the meeting. All the presentations are publicly available on the BUILD UP Skills website:

Programme

**Location: Fira de Barcelona - Gran Via venue – Av. Joan Carles I, 64
08908 L'Hospitalet de Llobregat – Barcelona**

16 May 2019 09:30 – 17:30 CET

Programme

09:30 – 10:00 Registration & Coffee

10:00 – 10:20 Opening and welcome: the role of skills in the transition to a sustainable building sector (Room CC1.4)

Patrik Kolar, European Commission EASME, Head of Department “LIFE and H2020 Energy, Environment, Resources”

Enrique Corral, Director General, Fundación Laboral de la Construcción

10:20 – 10:40 Keynote address by Ada Yvars Bravo, Director, Mangera Yvars Architects (MYAA) (Room CC1.4)

10:40 – 11:00 Inspiration : Digital innovation in the building sector, today and tomorrow (Room CC1.4)

Christophe Sykes, Director General, Construction Products Europe

11:00 – 11:15 Supporting the digitalisation and modernisation of EU buildings: the revised Energy Performance of Buildings Directive (Room CC1.4)

Pau Garcia Audi, Policy Officer, European Commission, DG Energy

11:15 – 11:30 Digital innovations transforming the construction sector – EU policy initiatives (Room CC1.4)

Roman Horvath, Policy Officer, European Commission, DG Internal Market, Industry, Entrepreneurship and SMEs

11.30 – 11:45 Coffee Break

11:45 – 12:45 Break-out session 1: Digital innovation - what does it mean for professionals of the building value chain?

Round table discussion on the changes happening in design and construction of buildings using digitalisation, and based on selected examples from EU funded projects

Session 1: Digital innovation in the design of buildings (Room CC1.4)

Valeria Ferrando, EU Head of Research, Integrated Environmental Solutions (IES)

Session 2: Digital innovation in the construction of buildings (Room CC1.5)

Thomas Messervey, Founder & CEO, R2M solutions

Programme

12:45 – 13:15 Highlights from Break-out session 1 (Room CC1.4)

13:15 – 14:15 Lunch and Demonstration of innovative technologies in the buildings sector

14:15 – 15:15 Break-out session 2: How to upskill building professionals for the energy transition

Round table discussion: what are the skills challenges to design and construct energy efficient buildings using digital technologies? How does this feed into existing qualification schemes? What is the role of certification? What about mutual recognition of skills across borders?

Session 1: National approaches (Room CC1.4)

Javier González López, Head of International Projects, Fundación Laboral de la Construcción

Session 2: Pan-European approaches (Room CC1.5)

Jan Cromwijk, Project Coordinator, Dutch Knowledge Centre for the building and building services sector (ISSO).

Sylvain Kubicki, Senior Research & Technology Associate, Luxembourg Institute of Science and Technology (LIST).

Paul McCormack, Innovation Manager & Andrew Hamilton, Course Director, Belfast Metropolitan College.

Anna Moreno, Senior Project Manager, Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA).

15:15 – 15:45 Highlights from Break-out session 2 (Room CC1.4)

15:45 – 16:00 Coffee Break

16:00 – 17:00 Panel discussion (Room CC1.4)

An expert panel will take stock of progress made so far in upskilling the industry for energy efficient buildings, and further steps needed in this field.

Followed by questions from the audience and live polls.

17:00 – 17:30 Closing & Next steps – Funding opportunities under Horizon 2020 (Room CC1.4)

Amandine De Coster-Lacourt, Project Advisor, EASME

Opening and welcome

Patrik Kolar, Head of Department: European Commission Executive Agency for SMEs (EASME) 'Life and H2020 Energy, Environment, Resources'



The link between digital skills and the energy performance of buildings is important enough to be the subject of a full-day workshop. On the one hand, the European building sector needs to complete the decarbonisation of building stock if the EU is to meet its climate targets. On the other hand, it needs to make the most of the new digital technologies that are rapidly changing the way buildings are designed and constructed.

The lack of a workforce trained in digital skills remains one of the biggest hurdles to Europe achieving its ambitious energy-performance targets for buildings. A 'cognitive revolution' is needed to provide everyone involved in the building process with updated knowledge and the required competence.

Sometimes, there is over 50% difference between the claimed and the actual energy performance of a building. Training building professionals to deliver better quality and ensuring a more efficient interaction between tradespeople on building sites can help reduce this 'performance gap'.

Although digital technologies, such as drones, 3D printing, artificial intelligence, building information modelling (BIM), or the Internet of Things are said to be revolutionising construction, the building sector remains one of the least advanced when it comes to the use of digital technologies.

Using these new digital tools will require those designing, constructing and operating buildings to reshape their organisations. Workers need up-to-date skills so that they can design and construct buildings faster, cheaper, and of higher quality and energy performance.



Energy and digital transitions should be seen as complementary objectives. Europe has set ambitious targets for the energy performance of buildings. From 2021, all new constructions will need to be nearly-zero-energy buildings, in line with the [Energy Performance of Buildings Directive \(EPBD\)](#). At the same time, renovation of existing buildings must be accelerated so that buildings can form part of a smarter energy system that uses a growing share of renewables. However, the smartest buildings or best-conceived retrofit projects will never come to fruition without the qualified professionals needed to build them.

In response to the building sector's skills shortage, the European Commission started the [BUILD UP Skills](#) initiative in 2011, funded by the [Intelligent Energy Europe Programme](#), then under [Horizon 2020](#). Initially, it targeted on-site workers and craftsmen within national projects, but has evolved to cover all professionals in the building value chain in multi-country projects. To date, 57 projects have been finalised, while 11 are ongoing, with EU support totalling EUR 40 million.

BUILD UP Skills has identified barriers to the upskilling of construction professionals, including a lack of awareness by companies or the lack of time to allow workers to enrol in training courses. The initiative has helped find concrete solutions to address these challenges. It is also supporting the rollout of digital skills to the building sector.

Enrique Corral Álvarez, Director General: [Fundación Laboral de la Construcción](#)

The Spanish Labour Foundation for the Construction Industry was created in 1992 to: ensure professional qualifications and vocational training for workers, promote health and safety measures on building sites, and promote measures to improve the labour market and implement an accreditation system. The foundation's vision is to impel an innovative construction sector and labour market. FLC is co-ordinating the ["Blueprint for Sectoral Cooperation on Skills in the Construction Sector"](#). Financed by the [Erasmus+](#) programme, this massive initiative aims to define a new strategy for professional competences and qualifications for Europe's construction industry.



The construction industry faces three challenges: becoming energy efficient, embracing digitalisation and responding to the needs of the circular economy. The foundation is working to smooth the construction industry's transition to energy efficiency and renewable technology by upgrading the skills of SMEs and building workers. The foundation has 47 training centres across Spain's 17 regions.

In Spain, 35 % of construction workers need to upgrade their energy efficiency skills. While the construction industry is making attempts to move to automation and digitalisation, it is the second-least digitalised sector in Spain after agriculture.



The industry has traditionally been based on a linear economy. The movement to a circular economy is slow but unstoppable. It will change the construction industry's way of working. To ensure it becomes circular, about 5 000 plants for recycling demolition waste are needed in Europe alone.

One of the foundation's initiatives is **Entorno BIM**. Anticipating the success of the BIM work methodology, it provides training on BIM for all professional profiles and for each stage of the construction process, for which software currently exists.

Ada Yvars Bravo, Director – Mangera Yvars Architects: Digital innovation in the design of buildings

As architects we do our best to promote sustainability and protect the environment. We navigate between the ideal and the real world. BIM is at the same point, between an ideal BIM world and the real one.



The construction industry assumes that using BIM for a building project, will reduce the cost and time. The industry does not always seem to realise that this can only be achieved when designers and architects are given the time and resources to comply with BIM. They need to be able to build the BIM model properly and ensure an efficient flow of work and information. To achieve a smoother construction process, architects need to apply a BIM-based approach from the start, rather than adopting it later in the design process.

Digital modelling is not just about geometric shapes, but includes all the information relating to a project, like sustainability studies and building-performance analysis. The model flows through a chain that starts with the concept and moves through the design, procurement and construction phases, ending with the operation and maintenance of the building.

The central model includes sub-models: architectural, structural, civil infrastructure and building services. These are all part of a common repository making information exchange easier and enabling a clash detection model to detect problems.

The architectural model describes an architect's vision and includes drawings and sched-

ules. The model can be used to focus on specific topics including shadowing and the potential loss of daylight due to neighbouring buildings. The structural model includes concrete and steelwork design. The civil infrastructure model is used to visualise the site topography and earthworks, and to design vehicle movements around the site to ensure accessibility. All the sub-models are used to inform the cost plan and build the 4D construction planning.

There is not a unique BIM environment, but several tools, using over 30 different software packages. Before finalising the software selection, it is important that everyone in the business value chain agrees on the minimum required interoperability for a BIM project file.



Christophe Sykes, Director General – Construction Products Europe: Construction and digital innovation in the building sector: today and tomorrow

Housing is a market with ups and downs, and this must be kept in mind when talking about construction. All over Europe housing is in crisis marked by high rents, gentrification, and a lack of affordable housing. In certain regions, there is talk defining ownership rules for more than one housing unit. Speculation and the delivery of building permits often impact land value and undermine the delivery of much-needed housing units.

The construction industry must ensure its employees have the skills to use digital tools and emerging technologies such as exoskeletons that protect workers and help them move heavy loads. Investment in digital technologies is huge. It delivers value for investors, but also needs to deliver value for the whole construction chain. Within the industry, 95% of players are SMEs and the question is how to ensure access to digital technologies for all players.



Billions of dollars are being invested in digital construction, which is a good indication of value creation. However, overall, SMEs included, the construction industry spends 1% or less of its annual sales on research and development. To ensure the uptake of digital solutions, this must be scaled up significantly. On the other hand, there is a risk that too many tools, platforms and initiatives could reduce market uptake.

The market must be ready to take up new technology and new ways of doing things, but technology suppliers must understand the needs and potential of the construction value chain to ensure a win-win situation. The whole value chain must be ready for innovative solutions: from the delivery trucks, to the on-site facilities and workers. Currently, there is very limited 'pull' effect for such solutions.

Across the EU, new build makes up approximately 1% to 3% of construction. Most of the work concerns renovation. In the 1950s and 1960s, there was an urgent need for housing, so buildings were constructed quickly. We should now ask what should be done with those as their energy efficiency performance is extremely low.

Concerning building information modelling (BIM), **there is a misconception that this digital tool will drastically reduce building costs.** It must be noted that the value of the BIM industry is forecast to reach USD 12 billion in the next three years, offering these returns to investors. Like all digital tools, it offers solutions, but BIM solutions differ across different member states and there is still too much fragmentation. We have so far identified 93 BIM initiatives across the EU and 185 associated software products.

In this context, the European Commission is running the **EU BIM Task Group**. It aims to facilitate the use of BIM in public procurement across the Member States.

If digital construction works, everyone will benefit. Citizens will have better places to live and work. But nobody is speaking the same language in terms of data policy and data ownership. A political framework could provide structure and give direction to Europe. We must try to keep the leadership in digital construction in Europe. I am very pleased to say that the European Commission has made money available for a digital construction platform, to be launched in September.

It is estimated that the deployment of digital tools in construction is 5-10 years off and would greatly benefit from standardisation and (EU) political guidance.

**Pau Garcia Audi, Policy Officer – European Commission
DG Energy: Supporting the digitalisation and
modernisation of EU buildings: the revised EPBD**



Designing EU legislation, for energy efficiency in buildings in this case, is extremely difficult. Each of the 28 Member States has a different way of building. Just as an example, there are different ways of calculating the internal area of a building because of the different ways of accounting for things like wall thickness, lofts and internal partitions. There are more than 28 regulations on energy performance of buildings, since some countries have more than one: Belgium has three.

Now try to get consensus on achieving X percent of energy savings. We have to, because scientists are warning us about climate change and we must do something about it, regardless of what the rest of the world is doing. **The EU has committed to reduce primary energy consumption by 32.5 % by 2030.**

We are in a bit of trouble right now, as with the current trend we will not achieve our objectives for 2020. **Buildings represent about 40 % of energy consumption; a total of 75 % of our housing stock is energy inefficient.** Not enough buildings are being renovated and they are not being renovated thoroughly enough. We need to dramatically change this, but it is not cheap and we have to find ways of financing it. There is also huge potential in the area of smart building technologies.

By March 2020, all EU Member States have to have transposed the revised EPBD into their national legislation. They will have to develop long-term renovation strategies to achieve a reduction of 80 % to 90 % in CO₂ emissions by 2050. **That means renovating pretty much every single building and doing it ambitiously.** Member States have to indicate how they will do it. They need to look at the skills gap that must be addressed and how construction companies are going to tackle this gap. These long-term renovation strategies have an important public consultation component.

From 2020, there will be additional requirements on the installation of self-regulating devices for room temperature. We are going to develop an optional common EU scheme for rating the smart readiness of buildings. To develop the **Smart Readiness Indicator** (SRI), a series of service contracts have been appointed. They are now looking for buildings to test the assessment scheme before finalising it. There is more information on the SRI website, as well as an open call for Horizon 2020 research projects.



Roman Horváth, Policy Officer – Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs, European Commission (DG GROW): Digital innovations transforming the construction sector – EU policy initiatives



The construction sector is competing with agriculture for the last place in digitalisation. Why are workers not being up- or reskilled? There is no need for it, say nearly 60% of respondents according to the Adult Education Survey 2016 made by Eurostat. **Workers are not aware of the need for training.** A study being conducted by DG Employment focuses on the ways to facilitate training in micro and small enterprises .

The European Centre for the Development of Vocational Training has predicted that, by 2030, the working age population will have increased by 3.7%, while the labour force is expected to grow by 1% only. **Digitalisation is one way to overcome this relatively shrinking workforce, of doing more with fewer people.**

As part of the EU BIM Task Group activities, a handbook has been produced to encourage public authorities to use BIM in public procurement to provide better value for money, better-quality public buildings and to contribute to a sustainable and competitive industry. DG GROW is running a study on digitalisation and SMEs, to map and address the gaps in digital skills.

The construction sector needs to compete with other sectors of the workforce and remain attractive to the public. DG GROW runs the Blueprint for Sectoral Cooperation on Skills in the Construction Sector. It is a stakeholder-led project which aims to create partnerships of employers and education providers and to respond to skills challenges in the construction sector. It focuses on vocational training in energy efficiency, digitalisation, circular economy and health and safety.

We are working on a digital logbook for buildings to get building data stored in one place. It is a digital repository of information about a building and the data can be used in various ways.

In 2015, we established the **European Construction Sector Observatory** which provides individual country profiles, policy measures, trend and analytical reports. The focus is on five priority areas of the **Construction 2020 Strategy**.

Two new trend reports about digitalisation of the construction sector were published in March. One is about the use of BIM in the EU construction sector, with France, Denmark and Poland as detailed examples. The other paper focuses on 3D printing and the use of drones in construction.



Breakout session 1:

Digital innovation – what does it mean for professionals of the building value chain

Digital innovation in the construction of buildings: Thomas Messervey, R2M Solutions



In 10 years, the construction sector will not be very different from the way it looks today. It is a hard sector to change and faces the increased risk of major market disruption. There will be an 'Uber moment' when construction companies will have to innovate and prepare for change, or disappear.

Amazon founder Jeff Bezos has made his first investment in a homebuilder making prefabricated family homes, to have homes that are linked to his voice-based services. We are impatiently waiting for a market disruptor. I am frustrated by the design-build construction process. I am tired of being paid six to nine months later, of being asked for discount after discount after discount for good products.

There are opportunities for companies that innovate, but we see resistance about people adopting innovative technologies.

If you are a small organisation – most companies are SMEs – you are fighting to survive each day. Small companies are more likely to suffer. If we do not upskill fast enough, we risk losing jobs. We need to use organisations like the World Green Building Council to achieve this upskilling.

The construction sector's productivity has dropped in all countries, while in other sectors it is rising. One of the reasons could be that we are the least likely to invest in each other, in training. In addition, it is not a given that people have smartphones, tablets and PCs on construction sites. These are the barriers to digitalisation. For us, facilitating this transition is a business opportunity.

Examples of what R2M Solutions does includes using 3D scanning of an interior, getting measurements and attaching tags, then putting the scan into a cloud-based BIM environment. This can be used as a powerful tool to tie construction processes together. We can make an historical record of a site and check whether the BIM model matches the on-site scan. However, it is still not as refined as we would like it to be.

Questions and comments

One audience member commented that Amazon is not the threat: it is the sector's unwillingness to change that is the threat. Another said that innovation is a good thing, regardless of the form it takes or how we get there, as long as we have a sustainable built environment that is good for the consumer. The skills set in the construction industry must be developed to embrace digital technologies.

Another audience member from France said he had experience with making training an obligation. Training had been brought to the site and tailored to the site. **Even though it is obligatory, and even though there are penalties for companies not complying, it is still difficult to get people to attend training.** Although companies have money for training, they do not use it because they feel it is useless.

An audience member from Norway predicted that in future the labour market in the construction sector will largely comprise two sections: a skilled, highly educated group of people in charge of designing and conceptualising projects, and a majority of 'not-too-well-paid' workers with low skills sets.

Digital innovation in the design of buildings: Valeria Ferrando, IES

The building industry faces multiple challenges. Buildings and cities have a strong impact on the environment. Even though new energy efficiency technologies are available, the sector is slow to pick up on them, let alone to embed them into their processes. While buildings have evolved, the way we design, hand them over and operate them, has not. Our cars are smart, why not our buildings? **It is time for the industry to shake off its 'slow to change' malaise and catch up with other industries in their use of digital technologies and data.** Making the built environment more sustainable should be top priority for the building industry.



During the past 25 years, Integrated Environmental Solutions's technology (IES) has helped improve buildings' energy efficiency. To address the above challenges, they developed the **Intelligent Communities Lifecycle** (ICL), a new range of digital twin technologies, all connected in a digital environment, a collaborative cloud. ICL facilitates the creation of sustainable and intelligent communities.

The ICL collaborative cloud receives data from building management systems and from simulations. Both serve as input for the definition of scenarios with different energy demand profiles, aggregations, and energy flow exchanges, and optimisation of the community energy system configuration and the buildings' operational phase.



The collaborative cloud connects all ICL tools and serves as one single environment, linking all aspects of all stages of every building:

1. Sustainable urban design in 3D and early stage master planning
2. New building or renovation design
3. Buildings operation and control
4. Resources analysis and control

Nanyang Technological University (NTU) Singapore **EcoCampus** is an example of how ICL twin technologies can be used to reduce energy, water and waste footprints.

Digital Twin technologies, like ICL, can help overcome barriers related to cooperation and information sharing. It can help identify areas where action is needed and provide qualitative and quantitative information to facilitate intelligent decisions. It leverages the best of building simulation, metered data and AI/machine learning, allowing for more accurate control of building operations. Digital twin technologies are accessible through tablets, smartphones and PCs. They are customisable and can be adapted to the size and resources of projects, and to different types of users. It provides benefits for the entire value chain, including both white- and blue-collar workers.

Questions and comments

What are the main advantages of the digital twin approach?

The digital twin approach provides one central place to store and access all project data. It provides more transparent information on energy consumption and costs and optimises cooperation between parties. It allows for virtually testing options to understand their impact before implementing them. Usually, the leading contractor launches the twin technologies in a collaborative space for smaller sub-contractors and suppliers, to allow them to provide the digital inputs related to their work.

How to promote upskilling to digital technologies in the building sector?

The building sector may be convinced by showing the benefits and advantages of the digital twin approach, while underlining its potential to be expansive and scalable, thus enabling it to reduce investment costs.

Is it possible to exchange data among projects? If so, how to handle data privacy?

All collected data is private and can be exchanged through a dedicated application program interface. For technical reasons and privacy issues, it is important to determine possible synergies at the beginning of the process.

Which are the benefits in connecting BIM and BEM (Building Energy Modelling)?

The benefits lie with the acceptance of the renovation action by the final user and improved setting of the operational and maintenance phase. Although there is always a gap between simulated and actual building performance, the continuous collection of data based on a design (compliance) model, a calibrated operational model which uses real data to make the model more accurate, allows for a real digital twin of the building, which behaves exactly as the building in reality. Based on that digital twin, adjustment of the management strategies and proper information to the users in the building life cycle, this gap can be reduced to achieve better building energy efficiency.

Breakout session 2:

How to upskill building professionals for the energy transition

National approaches: Javier González López, Head of International Projects – Fundación Laboral de la Construcción



Spain's construction sector is facing five market demands: digitalisation, energy efficiency, the circular economy, industrialisation, and human capital.

The sector has to catch up as stricter energy-efficiency legislation, which will affect the Spanish building code, is going to determine how workers construct buildings, which will impact on training needs.

The average age of a Spanish construction worker is 45. This is a disaster as it means that **the younger generation is not replacing older workers**. The problem can be solved by encouraging women, migrants and refugees to enter the sector. At present, women make up 9% of workers in the sector, migrants and refugees 16%.

The three main challenges facing the sector are legislation, market demand and the workforce. The market demand is for people with vocational training: trades- and craftspeople. Spain has many people with primary education and with university degrees, but there is a gap in the middle. According to data from the BUILD UP Skills Initiative, between 25% and 35% of the Spanish construction workforce needs training in green skills. This includes bricklayers, insulation installers, plumbers and roofers.

This is a big problem and is indicative of a mismatch between the skills available and those that are needed. We need to better anticipate future skills needs. **Another problem concerns experienced workers without accreditation**. There is currently no process to accredit these workers, although efforts are being made to solve this.



Years ago, we realised the important role certification plays and launched the **Tarjeta profesional de la construcción** (TPC). This card contains information about a worker's experience, training and professional qualifications. It has a QR code which makes it easy to see this information. Almost 800 000 have been issued. Maybe this is an opportune moment to introduce a European TPC, to give cardholders mobility throughout the EU.

Solutions to these problems include the **Women Can Build initiative**, led by the Fundación Laboral de la Construcción. This is intended to encourage more women to enter the sector. The **In2C** project aims to integrate migrants and refugees into the sector. Many of them were fired in the 2008 financial crisis, but now the sector needs them back. The **Construye 2020+** project will develop online training courses which are much cheaper, more accessible and convenient, including through a smartphone app, also developed in Construye 2020.

A national survey among 1 000 companies is being conducted to determine their training needs. The results will be uploaded into the European Construction Sector Observatory, where construction companies can find data to help them make decisions.

There are many good projects to provide solutions, but what happens to them once the money runs out? They end, which is a pity.

Questions and comments

A civil engineer from Cyprus commented that communication between blue- and white-collar workers is a problem in her country.

A Danish member of the audience said the construction industry in his country faces the problem of getting people to upskill, perhaps due to workers' lack of time. Older, experienced workers are teaching younger workers, but this means they are not taught the new skills that energy-efficiency demands require. **More digital technology is being used to teach the younger section of the workforce so that they can challenge the way older workers do things.**

A representative from North Macedonia said there had been great interest in training in new technology, because a tool like BIM was something new to the country. Training was provided with the help of a Spanish partner. They were surprised at how many blue-collar workers were willing to be trained in energy-efficient building.

Ada Yvars pointed out how Brexit will affect the construction industry. Most people in the sector in the UK come from Europe and will have to leave their work and go back there. 'It's a big mess at the moment,' she said. Efforts to provide certification for workers will allow them to move around more easily, but it is too late for UK.

Pan-European Approaches: Amandine De Coster-Lacourt, EASME; Jan Cromwijk, ISSO; Sylvain Kubicki, Luxembourg Institute of Science and Technology; Paul McCormack and Andrew Hamilton, Belfast Metropolitan College; Anna Moreno, ENEA

While Javier González López looked at ways to upskill building professionals for the energy transition at a national level, Amandine De Coster-Lacourt hosted a parallel session during which the question was explored from a Pan-European point of view.

Amandine first recalled the BUILD UP Skills initiative which started in 2011 and got public authorities, industry, academia and the vocational education sector to develop national roadmaps and training schemes for construction workers. The initiative began under the umbrella of Intelligent Energy Europe and is being continued under Horizon 2020.

In the quest to determine the skills challenges needed to design and construct energy-efficient buildings using digital technologies, Amandine presented four pan-European projects that make use of the skills required to deliver energy efficiency via BIM. These projects are developing BIM qualifications and training schemes.

The first project – **BIMplement** – was introduced by Jan Cromwijk from ISSO (NL). Acknowledging the need for an enhanced, systematic approach for delivering energy efficiency in buildings, the project is focusing on reducing the gap between the designed (predicted) and actual performance of buildings. Jan said this involves closing the gap between knowledge on paper and knowledge in practice. This can be achieved by having a qualified and well-equipped workforce that can implement and execute with a proper understanding of their own responsibility and actions, and those of the other professions involved in the value chain.

The second project – **BIMEET** – was introduced by Sylvain Kubicki from the Luxembourg Institute of Science and Technology (LU). BIMEET aims to broaden the BIM training agenda to support the European Union building energy efficiency agenda with the development of a skill matrix related to BIM and energy efficiency, for the architecture, engineering and construction sector.

Andrew Hamilton, of Belfast Metropolitan College (UK), presented the **BIMcert** project. Andrew pointed out that digital skills development is not a linear progression, and that several micro accreditations are one way of achieving this.



Anna Moreno from ENEA (IT) introduced the **Net-UBIEP** project. Anna focused on the various phases of a building's lifespan and looked at integrating the competencies needed for each of them, i.e. BIM evaluator, BIM facility manager, BIM manager, BIM coordinator, BIM expert, and BIM user.

Paul McCormack of Belfast Metropolitan College (UK) concluded the presentations by highlighting the common work done by the four projects under the "**BIMAlliance**" label to find solutions to common challenges (e.g. how to find synergies with the work of **buildingSMART** International professional certification committee). Paul introduced the work being done to create a **European passport for construction**. This is being considered as something that will feed into existing qualification schemes and allow mutual recognition of skills across borders.

The focus of the four projects remains using BIM to close the energy cycle of planning, design, building and operation.

The presentations were followed by a hands-on session where the audience was divided into four 'discussion corners' to explore:

1. How to use BIM to upskill building professionals towards a higher level of energy efficiency?

Issues discussed included the need for a good format to share data, to improve the IFC import/export, to achieve greater standardisation of data sharing during conception and implementation. The merits of the Open BIM were discussed. Simplification of the models to be used for the energy simulation was mentioned as a success factor. The BIM model should include components and libraries with all environmental and sustainability requirements that could then be used in the different certification processes.

2. How to design BIM training for blue-collar workers?

Participants discussed how to handle differences in BIM maturity and pointed out that the skills development should be embedded in the construction industry work processes, like other aspects of training such as safety and AR/VR. Participants raised the issue of a lack of communication among stakeholders, among different competencies, and even among employees in the same company. This appeared to be a common problem in different countries and should be taken into account in upskilling both blue and white collar professionals.

3. How to build capacity of public authorities on BIM?

Issues discussed revolved around the data/ information ownership and the need for more implementation guidelines for public authorities.

4. What are the options for designing certification and accreditation for BIM-related skills?

Based on the experience of the four projects, the merits of an EU-wide certification scheme were discussed. Participants discussed how to build trust in such a scheme (e.g. mechanisms for evaluation). The need to ensure industry engagement (and demand) for such a scheme was discussed.

Panel discussion:

Taking stock of progress made in upskilling the industry for energy-efficient buildings – and what more needs to be done

Participants: Ada Yvars, Javier González López, Thomas Messervey, Jan Cromwijk, Christophe Sykes, Pau Garcia Audi, Valeria Ferrando, Roman Horvath

Christophe Sykes: Digital construction is a niche market and most of the players in the industry have not been shown how it will give them added value. The challenge is first to understand the needs and then find solutions that match those needs. Digital construction is not taught in architecture schools, so even if the market is ready for it, the skills are not there to meet the demand.

Ada Yvars: We are in a niche market but if the rest of the architects do not step up and embrace technologies like BIM, they will die.

Valeria Ferrando: One way of bringing these new technologies to the market is to get students involved in pilot projects on their campuses, to give them access to the tools and software.

Thomas Messervey: Everyone needs to invest in students and train them.

What is your view of the sector in the next 10 years?

Ada Yvars: I am still waiting for a building material that will change everything. This workshop should allow us to move in a different direction that helps us to improve things.

Javier González: We are moving from a construction sector that is traditional and uses craftsmen, to industrialised processes. For example, we will no longer be using bricks to make a wall but will use prefab panels (“LEGO approach”).



Jan Cromwijk: We will see a mixed traditional and digital world. Many of the buildings we have now cannot be renovated using industrial methods, but digitalisation and industrialisation can help make it easier.

Christophe Sykes: We will see new players on the market. In the UK, an insurance company has invested in a prefabrication plant to deliver kit houses. There are new products in the construction industry every week. But every new product comes with an investment cost. It has no proof on the market and the construction industry likes to stick to what it knows. If public procurement, for example, always selects the lowest cost, instead of the highest return on investment, we will see little progress.

Thomas Messervey: The energy companies, the big utilities are losing out to the aggregators. Jeff Bezos wants to deliver homes enabled with voice technology that link to his services.

Christophe Sykes: And Honda is already designing smart homes that come with the electric car.

Which trades are most affected by the skills gap?

Pau Garcia: Using digital tools can help us to massively change things on-site. Most designers and engineers are already digitised. But when you go on-site, they are still using paper.

Roman Horvath: Evidence shows that more educated people understand the need for training better. However, on-site workers do not see the need for it. Everyone should be digitally skilled so that one group can understand what the other is doing.

Jan Cromwijk: If you want to change the building culture, you must reward workers: award them learning points, for example, for doing a self-inspection of a building with the BIM viewer. All training interventions need to create value for the trainees. Everybody needs to be upskilled – workers, manufacturers, facilities managers. We need to come out of our silos and use digitisation to network, so the manufacturer can get data about how a product is performing and a worker can get information about how well he or she installed the product.

Christophe Sykes: Uber or Airbnb are good examples of where the IT industry has come to a head with traditional industries. They have been to court. What we always forget in Europe is that tradition means resilience and trust. Our buildings do not collapse, and these deliver the shelter we all take for granted. The issue is the new players coming in. They come from the world of IT. Most of them think they have the answer and can transform the construction industry. But they forget the essential element, our building regulations are there to be followed for clear reasons and years of development. We should embrace the IT transformation, but the IT world should be aware of the requirements of the industry so that we do not deliver things that do not last. We need cooperation, coordination and exchange.

Ada Yvars: The BIM information model allows us to collaborate because it has to go from one sector to another. It is a tool that enables everyone to collaborate. It allows anyone to improve their skills, the end-users of the buildings, too. It will improve the well-being of the inhabitants and will help us to carry on living in the buildings.



What barriers must be overcome to unlock digital skills in the construction sector?

Christophe Sykes: With every digital tool there is a common problem, and that is data exchange and moving from big data into reliable information. We need a common language and interoperability to be able to exchange data. One advantage of Brexit is that now everyone has heard of the single market. There are 10s of BIM initiatives. If we are not careful, the BIM market will close the single market. BIM is just a data-management tool, nothing else. If we are not careful, the BIM market will lock you into a single BIM in your country. What we want is machine-readable data. We do need a data-management tool but whether you call it BIM or anything else is secondary.

Roman Horvath: We need shared management. The European Commission defines priorities with the help of Member States and those states have to decide what kind of sectors or professions they would like to upskill.

Javier González: I am astonished to hear that some partners consider it easy to involve SMEs, because it is difficult to involve SMEs in training in Spain.

Thomas Messervey: Things will change faster if we make them change. In the construction sector, we should have 'thou shalt do' in projects of a certain size. If we force people to do it, it will happen. The digital passport or digital logbook is a very interesting concept. We need to get rid of the corruption in the sector. It is hard to compete if some companies are paying people in the black or using kickbacks.

Ada Yvars: It is quite amazing that the governments make the rules – for example, that everything has to be BIM 2020 – but they do not upskill their own staff. People in government do not know much about BIM. They must upgrade their skills as well.

Roman Horvath: The European Commission introduced professional cards three years ago, with four or five sectors as pilot projects, including estate agents. The intention was to add engineers, but we found so few common points regarding the education of engineers that we have given up for the moment. I was told by colleagues that it is difficult to introduce that for construction sector because much of it is regulated by Member States, which makes mobility difficult for blue-collar workers.

Closing and next steps:

Amandine De Coster-Lacourt, EASME

A variety of funding areas related to energy efficiency exist under the Horizon 2020 programme. There is 100% funding of direct eligible costs for projects developing new energy-efficient technology and solutions (so-called Research and Innovation Actions); and for projects that help improve skills, mobilise large-scale investment or facilitate EU policy implementation (so-called Coordination and Support Actions). For projects to demonstrate the viability of new technologies (so-called Innovation Actions), the funding rate is 70% of direct eligible costs.

A total of EUR 112 million in funding is available under the [H2020 Energy Efficiency Call 2019](#), which covers five areas: buildings; consumers and services; industry and products; financing energy efficiency; and public authorities and policy support. Proposals can be submitted until 10 September 2019.

In January 2019, EASME organised an Info Day during which all the open topics of the Call 2019 were presented. Presentations and recordings of this event are available at: <https://ec.europa.eu/easme/en/horizon-2020-energy-efficiency/horizon-2020-energy-efficiency-information-day-main-takeaways>

From June 25-27, 2019, the European Commission is organising an Info Day on the Call 2020 Energy priorities. June 27 will focus on energy efficiency topics. The event will take place in Brussels and will be web-streamed. More information and registration: <https://h2020-energy-info-day-2019.com/registration/>

In May 2018, the Commission has published its proposal for [Horizon Europe](#), the ambitious EUR 97.6 billion research and innovation programme that will succeed Horizon 2020. The proposal was made as part of the EC proposal for the next EU long-term budget, the “multiannual financial framework (MFF)” that is expected to be adopted by the end of this year. Horizon Europe will run from 2021 to 2027, and will continue the tradition of structuring funding calls around global challenges such as energy. The current proposals include a Climate-Energy-Mobility cluster.



In parallel, the Commission has proposed strengthening the [LIFE programme](#) and measures promoting energy efficiency by including a pillar on “Clean Energy transition” in LIFE.

Main take-aways

The digitalisation of the building sector requires more than adopting innovative software. It calls for a redefinition of organisations and business models, therefore affecting not only technical skills, but also managerial ones (see January 2019 [study](#) commissioned by the Committee for European Construction Equipment).

- ▶ Only a limited number of players in the building value chain have embraced the move to digitalisation. The others, in particular SMEs, still need to be convinced about the benefits.
- ▶ Stakeholders, in particular within SMEs, need to find their way in the fast-changing landscape of digital tools and the myriad products and services available on the market, as investing in the ‘wrong’ ones can be very costly. This can explain the reluctance of a number of players.
- ▶ We need to move from the traditional ‘construction sector’ to a new ‘construction industry’ paradigm, (e.g. pre-fabrication of building components will become key).
- ▶ Digital technologies have the potential to reduce the energy ‘performance gap’ of buildings, notably if used in combination (e.g. 3D scanning and BIM).
- ▶ More effort/investment should go into using digital technologies on construction sites.
- ▶ All professions involved the building value chain need digital and energy skills, including manufacturers and building managers/owners. On-site workers deserve special attention (user-friendly tools, attractive training formats, short training durations etc) as they are less likely to enrol in trainings.
- ▶ The lack of adequate/up-to-date national curricula, reflecting emerging digital skills, remains a major issue in most Member States.
- ▶ Several participants highlighted the difficulties in recruiting qualified professionals, let alone recruiting skilled/trained workers.
- ▶ Training and qualifying the ‘demand side’ (e.g. building owners, public administrations) is essential to secure the roll-out of digital technologies

Speakers biographies

Patrik Kolar

**Head of Department,
European Commission
EASME**



Patrik Kolar obtained his PhD in chemistry at the University of Ljubljana, Slovenia, in 1995. From 1997 to 1998, he worked as Alexander von Humboldt postdoctoral research fellow at the University of Karlsruhe in Germany. From 2004 to 2007, he served as science attaché at the Permanent Representation of the Republic of Slovenia to the EU in Brussels.

Kolar joined the European Commission in 2007 and worked as Head of Unit in several Directorates (Health, Bioeconomy and Industrial Technologies). His work included contributing to the design and implementation of EU Research and Innovation (R&I) policies, in particular the

Seventh Framework Programme (FP7) and Horizon 2020.

In October 2017, he was appointed Head of Department B (LIFE and Horizon 2020 Energy, Environment, Resources) in the Executive Agency for Small and Medium-sized Enterprises (EASME). His department is responsible for implementation of the LIFE programme, as well as the energy efficiency component of the «Energy Challenge» and the «Environment/Climate Challenge» of Horizon 2020.

During his scientific career, Kolar co-authored over 20 original scientific and review papers and wrote several papers on EU R&I policy.

Speakers biographies

Andrew Hamilton

**Course Director,
Belfast Metropolitan
College**



Fulltime lecturer in Belfast Met and experienced Chartered Architect. Prior to Belfast Met Andrew was an Associate Director in a Belfast based architectural practice, with a wide range of experience of architectural design, responsible for the preparation of architecture projects from concept to completion including concept development, planning & building control application, and site delivery, both individually and as a leader of multidiscipline teams.

He is Course Director for the Foundation Degree Science in Architectural Technology. With over 20 years' experience of CAD

combined with his professional experience in Architecture and Construction Andrew is actively involved in the development and delivery of BIM and Construction courses. He has delivered bespoke business support training in CAD and BIM, notably the Creagh Concrete CAD Academy and recently commenced BIM Academy.

Andrew is a member of the Architects Registration Board (ARB) and Royal Institute British Architects (RIBA).

Paul McCormack

**BIMcert Project Manager,
Belfast Metropolitan College**



A dynamic entrepreneur, Paul McCormack is the Programme Manager for the BIMcert project. An international award winning engineer Paul holds several international patents and was the first Northern Ireland recipient of a National Endowment for Science Technology and the Arts (NESTA) award.

Paul has a robust record of achievement in all levels of management in industry, research and education including roles as founder/CEO of multi-award winning start-up SMEs, leading highly successful international collaborative projects and

developing curricula for professional courses in renewable energy, digital design, energy efficiency, cyber security, IOT adaptations and Smart Cities.

BIMcert seeks to embed BIM modelling throughout the construction sector through certified training in order to maximise energy efficiency during the full life cycle of a building. Paul has created the innovative BIMcert Strategy Compass, a navigation tool informing strategic direction ensuring the training materials and deliverables meet industry requirements.

Enrique Corral Álvarez

**Director General,
Fundación Laboral de la Construcción**



Born in the Spanish city of Lugo in 1966, Enrique Corral Álvarez holds a law degree with a speciality in business from San Pablo CEU in Madrid. He has been Managing Director of Fundación Laboral de la Construcción since May 2003.

Between 1998 and 2003, he worked as manager at the Asociación de Promotores y Constructores de España (APCE), representing it within the Confederación Nacional de la Construcción (CNC) and Fundación Laboral de la Construcción until he joined the General Direction in 2003.

From 1994 until 2003, he took part in the Negotiation Commission of the General

Agreement of the Construction Sector and all national sectorial agreements.

He was an advisor at the National Commission of Occupational Health and Safety between 1999 and 2003.

In 1994, he joined the Confederación Nacional de la Construcción, taking over legal consulting and territorial coordination until 1998 and participating in the preparation of legal initiatives.

He has contributed as a speaker in several public procurement forums in Spain and other European countries.

Ada Yvars

**Director,
MYAA Mangera
Yvars Architects**



Ada Yvars Bravo studied architecture at ETSAB in Barcelona, Spain. She has since worked at Carlos Ferrater Architects in Barcelona and tutored with Florian Beigel Architects in London. She has also worked at Stirling Prize-winning David Chipperfield Architects where she was responsible for the Francis Bacon Studio, London, the MACLA office building in Barcelona and a Rothschild house in New York.

Yvars is a co-founder of Mangera Yvars Architects (MYAA) and has worked on the Qatar Faculty of Islamic Studies in Education City, Doha; the Msheireb Phase 3 project, Doha; the Jeddah Creek mega

project; KAND Smart Eco City; KA Sports City, Jeddah, and a fifty storey Al Khobar Tower. In London, Yvars was responsible for the Kensington and Chelsea Amenity building.

Her more recent work includes strategic overview of rail and infrastructure projects, cultural and faith-related projects and a World Cup stadium. She was recently shortlisted for the Moira Gemmill Emerging Woman Architect of Year sponsored by the Architectural Review and Architectural Journal.

Anna Moreno

**Senior Project Manager,
ENEA**



Anna Moreno is a Senior Project Manager at ENEA, the national Italian Agency for energy and sustainable economic development.

She has developed the ENEA e-learning platform to promote the technological transfer from the researchers to public administration and enterprises.

She is member of the technical scientific committee at ENEA and is President of the Italian chapter of BuildingSMART

international. She has been the coordinator of two Italian projects within the Buildup Skills initiative and she is now the coordinator of net-UBIEP project to promote the use of BIM to increase the energy performance of new and existing building throughout the life cycle of a building.

Sylvain Kubicki

**Senior Research
& Technology Associate,
Luxembourg Institute
of Science and Technology**



Dr. Sylvain Kubicki. Dipl. Arch, PhD in Architecture Science (2006).

He is involved at the Luxembourg Institute of Science and Technology, in the IT for Innovative Services Department, as Senior Research and Technology associate. He works on research and technology projects related to construction informatics, BIM and smart buildings/cities funded either by competitive programs or industrial collaborative projects. He is the coordinator of BIMEET (H2020 CSA project, 2017-2020, 1M€ total budget), and coordinator of 4DCollab (funded by ANR, France, and FNR, Luxembourg, 2017-2020, 1M€ total budget). Sylvain Kubicki also supervises master and doctoral research.

Relevant publications

Kubicki, S., Guerriero, A., Schwartz, L., Daher, E. & Idris, B. 2019. Assessment of synchronous interactive devices for BIM project coordination: Prospective ergonomics approach. *Automation in Construction* 101(May 2019):160-178.

Guerriero, A., Kubicki, S. & Reiter, S. 2016. *Building Information Modeling in use: How to evaluate the Return on Investment?* ECPPM 2016 Conference. Limassol, Cyprus. September 7-9, 2016.

Daher, E., Kubicki, S. & Guerriero, A. 2016. *Data-driven development in the smart city. Sustainable Places 2016*, Anglet France.

Boton, C., Kubicki, S. & Halin, G., 2013. *Automation in Construction. Automation in Construction*, 36, pp.1-16. Boton, C., Kubicki, S. & Halin, G., 2015. *The Challenge of Level of Development in 4D/BIM Simulation Across AEC Project Lifecycle. A Case Study. Proceedings Engineering 172(C) n° 50. 67*

Christophe Sykes

**Director General,
Construction Products
Europe**



Christophe Sykes is Director General of Construction Products Europe. An experienced EU public affairs professional, he has been working for Brussels-based European non-profit associations for over a decade.

Sykes started his EU career with the raw material industry and was then invited to relaunch a construction product association. Having successfully expanded this organisation and its corresponding network, he was invited in 2012 to bring Construction Products Europe, then known as CEPMC, to a position of European public affairs eminence.

Sykes has an extensive amount of experience organising and chairing workshops and has the ability to address a wide range of audiences. As the Director General of Construction Products Europe, his main task is to identify, report and help define industry positions vis-à-vis EU legislative initiatives that may impact the EU construction industry. He accomplishes this through the development and execution of public affairs strategies, network development and coalition-building, as well as management of the secretariat.

Pau Garcia

**Policy Officer,
European Commission
DG Energy**



Pau Garcia is a graduate of the Polytechnic University of Catalonia in Spain and holds a Master of Science in building services engineering from Loughborough University in the UK.

He has worked as a building services engineer in the private sector both in Spain and the UK.

For the past eight years, Garcia has held different positions within the European Commission. He began as a project

Jan Cromwijk

**Project Coordinator,
ISSO**



Educational technologist, working in the field of sustaining the built environment. Driven by signaling and utilizing opportunities to optimize learning infrastructures.

Working with practical methods for innovation analysis of technical innovation systems and learning functions within those systems. Expert in developing task based qualification schemes and underlying databases for mutual recognition. Experienced in developing learning networks focused on craftsmanship in the building sector. Coordinating development of teaching materials for initial and post-initial education, especially by coaching

of experts writing teaching materials on didactics. Experimenting with developing mobile e-learning interactions, for example on learning from building errors. Educational designer of the BUILD UP Skills advisor-app. This app can be used by craftsmen and professionals to find actual upskilling opportunities in the field of sustaining the built environment.

Project leader of the IEE-projects BuildUpSkillsNL 2011 – 2013, BUS-N@W 2013-2015 and H2020-project BUSToB. Involved in H2020-projects PROF/TRAC, INSITER, BIMplement, NEWCOM, TripleA-reno and NET-UBIEP.

Javier González López

**Head of
International Projects,
Fundación Laboral
de la Construcción**



Born in Segovia, Spain, in 1974, Javier González López holds a Master's in health and safety at work, as well as in the training of trainers (detection and analysis of training needs, learning programs and pedagogical skills).

He has been Head of International Projects of Fundación Laboral de la Construcción since 2010.

He has extensive experience in the design, development and management of research and development projects in the construction industry, not only nationally but also internationally. Having led more

Roman Horváth

**Policy Officer,
European Commission
DG GROW**



Roman Horváth is a policy officer at the European Commission's Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs (DG Grow). As part of the sustainable construction team, he deals with skills, qualifications and employment issues in the construction sector.

Horváth holds Master's degrees in construction engineering and business management. After a short academic career at the Slovak University of

Technology, he worked in Slovakia's Ministry of Transport for eight years where he dealt with EU affairs and EU-funded infrastructure projects. He joined the European Commission in 2007 and became part of its sustainable construction team in 2014.

Valeria Ferrando

Head of
European Research,
Integrated Environmental
Solutions



With a PhD in material science, Valeria Ferrando's background is in applied physics. Ferrando joined the R&D division of IES Ltd. after seven years at a private engineering consultancy company where she worked as project manager of national and EU-funded research and innovation. She is responsible for contributing to the IES vision for sustainable communities through R&D-funded research and for the management and coordination of projects, ensuring that they lead to marketable products for the company.

Ferrando has multidisciplinary expertise and skills related to innovation and project management, particularly in the field of sustainability of the built environment. She also has extensive experience related to proposal and tender writing, having worked on EU projects since the Sixth Framework Programme (FP6) and tenders for the European Commission, United Nations and the European Space Agency.

Thomas Messervey

Founder & CEO,
R2M Solution



Tom Messervey has over 20 years of engineering experience spanning military service in the US Army Corps of Engineers, the Italian engineering company D'Appolonia, teaching at the United States Military Academy at West Point, and coaching services as the EU Facilitator for the Intelligent Manufacturing Systems program (www.ims.org).

He serves as an expert for the European Commission in textiles, manufacturing, and energy efficiency. His research interests focus on using sensor data to make better engineering decisions across design, assessment, maintenance, inspections, and energy management to include machine learning.

Passionate about linking international research efforts to boost competitiveness, he has been involved in the development and conduct of 14 collaborative research projects involving 212 partner organisations with a total value of EUR 84.5 million.

Main area of activity in R2M:

Strategic direction and management of the company's vision, research and consulting activities. Professional development of staff and growth of R2M branches and affiliated companies. With respect to R2M's research portfolio, Tom contributes horizontally across many projects.

Annex 2: List of participants

**Digital construction skills:
Enabling the energy transition in Europe's building stock**

*16 May 2019 | 09:30 – 17:30
Fira de Barcelona - Gran Via venue – Av. Joan Carles I, 64
08908 L'Hospitalet de Llobregat – Barcelona*

LIST OF PARTICIPANTS

	Family name(s)	First name(s)	Institution/Organisation
1	Arizankovska	Jadranka	Economic Chamber of Macedonia
2	Artola Maiz	Ekain	Tecnalia Research & Innovation
3	Ayats Reixach	Jordi	Ajuntament d'Olot
4	Ayuso	Patricia	Fundación Laboral de la Construcción
5	Bayliss	Richard	CITB
6	Braun	Bettina	ESN
7	Clerbois	Eléonore	ESN
8	Conserva	Andrea	Fundación CIRCE
9	Corral	Enrique	Fundación Laboral de la Construcción
10	Cromwijk	Jan	ISSO

11	Doktor	Frantisek	ViaEuropa Competence Centre
12	Doktor	Peter	ViaEuropa Competence Centre
13	Dubois	Jin	ESN
14	Dymarski	Piotr	Mostostal Warszawa S.A.
15	Ferrando	Valeria	Integrated Environmental Solutions
16	Garcia	Ramon	Consultoria Empresarial
17	Garcia Audi	Pau	European Commission, DG Energy
18	González López	Javier	Fundación Laboral de la Construcción
19	Hamilton	Andrew	Belfast Metropolitan College
20	Hartleb	Thomas	ESN
21	Hereter	Ramon	PROMERCA
22	Horvath	Roman	European Commission, DG GROW
23	Ivanov	Risto	CREATION, Association of Business and Consultancy



24	Jensen	Anders Brodersen	Danish Transport, Construction and Housing Authority
25	Kapros	Evangelos	Endurae OÜ
26	Karra	Soulla	Cyprus Energy Agency
27	Kolar	Patrick	EASME
28	Kubicki	Sylvain	Luxembourg Institute of Science and Technology
29	Kuzma	Valentina	Chamber of Commerce and Industry of Slovenia - CCIS,
30	Lacourt	Amandine	EASME
31	Legat	Andraz	ZAG
32	Li	Yu	Luxembourg Institute of Science and Technology
33	Lollini	Roberto	Eurac research - Institute for Renewable Energy



34	Maia	Iná	TU Wien
35	Mampaso	Joanne	Universidad Camilo José Cela
36	Martínez	José Pablo	CNC-Confederación Nacional de la Construcción
37	Mccormack	Paul	Belfast Metropolitan College
38	Messenger	Thomas	R2M solutions
39	Moniz	Pedro	ESN
40	Moreno	Anna	ENEA
41	Navarro Escudero	Miriam	Instituto Valenciano de la Edificación
42	Oriol Vico	Mercedes	Fundación Laboral de la Construcción
43	Paron	Emilien	CSTB
44	Pérez Arnal	Ignasi	BIM Academy-WITS Institute
45	Pointelin	Richard	Ajuntament de Girona
46	Ruzafa Millán	Juan	Independent Consultant

47	Sánchez Antúnez	Rosalía	Fundación Laboral de la Construcción
48	Šebek	Václav	SEVEN
49	Stojanovska-Georgievska	Lihnida	University Ss Cyril and Methodius in Skopje, Faculty of electrical engineering and information technologies
50	Sykes	Christophe	Construction Products Europe
51	Tenorio	José	CSIC
52	Toledo	Linda	EURAC Research
53	Trnka	Georg	Austrian Energy Agency
54	Tzanev	Dragomir	EnEffect, Center for Energy Efficiency
55	Vander Kuylen	Katrien	EVERIS
56	Verdaguer	Segis	AIGUASOL
57	Victòria Pujoldevall	Eduard	GNEFINANCE
58	Wagenhofer	Gerald	UBW GmbH
59	Yvars Bravo	Ada	Mangera Yvars Architects

60	Le Marois	Henri	<i>AVE</i>
61	Riqué	Eugénie	<i>EDIFEC. Arquitectura Sostenible</i>
62	Rosios	Evangelos	<i>BIM Academy</i>

An additional 13 people registered directly on site.

