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Build up Skills (BUS) initiative in CZ and SK –

Rebooting the National qualification platforms and Roadmaps towards implementation of nearly Zero Energy Buildings and support for Renovation Wave

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Further information

More details on BUILD UP Skills can be found at www.build-up.ec.europa.eu

More details on the LIFE CET programme can be found at
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Foreword

The construction industry faces challenges like never before. Given that around 80% of existing buildings in the EU will still be in use in 2050 and 75% of buildings in the EU are energy inefficient, their renovation to zero-emission buildings is necessary. Significant challenges are in particular the introduction of innovations, digitalization, integration of renewable energy sources, the high energy consumption of buildings, reduction of greenhouse gas emissions, low labor productivity in the construction sector, high prices of materials, securing the necessary financing for the renovation and construction of buildings from private and public sources and, in last but not least, the lack of qualified labor required to manage these challenges successfully. Since the construction sector has already exhausted the sources of employment growth, its transformation is essential to attract young people to the sector, which will provide them with interesting, motivating and financially attractive work. This requires the cooperation of all actors in the value chain, policy makers, financial and educational institutions.

The DoubleDecker project reflects on these challenges and therefore brought together representatives of all relevant sectors and institutions. Over eighteen months, it brought together a wide range of stakeholders who revitalized the work of the National Qualification Platform (NQP), collaborated on the analysis of the status quo, and subsequently formulated the Roadmap for the years 2025 to 2031, which is presented in this document.

The partners of this project would like to thank the stakeholders who contributed the most to the dialogue within the NQP and expressed their support for the resulting Roadmap. These stakeholders and partners are:

Competent Authorities – national, regional, local

Ministry of Education, Research, Development and Youth of SR

Ministry of Economy of SR

Ministry of Transport of SR

Ministry of Environment of SR

Prešov Self-Government Region

Žilina Self-Government Region

Košický samosprávny kraj

Union of Cities and Municipalities

Secondary and tertiary education institutions

Secondary School of Electrical Engineering, 85101 Bratislava

Secondary School of Electrical Engineering, 84102 Bratislava

Secondary Industrial School Lučenec O. Winklera

Secondary School of Civil Engineering and Geodesy, Košice

Secondary School of Civil Engineering, Prešov

Secondary School of Civil Engineering of Emil Belluš, Trenčín

Secondary School of Civil Engineering, Žilina

Secondary Vocational School of Crafts and Services, Poprad

Secondary Vocational School of Crafts and Services, Bratislava

Secondary Vocational School of Construction, Nitra

Secondary Vocational School of Construction, Žilina

Technical Secondary Vocational School, Prešov

Integrated School, Banská Bystrica

Technical University Košice

Employers

Strabag Pozemné staviteľstvo s.r.o.

Chemkostav a.s.

Proma s.r.o.

BALA a.s.

HORNEX a.a.

Koga Bau s.r.o.

STRABAG s.r.o.

Metrostav a.s. - organizačná zložka Bratislava

VÁHOSTAV-SK a.s.

Representatives of Employees

Integrated Trade Union

Associations of employers

Confederation of Industry Associations and Transport

National Confederation of Employers

Professional Associations, Guilds, Clusters, and other stakeholders

Friends of Earth-CEPA

Slovak Green Building Council

Roofers' Guild

Energy cluster

Chamber of Geodesy and Cartography

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1. Executive summary

In a survey conducted for the status quo analysis, **100% of firms** reported that they experience chronic labour shortages in key occupations. Although the result for individual occupations or groups of occupations varies considerably, it can be concluded that the shortage of workers in the sector is perceived to be acute challenge. This is caused by the retirement of the older generation already announced in 2013 (in the BUS SK status quo analysis), for which the construction sector has had no replacement, as a strong enough generation of middle-aged craftsmen has not been created, as not enough young craftsmen have been added to the sector over the last 20 years.

On the other hand, according to a recent study commissioned by the government, **only 9% of graduates from construction vocational schools at secondary and tertiary level find employment in the construction sector** and the rest leave for other sectors. Although the 9% figure has often been questioned by the cited schools during discussions on the status quo analysis, even an estimate of 20% is still too low to make a difference.

In addition, it should be noted that the demographic trends in Slovakia do not allow for further increases of the number of new pupils entering these schools and the **number of new pupils has been steadily declining** while the average age of the population increased.

It follows that the main problem of the construction sector is the **low ability to retain young people** in the sector, especially graduates of vocational schools at the secondary level.

It must therefore be concluded that **the extensive sources of employment growth in the construction sector have been exhausted** and no increase in employment can be expected in the future without qualitative changes in the construction techniques used and the new professions created by them, which will be attractive to young people.

The need to meet these, and other external challenges detailed in the roadmap, is leading to changes in the construction sector towards industrial construction production, much of which will take place off-site (**off-site construction**). For this reason, many new (new or old in the industry but new to construction) technologies are beginning to make their way into the construction sector and their clusters are enabling further developments in construction techniques.

As we expect rather **revolution** than a slow evolution in the construction sector, the role of continuing education will increase, and it is only logical that the collaboration and **symbiosis of formal and continuing education** can provide an effective tool to ensure qualified professionals for the construction industry with the required skills, knowledge, and competencies.

The status quo analysis showed that the biggest obstacle to the introduction of innovative educational concepts is the **lack of state funding for vocational education schools**. This lack of funding is an insurmountable obstacle to the development of education in terms of needs in the horizon of 2035. It should be stressed that insufficient funding limits the ability of schools to provide even the currently necessary material and technical provision and to keep pace with current changes. The next biggest obstacle related to funding vocational education at secondary level is **the lack of teaching and professional staff** due to low interest to work in education sector due to insufficient financial remuneration.

Based on these results, the roadmap adopted **10 recommendations addressed to the Government of the Slovak Republic** and to the regional governments that are the founders of vocational education schools at secondary level. These recommendations/measures are detailed in Section 6 (scope, target groups, time frame, costs, et.).

Table 1

No.	Recommendation/Measure	Implementation time frame
1	Update existing and create new fields of study to adapt the fields to technical progress and the needs of the transformation of the construction sector	2024-2026
2	Support scholarships for pupils in disciplines that are in short supply and needed to cope with the current changes resulting from European and international agreements.	2024
3	State support for the creation of new educational programmes for pupils and adults.	2024-2026
4	Government support for companies involved in the education process.	From 2024
5	Providing additional training for teachers on the new skills requirements.	From 2024
6	Making the teaching profession more attractive and creating the conditions for a significant increase in the interest of young people and professionals in the teaching profession	2024-2025
7	Review and increase the financing of schools and material and technical provisioning, to create a network of schools with a smaller number of schools, which will be supra-regional and specialised in the construction sector, so that they are provided with the required material and technical provision.	2024-2025
8	Ensuring effectively sufficient data collection on the education system needed for its management, including the employability of graduates	2024-2026
9	Creation of national campaigns on the employability of education in the construction sector and systematic promotion of the sector by the state in the media	2024-2028
10	State support of continuing education scheme	From 2025

In terms of the Recommendation No. 5 and to ensure implementation of other recommendations and measures, the professional training of pedagogical staff for vocational education and training (VET) will be necessary. According to the Status Quo Analysis, it will be necessary to train/retrain an adequate number of trainers/pedagogues for VET schools according to the following table:

Relevant groups of education disciplines	2023	2024	2025	2026	2027	2028	2029	2030

36 – Construction, geodesy and cartography	120	120	120	60	60	60	60	60
26 – Electrical engineering	50	15	15	15	15	15	15	15
33 – Woodworking	25	15	15	15	15	15	15	15

The industrialisation of construction production and the adaptation of the construction sector to the Industry 5.0 concept will inevitably have an impact on skills, knowledge and competences. Many of the future skills requirements will be **more adaptable and digitally focused**.

However, the construction industry will need to adapt and **attract people from other backgrounds such as strategists, cognitive and systems thinkers, data analysts, data-driven researchers, digital operators, and robotic programmers**, although the use of generative AI will bring further dramatic changes to the field, which only underlines how rapidly changing conditions, and the resulting skills requirements will be faced by employers and educational institutions.

There will also be an increasing demand for socially oriented skills, with the ESG agenda leading to a focus on sustainability in structural design and manufacturing techniques, as well as a more people-oriented skills base. This will mean new team types, new roles and new skills for existing roles that need to be sought from the best available talent. **In the future, talent, more than capital, will represent the critical factor of production.**

New professions at EQF level 3-5 and new roles within existing professions will include, for example:

- Information Processing Manager/Operator (EQF 4-5);
- Robot Operator (EQF 3-4);
- Digital Collaboration Operator/Specialist (EQF 3-5);
- Cybersecurity Specialist (EQF 5);
- Value Engineering Specialist (EQF 5);
- Smart Building Specialist (EQF 5);
- Artificial Intelligence Application Manager (EQF 5);
- Building installation technician/operator in modular construction (EQF 4-5);
- Construction drone operator (EQF 3-4);
- Planner for smart energy systems with flexibility management (EQF 5);
- Operator/integrator for smart energy systems (EQF 4-5);
- **Operator and other occupations in industrial construction production** (EQF 3-5).

For example, the **new required skills, knowledge, and competences** include:

- Cognitive and systems thinking;
- Programming;
- Data-driven decision-making;
- Complex problem solving with excellent communication skills;
- Modelling and simulation;
- Internet of Things (IoT);
- Computer visualisation;
- 3D printing;
- Circularity in construction;

- Data analytics, Artificial Intelligence (AI) and BIM;
- Prefabricate and module manufacturing in industrial construction;
- Working with robotic resources and drones;
- Integration of energy sources and sectors in smart energy systems;
- Extended reality (XR), including augmented reality (AR), virtual reality (VR) and mixed reality (MR);
- Integration skills, etc.

Professionals with these and other skills, knowledge and competences will work in the following teams, which are already taking shape and **two important stages** that the Slovak construction industry will have to go through will be important for their evolution:

- The **first stage by 2030**, when there will be two environments in which they will work - on-site and off-site production;
- The **second stage 2030-2035**, when integrated industrial construction will have already been formed.

Based on the lessons learned and the dialogue with the members of the NQP, measures were proposed to implement the adopted strategy and the roadmap steps, including the timeframe and the proposed topics to be covered by the new continuing education programmes, updated and new courses of study in vocational education and training at secondary level. The details are provided in Section 8 of the roadmap (scope, topics to be covered, costs, included apprenticeships, multidisciplinary skills and knowledge covered, time frame, target groups, entry requirements, etc.).

Table 2

No.	Measure/Projects	Implementation time frame
1	Zero emission buildings, carbon neutrality, and circularity of buildings.	2024-2026
2	Integration of decentralised energy assets and management of flexibility.	2026-2028
3	Integration of XR off and on construction site, and in education.	2027-2029
4	Industrialised construction and Industry 5.0.	2029-2031
5	Adaptation of education curricula to cross-trades.	2024-2025
6	Updating education curricula for vocational education at secondary level to technical progress in digital technologies in construction sector and regenerative cycle of buildings.	2026-2029
7	Updating education curricula for vocational education at secondary level to Industry 5.0 and industrial construction.	2029-2031
8	Launch of the updated curricula for vocational education at secondary level – phase one.	2028-2031

This implies the different steps in education and their synchronisation with the proposed measures illustrated by the following graph:

Milestones of the BUS SK Roadmap



2. Introduction

As a result of the structural changes triggered by the implementation of Industry 4.0 and Industry 5.0, as well as new requirements in the fields of energy efficiency, renewables, new learning methods, new even more ambitious climate and energy targets, there is a critical need to update the core documents of the Build Up Skills (BUS) initiative. A national analysis of the status quo has been produced as a background document for the development of the draft measures of this national roadmap.

The status quo analysis has highlighted several shortcomings in the assessment of the results achieved to date in improving the energy performance of buildings, and we have focused on assessing the contribution of building renovation to growth in the construction sector. On the basis of the very favourable assessment of the performance of building renovation so far by the responsible authorities, also taking into account the results of the audit of the Supreme Audit Office (audit in the field of public buildings), it can only be concluded that building renovation will not contribute significantly to growth in the construction sector in the future, as it did in the years assessed as very intensive in this field. Thus, according to official figures, flats and apartment blocks should be renovated by 2029 and family houses by 2040.

This also stems from the National Energy and Climate Targets of the Slovak Republic (SR) until 2030, which are based on the European-wide energy and climate targets set out in the Integrated National Energy and Climate Plan 2030, which is an update of the Energy Policy of the Slovak Republic approved by Government Resolution No. 548/2014 of 05.11.2014. Compared to the European Union (EU), the Slovak Republic has not defined its own targets for the key indicators for the reduction of greenhouse gas emissions and emissions in the sector covered by the Emissions Trading Scheme (ETS). For non-included sectors and for the use of renewable energy sources, Slovakia has set softer targets than the EU.

According to the Construction Yearbook 2022 published by the Statistical Office of the Slovak Republic, out of the total number of 160 910 employees employed in the construction sector in the Slovak Republic, about 88% worked as self-employed or employees of small businesses. From this perspective, small and medium-sized businesses in the construction sector occupy a significant position and it is assumed that such an organisational structure will be supported in the future.

Small businesses accounted for the largest share of construction output of around 50% in 2021 (a 36% increase in output from 2017), with this share rising steadily over the period 2017 to 2021.

The latest data available to the partners shows that there are 969 360 family houses in Slovakia (1 008 795 dwelling units in total, 45% of which have been renovated) and 64 846 apartment buildings (931 605 dwellings in total, 68% of which have been renovated). There are 15 435 public buildings.

There were 6 846 pupils and 1 925 graduates in vocational education in secondary schools (construction, building production, bricklayer, plumber) in the school year 2021/22. Although these figures are relatively high, a study carried out by Trexima has shown that only 9% of graduates will be employed and remain as workers in the construction sector. Although this figure has often been disputed and estimates of stakeholders have ranged between 20-30%, even such a figure is low and signals the unsustainability of the current situation. Therefore,

the focus of the construction sector is on retaining tradespeople in the industry rather than increasing the number of apprentices.

However, a targeted and significant increase in the number of pupils is needed in qualifications related to the implementation of renewable energy sources (especially solar and wind energy) and the replacement of gas boilers with heat pumps. Installers of heat pumps and renewable energy sources (RES) are trained in vocational secondary schools in the fields of building energy equipment technician, electromechanics-refrigeration and heat pump technician and installer. In 2022 there were 1 370 pupils studying in the above-mentioned fields and 378 graduates in the school year 2021/22. However, the number of students in these fields is limited by the secondary school founders (they decide on new and existing fields of study and the number of students who can be admitted to the first year for specific fields), despite the high need for apprenticeships and interest in recent years, in some cases the numbers have even been reduced.

In the field of education of installers of renewable energy sources in accordance with Directive 2009/28/EC, accredited training courses for installers have been implemented in Slovakia since 2011 as part of the system of further and continuous education. As of 30 June 2023, a total of 743 heat pump installers, 162 biomass boiler and furnace installers, 2261 photovoltaic and solar thermal system installers and 124 photovoltaic system installers have been certified for more than ten years. However, their numbers currently appear insufficient for a wider campaign to make substantial progress in replacing carbon-based sources for heating and hot water with heat pumps or RES to reverse their under-utilisation in the building energy mix. Slovakia is at the tail end of the EU in this area, despite having to import 95% of its gas from Russia, 75% of which is burned in buildings, mainly for heating and hot water. This situation is worrying.

We see increased pressure to transform the construction sector and the need to introduce innovative changes and approaches and the need to increase labour productivity. Productivity in the construction sector is the second lowest after agriculture. This is mainly due to a lag in the uptake of innovation and digitalisation. The evolution of the workforce is influenced by demographic developments (ageing population, increase in the representation of older age groups in the construction sector and outflows due to retirement and a reduced share of young people under 29 years of age) and the evolution of labour market needs. The findings of the status quo analysis also confirm the mismatch between current labour supply and developments in terms of the number of graduates in relevant fields of study and knowledge and skills and preparedness for new challenges and innovative trends and labour market needs in terms of both quality and quantity. According to the results of our survey, there is a shortage of skilled labour in Slovakia for up to 100% of employers in the sector. It is a combination of many factors that influence the interest in studying construction disciplines and consequently the availability of skilled workers in the sector.

One of the main barriers in overcoming the shortage of skilled workers identified by employers is a lack of interest in studying the construction trades. The analysis showed a low interconnection between the study of construction and practical training in companies, a lack of cooperation between the education system and the real needs of the labour market. The attractiveness of employment in the construction sector and the lack of awareness of the prospects were identified as one of the other main reasons for the shortage of skilled workers.

It is therefore necessary to anticipate a critical situation in the building sector in the 2035 horizon and therefore the building sector must undergo a necessary transformation to manage the rehabilitation of a significant part of the current building stock and to provide for new construction based on demographic developments.

To do this, it will be necessary to transform vocational education, to promote new approaches, methods and technologies in education and the assessment of learning outcomes, thus anticipating not only the needs of the labour market, but also the new social needs that will increasingly be at the centre of attention.

The status quo analysis showed that the biggest **obstacle** to the introduction of innovative education concepts is the lack of **funding** for vocational education schools and other support from the government. Therefore, the Roadmap formulated ten recommendations in Chapter 5 addressed to the government and to the higher territorial units (VÚC), which are the founders of vocational secondary schools.

The present Roadmap aims to build a system of continuing education, which must be more intensive than the continuing education addressed in the previous Roadmap. This increased intensity of training stems from the defined needs for kick-starting the transformation of the construction sector and the need for entirely new training programmes to help develop curricula in vocational secondary schools. The symbiosis of these two forms is justified and described in Chapter 4, which explains the general strategy. Specifically, the roadmap focuses on the EQF 3-5 levels of the European Qualifications Framework (EQF/EQF 3-5), as higher education curricula have already undergone the necessary modernisation, as demonstrated by colleges and universities in the preparatory discussions for the DoubleDecker project. Further training in this area has been kick-started thanks to the IngREeS project, which has provided the necessary resources for further training so far. At the same time, universities and colleges have contributed significantly to the discussion on the roles and focus of vocational training in secondary schools and are also very interested in participating in the implementation of the plans, including the retraining of secondary school teachers.

Existing professions will be addressed by a forthcoming project of the State Institute of Vocational Training (ŠIOV) with an expected budget of up to €100 million, while the project will add the necessary equipment to the training centres set up alongside secondary vocational schools. Build Up Skills (BUS) projects have provided the training resources developed for this project (curricula, teaching texts, qualification, and assessment standards for 32 professions relevant to building renovation). By working closely with vocational secondary schools, these schools will be effective facilitators of know-how transfer in this initiative of the Recovery and Resilience Programme.

The new professions and new roles for existing professions that are the focus of this roadmap, as well as the relevant skills, knowledge, and competences, are presented in Chapter 6, and the individual actions, their content and timing are explained in Chapter 7.

In terms of the current processes of adjustment in the education sector, we will be able to welcome the first graduates for the roles/professions equipped with the necessary skills, knowledge and competencies to our workplaces in 2030 at the earliest if we start working on this intensively right away, which will have an impact on the timeframe of the transformation

of the construction sector. The development of further education and work on a system of continuous learning must be adapted to this.

The roadmap and the work on it is the result of a comprehensive effort of partners and a large number of stakeholders of the National Qualification Platform (NQP), made up of representatives of the government, trade and professional organizations, secondary and higher education institutions, representatives of construction companies and employers in the construction sector in joint meetings and workshops. Their specific suggestions and comments were incorporated, and they actively participated in the discussions in the search for proposals for the various measures in the roadmap. The findings of the National Status Quo Analysis (SQA) were the starting point for the elaboration of the proposals for measures of this Roadmap, which could strategically guide the development of education for the construction sector and thus support it in its efforts to meet the objectives of the European Green Deal and the related Renovation Wave and other initiatives.

3. 2030 targets:

Slovak Republic has set the following targets for 2030 and is guided by the following key principles to meet these targets:

- Consistently apply green procurement principles to all energy efficiency measures, with an emphasis on energy consumption and emissions throughout the life cycle of the measure.
- Increase the achieved energy savings in the renovation of buildings from 30% to 60%, as the renovation of buildings is the most cost-effective and efficient measure, also according to the Low Carbon Study for Slovakia prepared in cooperation with the World Bank. In the short term until 2030, according to the Strategy, building renovation policy is the most important source of potential energy savings.
- Increase the pace of renovation of public buildings and family houses.
- In the renovation of public buildings, promote in particular the in-depth renovation of the building, in accordance with the principles of green public procurement.
- Setting up financial support mechanisms from the EU and the Slovak Republic so that they can finance in-depth renovation of public buildings and create the necessary opportunities for financing the renovation of buildings in the Bratislava region in accordance with the principles of green public procurement.
- Establish multi-source financing for regional development, so-called regional development funds, which would enable the financing of decarbonisation measures in the relevant regions (forms of financing ranging from grant to revolving financing, not only from EU resources and the relevant co-financing, but from all sources, both public and non-public).
- Promote the establishment of regional sustainable energy centres and subregional energy centres that would provide support and advisory services at regional and subregional level to increase energy efficiency and the share of RES.
- Encourage the improvement of the expertise of planners and construction companies with a focus on in-depth renovation of buildings.
- Promote the improvement of the energy efficiency of buildings through measures implemented in the heating and cooling sector aimed at decarbonising the supply of heat to buildings from district heating and cooling systems. Promote only efficient district heating (DH) systems with heat supply from RES, waste heat from industrial and energy processes, based on economically cost-effective use of RES, e.g. also locally available biomass/biomethane and waste.
- Modernise existing DH systems in the area of thermal energy.
- Introduce new district heating systems in a cost-effective way in valleys and basins with increasing deployment of RES in the systems.
- Expansion of the energy efficiency monitoring system operated by the Slovak Innovation and Energy Agency with the aim of creating a single database centre covering both the private and public sectors of building renovation, including an overall overview of public buildings in the Slovak Republic.
- Use of innovative financial mechanisms (green bonds and green vouchers, energy saving audits, guaranteed energy services, auction system for energy purchases, soft loans

through revolving funds, bonus-malus financial mechanism, mortgages with preferential rates for energy-efficient buildings).

- Installation and deployment of smart metering systems in energy systems and installations, including gas distribution and supply (where the benefit to the consumer demonstrably outweighs the cost of deploying the systems).
- Consistently apply the "polluter pays" principle.
- End environmentally damaging subsidies, such as support for coal or for biomass from unsustainable sources.
- Set the rules for drawing funds from financial support mechanisms from the EU and the Slovak Republic in the field of energy efficiency so that the energy sector is also eligible to draw subsidies for investments that demonstrably reduce greenhouse gas emissions.
- Support of ESCO (Energy Service Company) companies as providers of energy services with guaranteed savings for the public sector called EPC (Energy Performance Contracting) and support in the form of Guaranteed Energy Services under Act No. 321/2014 Coll. on Energy Efficiency.
- Encourage the development of heat pumps for heating and cooling by creating financing instruments to increase the accessibility of heat pumps also for low-income groups.
- In order to increase the energy efficiency of buildings, to take care of the active application of passive elements and passive technologies in the building, i.e. to focus on the reduction of heat transfer through the envelope and roof cladding (by applying elements of climatic, energy-active applications), as well as solutions using nature, such as well-planned greenery in the streets, parking lots (which would serve as climatic and energy-active areas), green roofs and walls providing thermal protection and shade to the buildings.
- As part of the update of the Low Carbon Development Strategy 2030 with a view to 2050, consider introducing a target for the entire buildings sector (whether for 2030 or 2040 or 2050) that would be consistent with achieving climate neutrality in 2050.
- The need for education, information and awareness raising for the general public on the need for additional measures in this sector.

4. General Strategy

In a survey conducted for the status quo analysis, **100% of companies reported that they lack workers in a key area**. The resulting Graph 1 summarizes the results of this survey. Although the result for individual occupations or groups of occupations varies considerably, it can be concluded that the shortage of workers in the sector is perceived to be acute. This is caused by the retirement of the older generation which was already reported in 2013 (in the BUS SK status quo analysis), for which the construction sector had no replacement, as a strong enough generation of middle-aged craftsmen has not been created, as not enough young craftsmen have been added to the sector over the last 20 years.

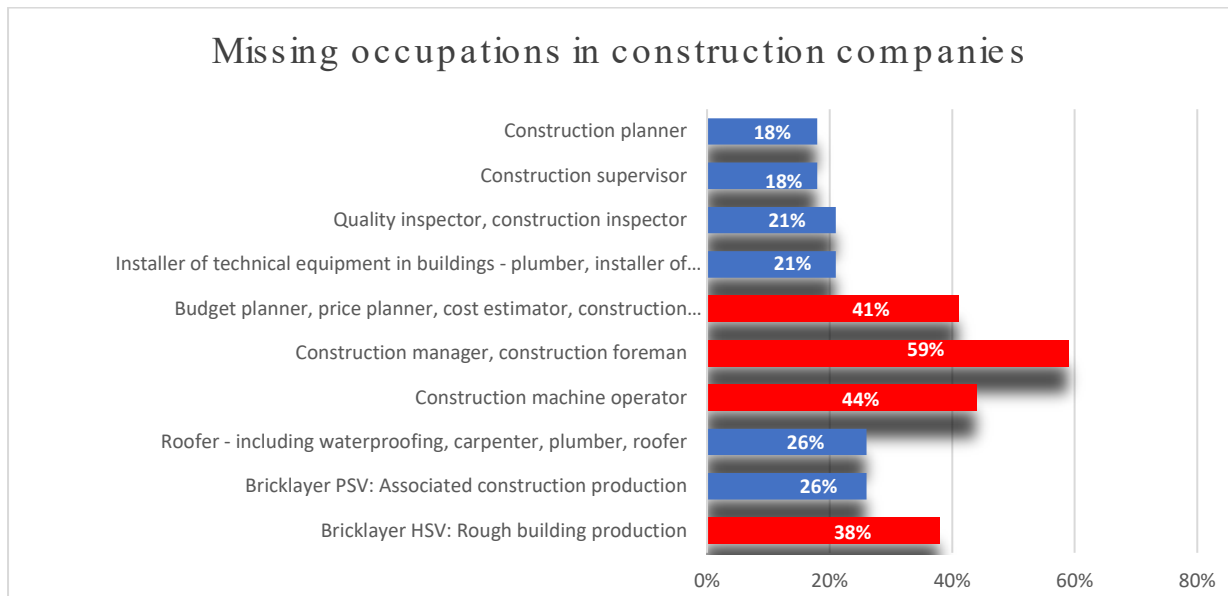
On the other hand, according to a study by Trexima done for the needs of the public administration, only 9% of graduates of secondary schools and universities in the field of construction, geodesy and cartography find employment in the construction sector and the rest leave for other sectors. Although the 9% figure has often been questioned by the cited schools during discussions on the status quo analysis, even a consideration of 20-30% is still not enough to maintain the status quo. This trend is similar abroad and is not specific to Slovakia.

It should be noted that the demographic development in Slovakia does not allow further increase of new pupils in these schools, as the average number of new pupils entering schools is constantly decreasing while the average age of the population is increasing.

This shows that the main problem of the construction sector is the low ability to retain young people in the sector, especially secondary school graduates, according to Trexima statistics, but also university graduates.

It must therefore be concluded that the extensive sources of employment growth in the construction sector have been exhausted and no increase in employment can be expected in the future without qualitative changes in the construction techniques used and the new professions created by them, which will be attractive to young people.

These inevitable qualitative changes are also triggered by the external environment in which the construction sector operates. Low labour productivity, which has more or less stagnated and grown only marginally over the last 20 years, is leading to an already prohibitive rise in the cost of obtaining and maintaining housing for households, and Slovakia, like Ireland for example, is facing a massive outflow of young people abroad, which is not only exacerbating demographic developments but is already threatening the country's economic growth, the sustainability of the social system, old-age pensions and quality of life. These consequences will, in the short term, lead to social instability, which will inevitably lead to political instability. It therefore requires the attention of political leaders and education experts alike.



Graph 1-Missing occupations in construction companies

Increased labour productivity depends on the introduction of innovations. These innovations are also essential for the adaptation of the construction sector to the changes in the supplier sectors that have already mastered the introduction of Industry 4.0 concepts and have successfully advanced in the implementation of Industry 5.0 concepts, the main pillars of which are:

- Full digitisation of the sector;
- Symbiosis of humans and robots in the workplace;
- Focusing solutions on people;
- Environmental and social sustainability.

The construction sector has so far been little affected by innovation compared to other sectors such as the electronics, IT, automotive sectors, which have radically changed the way their sectors operate, the quality and the way they meet customers' needs, with declining nominal prices or little increase compared to a substantial increase in value for the consumer.

The main reasons for this resistance to innovation were the outdoor-focused nature of the work being carried out and the fact that most of the actual construction takes place on the site that the building will occupy, with a large amount of construction from an assembly of parts and materials on site, limiting the use of fabrication methods and economies of scale that have long been the norm in other sectors.

At the same time, the construction sector will have to face important challenges in the short term:

- **Urbanisation**, as the rate of people moving to cities will continue to be high as people are attracted by the promise of better services, accommodation and job opportunities compared to rural areas. By 2050, around 500,000 new buildings will need to be built in the EU per year, **increasing pressure on the speed and scale of construction**. Demographic developments characterised by an ageing population will continue to have a major impact on the development of the construction sector. This will have a

major impact on building requirements. More healthcare facilities will be needed and the requirements for public transport and its supporting infrastructure will change.

- **The labour shortage** will continue to be keenly felt and the **solution cannot be to hope for more applicants** for careers in the construction sector, but to accelerate the introduction of robotics and automation, supported by the full digitisation of the sector.
- **The changing demands of consumers**, who will expect the construction sector to follow the path of other consumer-oriented industries that are creating networked capacities capable of mass-producing low-cost products with a high ability to meet specific customer requirements (**mass customisation**).
- **Increasing requirements for decarbonisation of buildings**, which have to adapt to the transformation to a high share (gradually up to 100%) of renewable energy, requirements for zero-emission buildings, for energy self-sufficiency of buildings and contributing to the balancing of energy networks at the level of housing estates, neighbourhoods and cities.

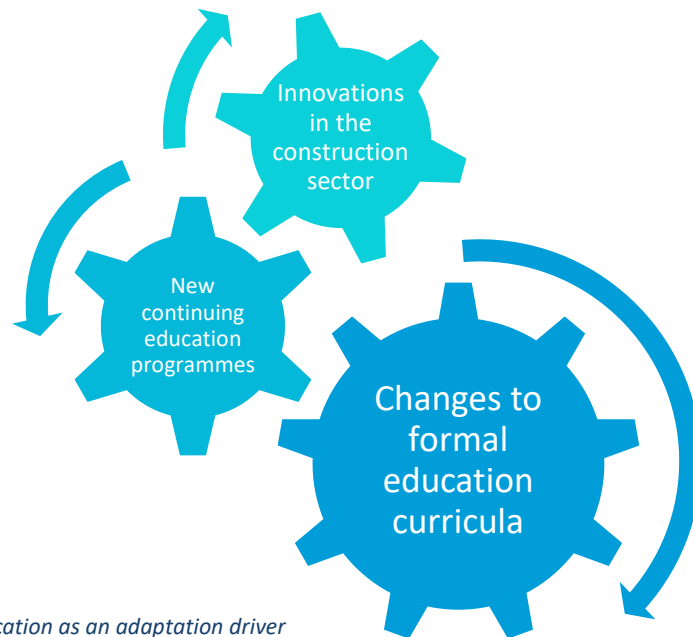
The need to meet these challenges is leading to changes in the construction sector towards industrial building production, which will be largely **off-site construction**, with buildings being assembled on site. Industrial building production combines attributes from: n-dimensional BIM (nD BIM), with a common data environment (CDE) and digital twins. It covers five key trends:

- (1) Big data, artificial intelligence (AI) and predictive analytics;
- (2) Robotics and automation;
- (3) Prefabrication and off-site construction;
- (4) Internet of Things (IoT);
- (5) Additive manufacturing techniques (3D printing).

For this reason, many new (new or old in the industry but new to construction) technologies are beginning to make their way into the construction sector and their clusters are enabling further developments in construction techniques.

For this reason, the role of continuing education will increase and it is only logical that the **collaboration and symbiosis of formal and continuing education can provide an effective tool** to ensure that the construction sector has skilled professionals with the required skills, knowledge and competencies. Continuing education can be a tool for the rapid recognition of future requirements for skills, knowledge, and competences. Its flexibility allows the necessary training programmes to be developed quickly to fill emerging gaps in the labour market. Close cooperation between employers and vocational secondary schools will translate this signal in the new demands of the construction sector into the design of formal education curricula. Cooperation between employers and vocational schools in the provision of continuing education will increase its professionalism and quality, which will clearly benefit employers.

This symbiosis, as the driving force behind the continuous adaptation of education to the new demands of the construction sector brought about by innovations in construction techniques, is illustrated in the following graph:

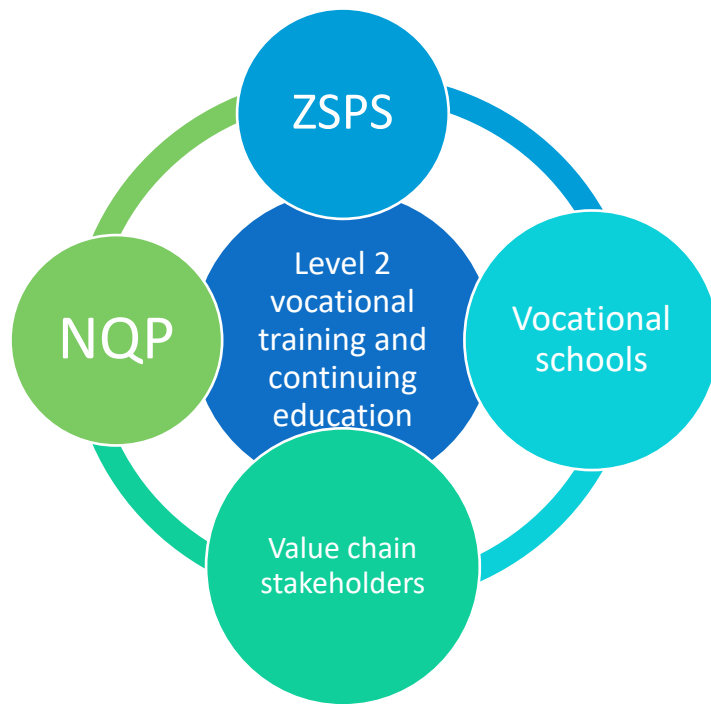


Graph 2- Continuing education as an adaptation driver

The creation of new continuing education programmes must go hand in hand with **intensive training of trainers - teachers in secondary vocational schools**. This training should be recognised as part of the professional education/professional development of teachers. This will increase the motivation of educators to acquire new knowledge in the field, which is essential for the effective preparation of students for careers in the reformed construction sector.

The overall strategy will therefore be built on the cooperation of 4 main stakeholder groups:

- The Association of Construction Entrepreneurs of Slovakia as the main sectoral employers' organisation, which will ensure the sustainability of the dialogue and stakeholder cooperation.
- The National Qualifications Platform (NQP), bringing together training institutions and providing a forum for dialogue between training institutions and employers, employee representatives and other relevant stakeholders.
- Secondary Vocational Schools (SOŠ) (state-run) providing formal education at secondary level as guarantors of continuing education.
- Stakeholders in the value chain, bringing together suppliers to the construction sector throughout the building lifecycle, who influence developments in construction techniques and hence the skills, knowledge, and competence requirements of the construction sector.



Graph 3-Overall strategy

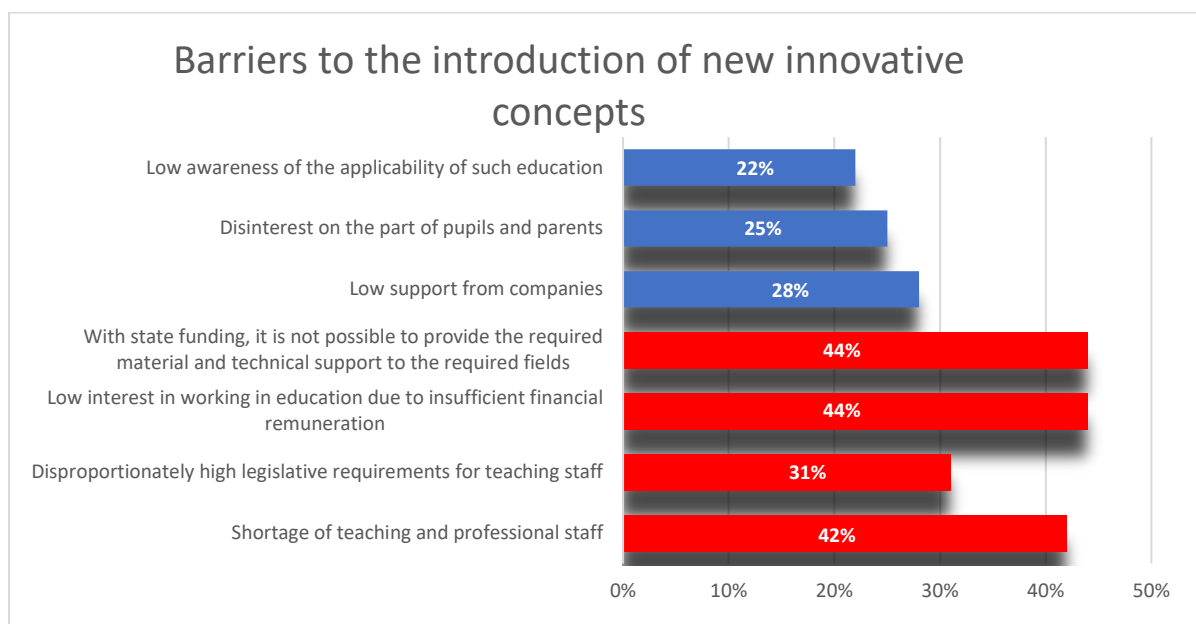
5. Recommendations for the Slovak government and Regional governments

The Status Quo Analysis (SQA) showed that the biggest **obstacle** to the introduction of innovative educational concepts is the lack of state **funding** for vocational education schools. It is not sufficient to provide the required modern technical facilities. This lack of funding is an insurmountable obstacle to the development of education in terms of needs in the horizon 2035. It should be recalled that education and training for employment is, among other things, guaranteed by the Constitution of the Slovak Republic. If we put this fact in the context of repeatedly unspent EU funds, it is difficult to explain why schools do not have everything they need, even in a sector that is key to achieving climate neutrality by 2050 (although the Slovak Government should be able to cover these needs from its own resources, as European taxpayers cannot be expected to contribute indefinitely to ensuring constitutional rights in Slovakia).

It should be stressed once again that **insufficient funding** limits the ability of schools to **provide even the necessary material and technical support** and to keep up with current changes. Modern technical equipment is an essential part of the educational process in the construction sector, enabling pupils to gain practical experience and to become familiar with current technologies and practices.

Another major obstacle related to the financing of secondary vocational education is the **shortage of teaching and professional staff** due to low interest in working in the education sector because of **insufficient financial remuneration**. These are the factors that hinder schools from recruiting qualified teachers, vocational masters as well as school principals. Insufficient financial remuneration discourages experienced professionals from pursuing a career in education and focusing on more financially attractive job opportunities. This situation consequently has an impact on the quality of teaching and training, in terms of reduced motivation and reduced interest in working in an environment with inadequate financial rewards. This also has an impact on the lack of interest in updating knowledge and skills on the part of teachers and results in an unfavourable generational structure of the teaching staff.

Other survey results that were used are summarised in the following graph.



Graph 4- Barriers to the introduction of new innovative concepts

Based on these results, the Roadmap adopted the following recommendations addressed to the Government of the Slovak Republic (SR) and to the higher territorial units that are the founders of vocational secondary schools:

Table 3

Recommendation No. 1
<p>Name of the Recommendation:</p> <p>Updating of existing and creation of new fields of study in order to adapt the fields to technical progress and the needs of the transformation of the construction sector</p>
<p>Content of the measure (brief description of the issue):</p> <p>The transformation of the construction sector towards industrial building production, which will be largely carried out off-site with buildings being assembled on site, places new demands on skills, knowledge and competences. Industrial construction manufacturing encompasses five key trends:</p> <ol style="list-style-type: none"> (1) Big data, AI and predictive analytics; (2) Robotics and automation; (3) Prefabrication and off-site construction; (4) Internet of Things (IoT); (5) Additive manufacturing techniques (3D printing). <p>For this reason, it is necessary to revise existing curricula and develop new curricula to meet new roles in existing professions and entirely new emerging professions in the construction sector. Examples of these professions and new roles include:</p> <ul style="list-style-type: none"> • information manager; • robot operator;

<ul style="list-style-type: none"> • digital collaboration; • cyber security; • value engineering; • AI architect; • building assembly technician; • construction drone operator; • operator and other occupations in industrial construction production. <p>For example, the new required skills, knowledge and competences include:</p> <ul style="list-style-type: none"> • cognitive and systematic thinking; • programming; • active approach to further education; • data-driven decision-making; • Complex problem solving with excellent communication skills; • data analysis, artificial intelligence (AI) and BIM; • production management in industrial construction; • modelling and simulation; • management of robotic resources and drones; • Internet of Things (IoT); • computer visualisation; • 3D printing; • Extended Reality (XR), including Augmented Reality (AR), Virtual Reality (VR) and Mixed Reality (MR); • integration skills, etc. 	
<p>Target group:</p> <p>Operators and specialists, EKR/EQF 3-5</p>	<p>Implementation timetable:</p> <p>2024-2026</p>

Table 4

<p>Recommendation No. 2</p>	
<p>Name of the Recommendation:</p> <p>Support scholarships for pupils in disciplines that are in short supply in the country and needed to cope with the current changes resulting from European agreements.</p>	
<p>Content of the measure (brief description of the issue):</p> <p>In order to increase the percentage of graduates who remain in the construction sector after secondary vocational training, it is necessary to motivate pupils already during their vocational training in the form of scholarships.</p>	
<p>Target group:</p> <p>Operators and specialists, EKR/EQF 3-5</p>	<p>Implementation timetable:</p> <p>2024</p>

Table 5

<p>Recommendation No. 3</p>	
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Name of the Recommendation: Government support for the creation of new educational programmes for pupils and adults.	
Content of the measure (brief description of the issue): The transformation of the construction sector will require a major change in existing study programmes and the creation of new ones. These programmes not only concern pupils in preparation for the profession but also the retraining of adults in continuing education programmes. This scope of work and focus on the latest knowledge in the sector will require experts to work with stakeholders. The government needs to support this work financially and organisationally. It can also make use of EU funds, which are part of the operational programmes.	
Target group: Operators and specialists, EKR/EQF 3-5	Implementation timetable: 2024-2026

Table 6

Recommendation No. 4	
Name of the Recommendation: Government support for companies involved in the education process.	
Content of the measure (brief description of the issue): The construction sector is characterised by a high proportion of micro, small and medium-sized enterprises, which do not have the opportunity to engage in the training process without financial support from the government. Since their input into education by providing know-how and taking on apprentices for practical training is irreplaceable, it is necessary to facilitate their involvement through cost recovery and possible additional benefits.	
Target group: Small and medium sized enterprises in construction sector	Implementation timetable: 2024

Table 7

Recommendation No. 5	
Name of the Recommendation: Providing additional training for teachers on new requirements.	

Content of the measure (brief description of the issue):	
<p>The adaptation of existing and the creation of new curricula and continuing education programmes must go hand in hand with intensive training of trainers - teachers in secondary vocational schools. This training should be recognised as part of the professional education/professional development of teachers. This will increase the motivation of educators to acquire new skills and knowledge in the field, which are essential for the effective preparation of students for careers in the reformed construction sector.</p>	
Target group:	Implementation timetable:
Teaching and professional staff of secondary vocational schools	2024

Table 8

Recommendation No. 6	
Name of the Recommendation:	
<p>Making the teaching profession more attractive and creating the conditions for a significant increase in the interest of young people and professionals in the teaching profession.</p>	
Content of the measure (brief description of the issue):	
<p>Secondary vocational schools are struggling with a shortage of teachers and the rising average age of current staff. It is therefore necessary to attract new young teachers into vocational education so that the age structure of the teaching staff is sustainable in terms of the need to continuously respond to new demands of practice.</p> <p>However, average starting salaries for secondary school teachers lag behind not only all EU Member States, but also candidate and associated countries. According to Eurostat, Slovakia ranks second worst with its average starting salaries in secondary schools, just behind Albania. Such starting salaries are un motivating and have stopped the inflow of young teachers into schools.</p>	
Target group:	Implementation timetable:
New teaching staff at secondary vocational schools	2025

Table 9

Recommendation No. 7	
Name of the Recommendation:	
<p>Change in the method and amount of financing for schools and material and technical provisions, so as to create a network of schools with a smaller number of schools, which will be supra-regional and specialised in the construction sector, so that they are provided with the required material and technical provisions.</p>	

Content of the measure (brief description of the issue):	
<p>The status quo analysis showed that the biggest obstacle to the introduction of innovative educational concepts is the lack of state funding for vocational education schools. It is not sufficient to provide the required modern technical equipment. This lack of funding is an insurmountable obstacle to the development of education in terms of needs in the horizon 2035. It should be recalled that education and training for employment is, among other things, guaranteed by the Constitution of the Slovak Republic and the role of the State in its financing is unmistakable.</p> <p>The creation of a network of schools with a smaller number of schools that are supra-regional and specialised in the construction sector will facilitate a more efficient use of financial resources to meet current and future demands for skills, knowledge and competences in the construction sector.</p>	
Target group:	Implementation timetable:
Secondary vocational schools in the construction sector	2024-2025

Table 10

Recommendation No. 8	
Name of the Recommendation:	
Ensuring effective and sufficient data collection on the education system for its management, including the employability of graduates.	
Content of the measure (brief description of the issue):	
<p>Good quality and reliable data is needed for effective planning and programming of education, not only in the construction sector. It is therefore important to ensure that it is collected, processed and made available to the public. In view of the Statistics Act, such data collection and processing is the exclusive responsibility of the government.</p>	
Target group:	Implementation timetable:
Pupils in secondary vocational schools, employers' needs in terms of graduates by study programmes in secondary vocational schools	2024-2026

Table 11

Recommendation No. 9	
Name of the Recommendation:	
Creation of national campaigns on the applicability of education in the construction sector and systematic promotion of the sector by the state in the media.	

Content of the measure (brief description of the issue):	
The transformation of the construction sector, changes in the nature and conditions of work in the construction sector must go hand in hand with the promotion of employment and career opportunities aimed at the general public, primary school pupils and their parents. Given the urgency of meeting the Slovak Republic's obligations under EU legislation and other international commitments, it is essential that the government develops and finances nationwide campaigns with this focus.	
Target group:	Implementation timetable:
Public, primary school pupils and their parents	2024-2028

Table 12

Recommendation No. 10	
Name of the Recommendation: Government support for continuing education.	
Content of the measure (brief description of the issue):	
Construction is becoming a sector in which rapid changes in skills, knowledge and competence requirements will take place. For this reason, continuing education will play an important role, unparalleled in the past when the construction industry has resisted change and innovation.	
Lifelong learning in this sector needs to be systematic, and its stability, quality and accessibility must be improved. For this reason, government intervention and financial support for all forms of lifelong learning is essential.	
Target group:	Implementation timetable:
Job seekers in the construction sector and current employees and tradespeople in the construction sector.	From 2025

6. Needs and gaps in the construction sector in terms of new qualifications

The industrialisation of construction production and the adaptation of the construction sector to the Industry 5.0 concept will inevitably have an impact on skills, knowledge and competences. Many of the future skills requirements will be **more adaptable and digitally focused**. Combined with a greater selective awareness of the ESG (Environmental and Social Governance) agenda among the next generation, construction could become an attractive profession (a profession that will be "in") for developing, designing, and building the communities of the future. While the reason we live in cities has not changed for thousands of years (despite the networks that connect us we need places where we can meet in person), they will no longer need to be large hubs of value streams to make things. They will make more use of local resources thanks to 3D printing and robotics, and the focus will be on high quality of life in cities and providing a dignified old age.

However, the construction sector will need to adapt and **attract people from other backgrounds** such as **strategists, cognitive and systems thinkers, data analysts, data-driven researchers, digital operators and robotic programmers**, although the use of generative AI will bring further dramatic changes to the field, which only underlines how rapidly changing conditions and the resulting skills requirements will confront employers and educational institutions.

There will also be an increasing demand for socially oriented skills, with the ESG agenda leading to a focus on sustainability in structural design and manufacturing techniques, as well as a more people-oriented skills base. This will mean new team types, new roles and new skills for existing roles that need to be sought from the best available talent. It also means that employers need to adapt to create a real focus on attracting people from more diverse and inclusive backgrounds. This includes increasing the employment of women and disadvantaged groups of employees in the sector, who are well placed to cope with changing job requirements and, as experience in Western Europe has shown, will bring significant skills to the sector. A fundamental condition for exclusivity is transparency of qualification requirements and increased efforts to introduce non-discriminatory recruitment practices.

Preparing secondary vocational schools for the new requirements in skills, knowledge and competences will require curricula to be redesigned, accredited, and introduced into school practice. At the same time, schools will need to respond to changes in requirements. Some of the changes in requirements will be transitory and formal education will not be able to respond effectively to these requirements without the risk that already outdated curricula will be put into school practice, even if the requirements for these curricula have only emerged 2-3 years ago. The cycle of complete information exchange will be shorter in many professions and in some it will be shorter than the cycle of preparation, accreditation, induction and revision of the curriculum.

New professions at EQF level 3-5 and new roles within existing professions will include, for example:

- Information Processing Manager/Operator (EKR/EQF 4-5);
- Robot operator (EKR/EQF 3-4);

- Digital collaboration operator/specialist (EKR/EQF 3-5);
- Cyber Security Specialist (EKR/EQF 5);
- Value Engineering Specialist (EKR/EQF 5);
- Smart Building Specialist (EKR/EQF 5);
- Artificial Intelligence Application Manager (EKR/EQF 5);
- Building construction technician/operator in modular construction (EKR/EQF 4-5);
- Construction drone operator (EKR/EQF 3-4);
- Preparer of smart energy systems with flexibility management (EKR/EQF 5);
- Operator/integrator for smart energy systems (EKR/EQF 4-5);
- Operator and other occupations in **industrial construction production** (EKR/EQF 3-5).

For example, the new required **skills, knowledge and competences include:**

- cognitive and systems thinking;
- programming;
- an active approach to further education;
- data-driven decision-making;
- comprehensive problem solving
- with excellent communication skills;
- data analysis, artificial intelligence (AI) and BIM;
- production of components and modules in industrial construction;
- modelling and simulation;
- working with robotic assets and drones;
- Internet of Things (IoT);
- computer visualisation;
- 3D printing;
- circularity in construction;
- integration of energy sources and sectors in smart energy systems;
- extended reality (XR), including augmented reality (AR), virtual reality (VR) and mixed reality (MR);
- integration skills, etc.

The European Commission has identified the construction sector as key to achieving climate neutrality by 2050. In addition, the Slovak construction sector has a very important position in the Slovak economy. Nevertheless, it is not such a priority of the government that resources adequate to the requirements of this sector and its role in the transition to clean energy are provided, either from the EU funds (even from those designated for this purpose by the priorities set by the EU budget) or from the state budget's own resources. It therefore faces various challenges that it cannot overcome. The undercapitalisation of the sector, the underfunding of education and the lack of investment in areas where the fragmented construction sector, composed mainly of medium, small and micro enterprises, has no chance to invest, such as the material and production base for modular construction, the industrialisation of construction production, its transfer off-site and ensuring the application of other innovations that are already shaping the construction industry in Western Europe. If Slovakia continues to see its future in the European Union, it will also need to undergo such a transformation to support the climate ambitions of the EU and Slovakia.

No solution to these barriers could be found other than a change in the situation by the competent authorities. Therefore, the Roadmap formulated a number of recommendations for the Slovak Government and the local authorities that are the founders of secondary vocational schools. These recommendations have already been described in Chapter 5.

The transformation of the construction industry also includes changes necessary to address the skills shortage. Construction companies are competing with more technology-based industries that offer better prospects and that make better use of the natural skills of the so-called 'Xbox generation', who have grown up with technology and expect to use it in their work. For this reason, the transformation of the construction industry briefly described in the overall strategy in Chapter 4 is also expected to make construction jobs more attractive. In addition to new technologies, this transformation will mean better working conditions, high occupational health and safety and higher wages for the work done.

One of the technologies that is coming to the construction sector and is also becoming a new method in education is **Extended Reality (XR)**, which is coming to construction sites together with digitalization, BIM, digital twins, AI and robotics to create a symbiosis in the sense of the **Industry 5.0** concept. It will not only become a powerful tool in guiding and navigating workers (both workmen and technicians) throughout the construction production/installation process to achieve strict technological discipline and the highest possible quality of work delivered. In education, XR will provide Virtual Reality (VR), Augmented Reality (AR) and Mixed Reality (MR) to create learning environments enabling the delivery of engaging educational programs. The XR family will thus become the technological link between the workspace and the learning space.

An empirical survey of employers was the basis for the analysis of the barriers and reasons why there is a shortage of workers who lack professional skills or knowledge. The aim was to gather information directly from construction companies that have direct contact with these challenges.

The results of the SQA survey show that the shortage of skilled workers in the Slovak construction sector is the result of a combination of various factors that we have already written about. These results help us to validate our conclusions about the main factors influencing the interest in studying construction disciplines and, consequently, the availability of skilled workers in the sector.

One of the main barriers identified by employers is a lack of interest in studying construction disciplines, which was reported by 79% of respondents - companies doing business in the construction sector. This lack of interest is due to the perception of the construction sector as less prestigious and less attractive compared to other sectors. Many young people prefer other disciplines or study programmes that make use of new and digital technologies. The use of already outdated practices and technologies and the associated working conditions lead to a limited number of students interested in studying construction disciplines. As data analysis from other studies has shown, even of those students who do graduate with a construction degree, few remain in the industry. One of the studies indicates only a 9% retention rate, which has been questioned by the schools and previously assessed at 20%, but even so it can be concluded that a significant proportion of graduates are leaving for other sectors. There is no data on the reasons for leaving for other sectors, but it is possible to accept the conclusion that, on the one hand, many do not find a job in the construction sector in Slovakia or do not believe

in an interesting long-term career in this sector. Another significant proportion of graduates leave because they have already enrolled in the studies for reasons other than an interest in working in the construction sector. This barrier will be removed by transforming the sector, making it more attractive and able to offer interesting work and long-term careers.

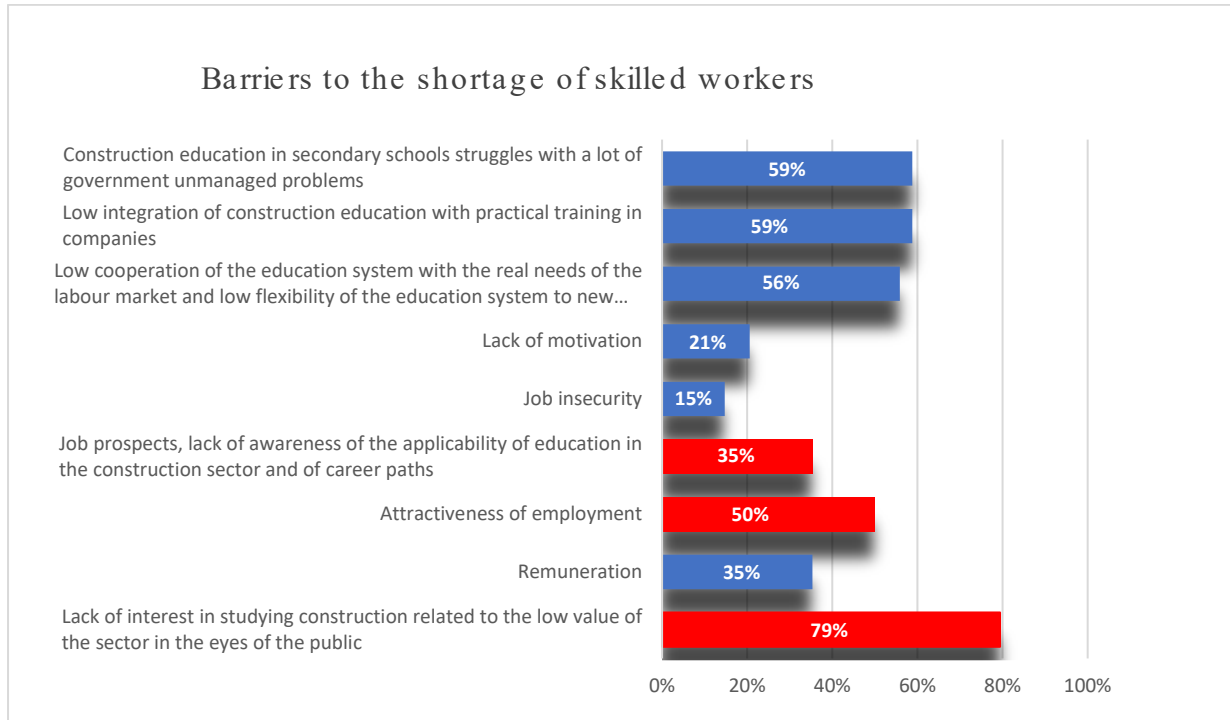
The analysis also showed that the **low linkage of construction studies with practical training in companies** is another important barrier (59% of respondents - companies doing business in the construction sector). This barrier can be overcome and the roadmap discusses possible solutions. There is a need to ensure that construction students have access to practical learning on real construction sites and encounter real situations. In this way, they will gain better practical skills and experience, which are essential for a successful career in the construction sector, as well as better information about the employability of their training, which in turn also has the effect of making the construction sector more attractive in their eyes. The same number of respondents from construction companies believe that education in the construction sector faces many problems that are not managed by the government. There is a need on the part of the government to address these problems and invest in the education system to be able to provide quality and relevant education in the construction trades.

In addition, the analysis also pointed to a **lack of cooperation between the education system and the real needs of the labour market** (56% of respondents - companies operating in the construction sector). This means that educational institutions do not always sufficiently take into account the current requirements and trends in the construction sector when preparing their study fields/programmes and their curricula. It is important to strengthen this cooperation and ensure that students acquire relevant skills, knowledge, and practical experience to help them better manage the gap between education and practice. The strategy described in Chapter 4 includes such cooperation.

The attractiveness of employment in the construction sector was identified as a reason for the shortage of skilled workers by 50% of respondents - companies doing business in the construction sector. Working conditions in the construction sector, such as working outdoors and physical exertion, may be less attractive to some people. Low job stability and working conditions in construction companies are also shown to be less attractive than in other sectors. It is therefore necessary, in addition to the transformation of the sector, to set up new approaches to employees and to emphasise the advantages and prospects of employment in the construction sector, such as opportunities for rapid career development, working on permanent diverse projects, as well as the use of digitisation and other new technologies.

Another factor is the **lack of awareness of employment prospects in the construction sector**, which was identified by 35% of respondent construction companies. Young people have limited information about career opportunities and about current changes and developments in the construction sector and this may lead to a lack of interest in studying construction related subjects. Another factor to add to this, which the survey has shown, is remuneration. As many as 35% of respondent companies operating in the construction sector identified this barrier. Low wages, job stability but also the possibility to take out a mortgage loan discourages potential students and workers from getting a job in the construction sector because they prefer fields with more attractive and stable conditions. It is essential to improve working conditions in the construction sector in order to increase its attractiveness and competitiveness vis-à-vis other sectors. This is only possible through a total transformation of the sector, which

will increase labour productivity and thus allow the sector to invest in human resources, which will increase the attractiveness of the sector not only for young people but also for the talent that the sector needs to attract. In the future, **talent will be more of a decisive factor of production than capital.**



Graph 5- Barriers to skills shortages

As is evident, all the secondary barriers are based on the primary barriers mentioned in the introduction of this section.

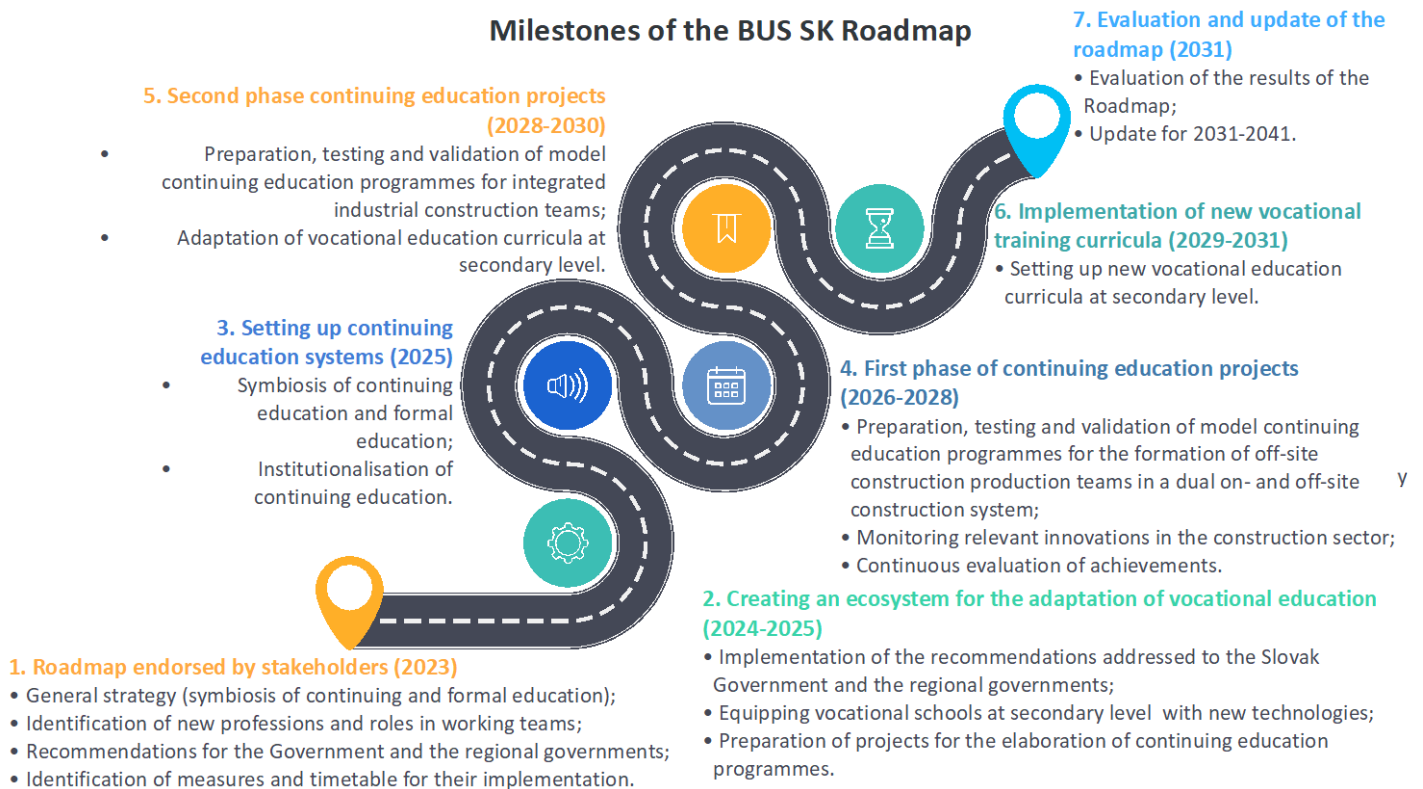
7. Identification of priority measures

Chapter 6 presented examples of new professions and new roles for existing professions. Some key new skills, knowledge and competences were also identified. The stages of transformation of the construction sector are as follows:

- 1) The first stage by 2030, when there will still be two environments in which employees of all levels, including craftsmen, will work - on-site and off-site production.
- 2) The second stage 2030-2035, when the integrated industrial construction will have already been formed as a unified environment in which employees of all levels will work, with most craftsmen going into industrial construction production as employees.

The timing of these stages is a matter for further stakeholder dialogue.

Hence, the different steps in education and their synchronisation with the proposed measures are illustrated by the following graph:



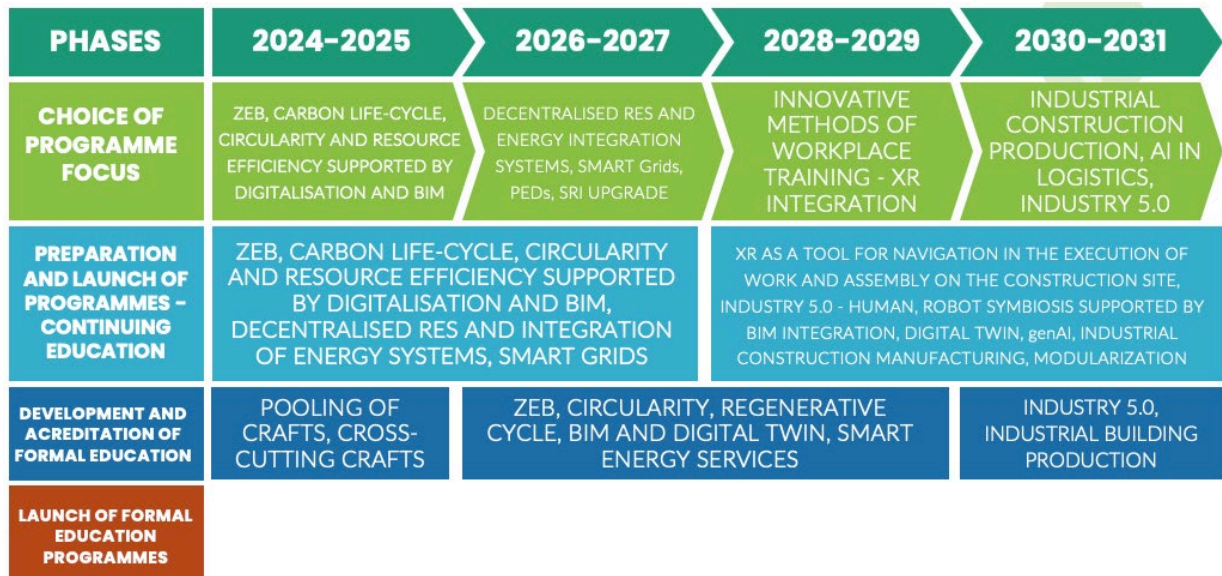
Graph 6-Milestones of the BUS SK Roadmap

Stakeholders identified topics that will need to be included in template (ready for replication) continuing education programmes from today's perspective, which will validate the approach to the topics and help initiate the process of developing new or updating existing secondary vocational education curricula.

The adaptation of education will also include a review of existing programmes and the process of grouping some trades into cross-cutting ones, thus kick-starting a process that has already been successful in countries that are more advanced in the transformation of the construction sector. In this way, Slovakia can learn from the mistakes of these countries and draw on know-

how that has been proven in practice. The curricula for the trades concerned will also need to be updated in the light of the new requirements. A large part of the current craftsmen will be employed in industrial construction production as operators or specialists.

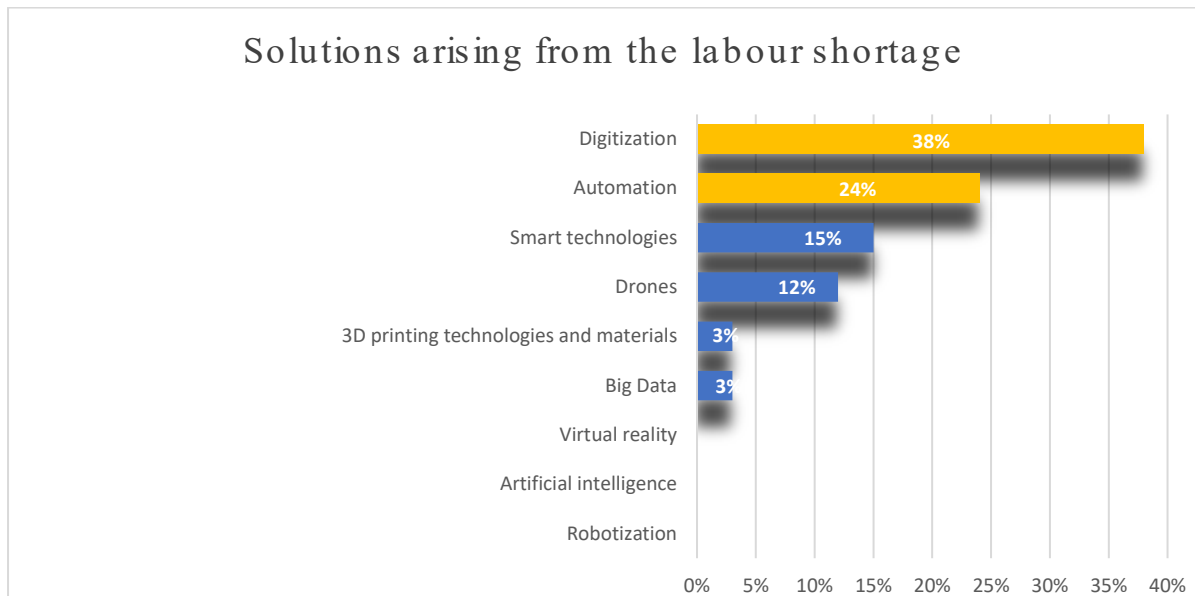
The following graph illustrates the timeframe for the adaptation of education and the plan for the development of continuing education programmes by topic within this timeframe:



Graph 7- Milestones of the BUS SK Roadmap

Faced with a shortage of workers in the construction sector, companies are turning to different strategies, technologies, and measures to respond to the current situation. The survey results show that companies that use the Industry 4.0 concept see the solution mainly in digitalization, automation and partly in smart technologies. However, the results are influenced by the fact that companies do not yet fully feel the need to implement current technologies, as the status quo analysis showed.

The survey conducted among companies showed (as can be seen from the corresponding graph), the problem of the lack of qualified workers is already being solved in some companies by digitalization, currently up to 38% of respondents of construction companies said so, and it brings with it a wide range of opportunities and expectations. In Slovakia, the digitisation of the construction sector is gradually developing, but it is not yet at the same level as in some other developed sectors and countries, but efforts to introduce new digital tools and technologies are visible.



Graph 8- Solutions arising from the labour shortage

Currently, the digitalisation of the construction sector in Slovakia is manifested mainly in the areas of:

- **Building Information Modelling (BIM)**, where several construction companies are implementing it, whether in preparation, construction, or management. BIM enables the creation of digital models of buildings that contain information on construction, materials, costs, and other relevant factors. This allows for better coordination, resolving conflicts and improving overall project planning and management.
- **Online communication**, where construction companies and workers use new online tools and platforms to increase productivity in construction projects. Cloud-based platforms enable the sharing of documents, information, and plans between different project participants. This improves the efficiency and speed of communication and enables better collaboration between different stakeholders.
- **Digital planning tools**, scheduling tools and software are becoming part of the construction sector in Slovakia as well. These tools enable better planning, tracking and management of construction projects. They help to monitor time and financial budgets, manage resources, and coordinate different activities.

However, according to data from Eurostat¹, the digitisation rate of the construction sector in Slovakia is less than 7%, while the EU average digitisation rate is 12.7%.

The low digitalisation of Slovak companies may be because the construction industry is known for its traditional practices and conservative approach to change. Many companies prefer tried and tested methods and are concerned about the risk associated with implementing new

¹ Source: Eurostat: <https://sita.sk/vrealitach/digitalizacia-stavebnictva-to-nie-je-pdf-vykres/>

technologies, even if these technologies are already proven by long-standing practice in other industries.

On the other hand, the survey of vocational schools showed that both universities and several secondary schools already have experience in incorporating skills, knowledge, and competences relevant to the transformation of the construction industry. This means that the know-how is available in the schools to kick-start an adaptation programme for education. This experience also provides a basis for the development of new continuing education training programmes for adults who are already in the workforce and meet the entry requirements. Nevertheless, it will be necessary to mobilise external expertise, either from other sectors that have successfully managed the issue or from the construction sector abroad.

In the survey, schools were asked to report whether, and if so to what extent, the curricula, and courses of study in their schools include **skills, knowledge and competences in the following areas:**

- **Energy efficiency in buildings and renewable energy in buildings;**
- Energy renovation of historic buildings;
- Electrification of heating and hot water preparation;
- Renewable energy and fuel technologies;
- Installation of renewable energy and fuel technologies;
- Maintenance of renewable energy and fuel technologies;
- **Green economy;**
- Efficient use of energy sources and the use of appropriate system solutions for energy efficient buildings;
- New technologies and materials for construction products with high recycling rates;
- Vegetated (green roofs), mobile roofs and waterproof roofs;
- Life Cycle Sustainability Assessment;
- New techniques and technologies for processing construction and demolition waste into recycled materials;
- Digitised documentation of demolition waste and data on the quantity and type of recyclates produced;
- Vegetation facades;
- **Automation** /in general;
- Automatic control of construction machinery;
- Automated building ventilation;
- **Big Data**, data storage and cloud systems;
- **Digitalisation** in construction;
- Software for BIM;
- Software for LIM;
- Roof composition configurator;
- Electronic geometric plans;
- Digital processing of parameters and technical data of building materials;
- Digital management, inspection and maintenance of buildings;
- Digitisation of the documentation of the actual design;
- **IoT** (Internet of Things);
- Digital building scanning and facility management;

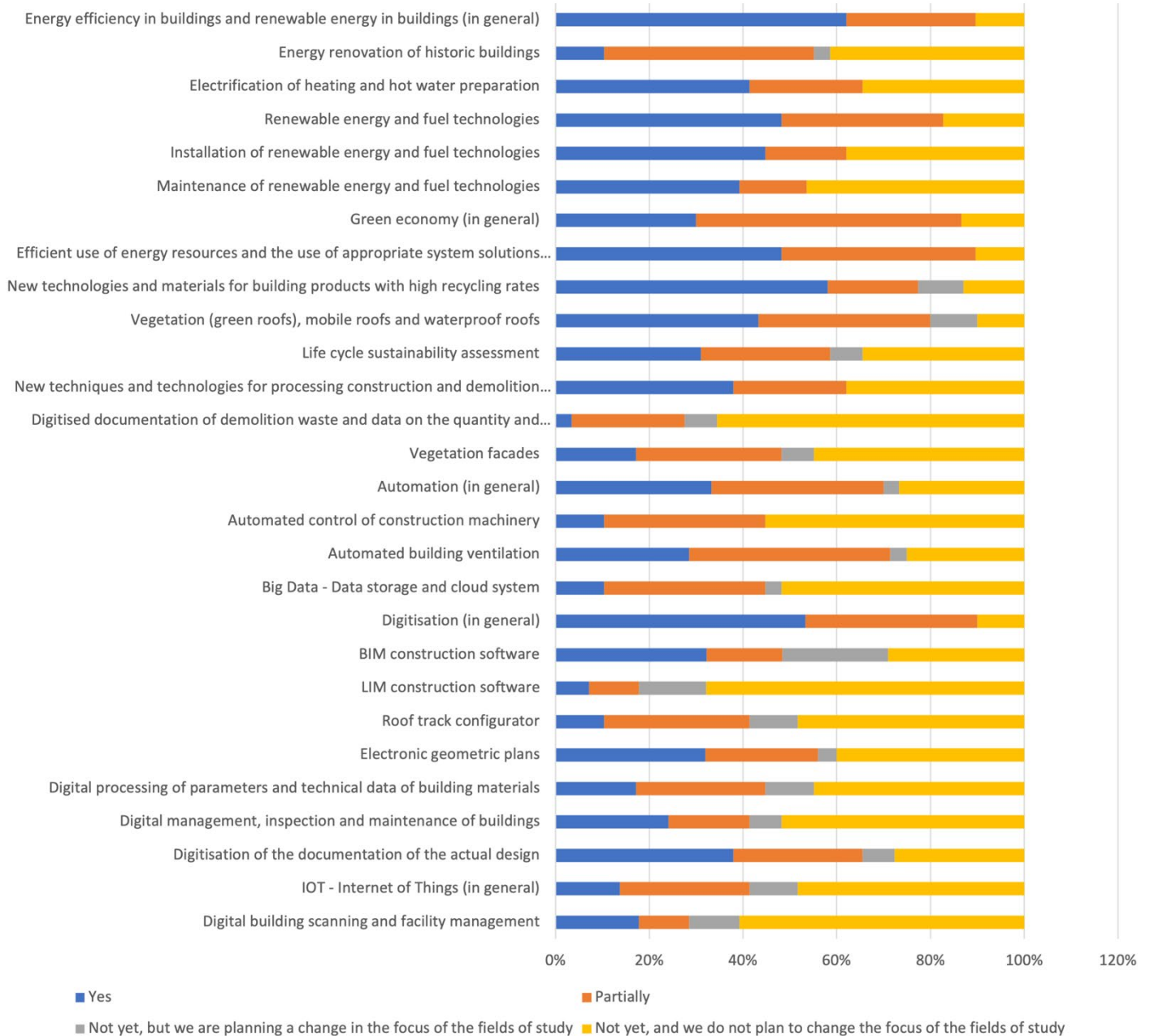
- Measurements and non-destructive roof leakage detection;
- **Drones** /in general;
- Photogrammetry, drones and 3D building scanning;
- Use of drones for area data collection of terrain and building objects in the form of scanning and photogrammetry;
- **New methods** / in general;
- Functional units - bathrooms or rooms;
- Prefabricated homes and commercial modular buildings;
- Above-grade insulation;
- Insulation with TPO and EPDM foils;
- Cassette facade tiles;
- Ventilation of roof structures and attic leakage ratings;
- **Robotics** /in general;
- Autonomous robots in the construction sector (remote-controlled machines, cranes, dumpers, robots for 3D printing...);
- Automatic assembly by robots;
- **Smart technologies** /in general;
- Smart buildings;
- System components of building technical equipment;
- Smart meters;
- Smart energy systems in buildings;
- BEMS (Building Energy Management Systems);
- Energy storage, installation, maintenance;
- e-mobility (charging stations for e-mobiles in buildings and adjacent areas - maintenance, installation);
- Decarbonising the flexibility of energy systems - the contribution of buildings to flexibility, the design and installation of systems in buildings;
- **Artificial intelligence in construction;**
- **Virtual reality in construction;**
- **3D technologies and materials** /in general;
- Production of prefabricated concrete parts through 3D printing.

The survey questionnaire was designed to identify the current state of school readiness of education of students in the construction and energy sector, using four pre-defined responses from which respondents could choose:

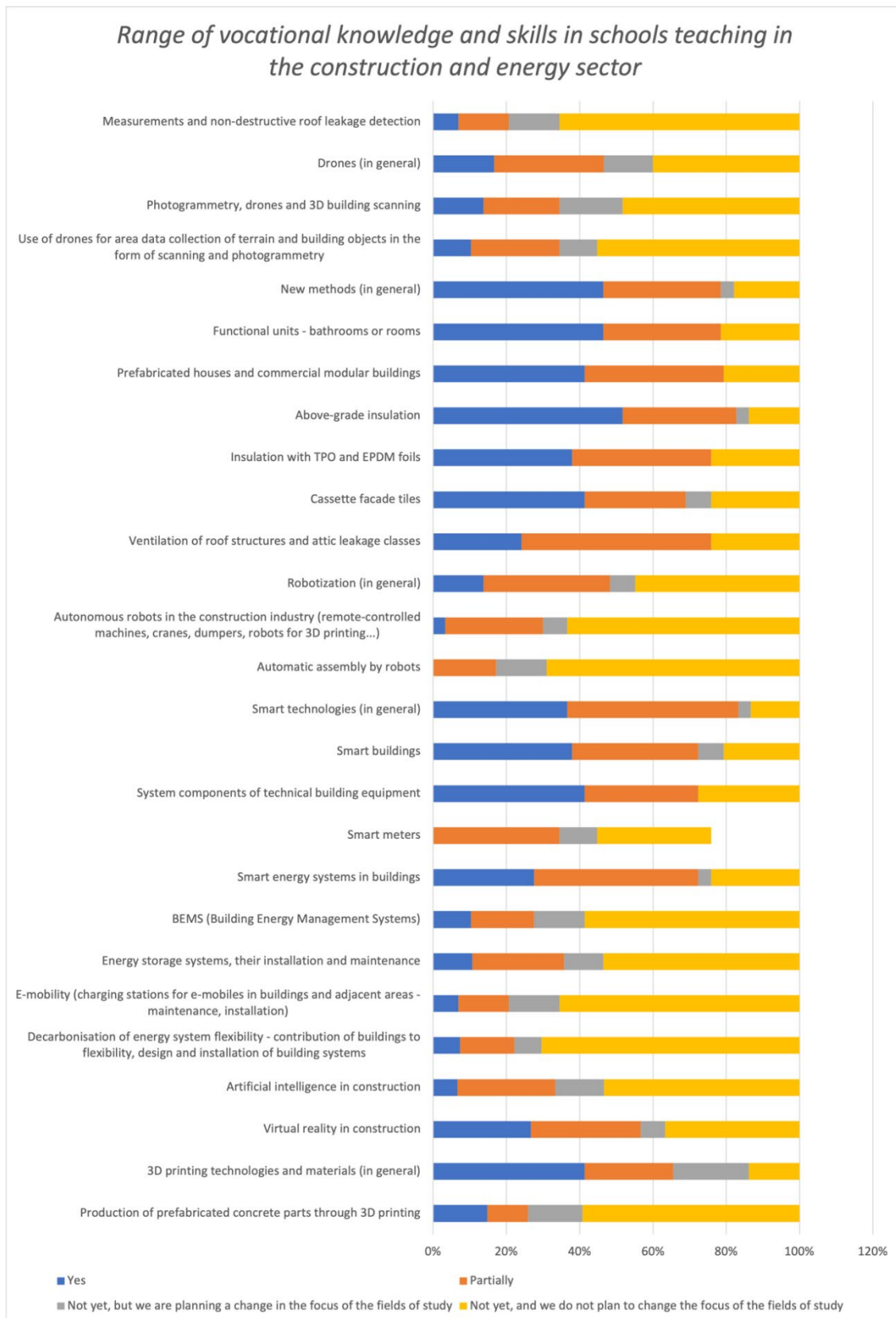
- Yes
- Partially
- Not yet, but we are planning a change in the focus of fields of study
- Not yet, nor do we plan a change in focus in the fields of study

The percentage of responses is shown in the following graph.

Range of vocational knowledge and skills in schools teaching in the construction and energy sector

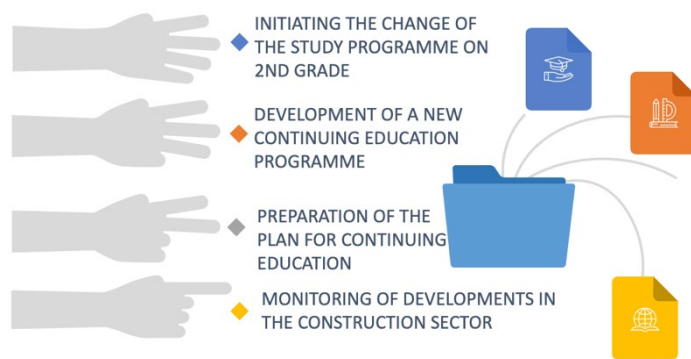


Graph 9 (1/2)-Range of vocational knowledge and skills in schools teaching in the construction sector



Graph 9 (2/2)-Range of vocational knowledge and skills in schools teaching in the construction sector

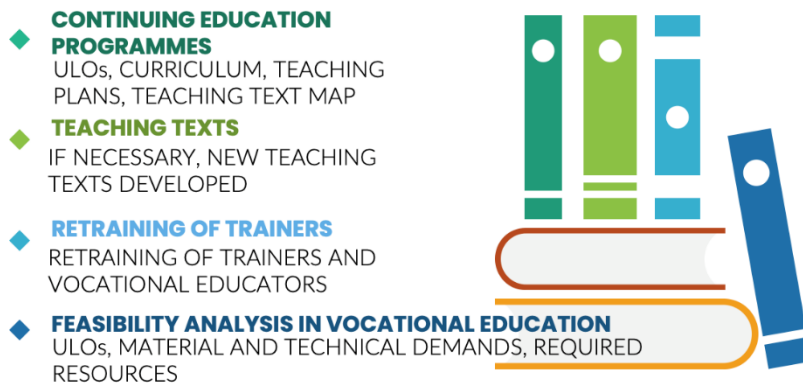
Based on the lessons learned and the dialogue with the members of the NQP, measures were proposed to implement the adopted strategy and the steps of the roadmap, including the timeframe and the proposed topics to be covered by the new continuing education programs, updated and new fields of study of secondary vocational education.



Graph 10-Cycle of development of continuing education programmes

The cycle of development of continuing education programmes is illustrated in Graph 10.

The outputs of these projects will be the same and are shown in Graph 11.



Graph 11-Outputs of continuing education projects

Continuing education courses will be implemented by secondary vocational schools, thus guaranteeing quality (through a quality assurance system according to EQAVET principles) and ensuring the required pedagogical education of trainers in continuing education. The secondary vocational schools will provide the administration related to the training and will be the recipients of the tuition fees for participation in the courses. In this context, it is necessary to further elaborate the conditions for running these courses and to ensure that the relevant implementing rules and regulations are issued, if necessary. The programmes being developed will be subject to accreditation under the terms of Slovak legislation. Examination and certification of training graduates will be carried out according to approved assessment standards and in accordance with the requirements for the recognition of acquired qualifications, which will be carried out by the schools themselves as well as by independent assessors.

Successful graduates of the course will receive a micro-qualification. The training programmes will follow the EU Recommendation on standard documentation for micro-qualifications, which will include:

- identification of the trained person;
- name of the micro-qualification;
- country/region of issuer;

- granting institution;
- date of issue;
- earning outcomes obtained;
- the nominal workload required to achieve the learning outcomes;
- the level (and, if applicable, cycle) of the course, the experience needed to obtain the micro-qualification (EQF/EQF);
- type of evaluation;
- form of participation in the training received;
- method of quality assurance.

The trainee's digital Europass account will be used to store information on the micro-qualifications acquired.

The projects will also follow the development of the EU acquis on micro-skills to include additional elements applicable to the type of trainees and levels of competence. Meeting the EU requirements for micro-qualifications will allow them to be assessed in formal mutual recognition systems as well as by direct assessment by the employer in the employment decision of the jobseeker.

Micro-qualifications that can be obtained in Slovakia in accredited training programmes are included in the relevant database of the National Qualifications Framework. Therefore, it is not currently proposed to create other type of national register. The acquired micro-qualifications will also be part of the assessment of the qualification of work teams in the framework of the certification of the management system of contractors of reserved constructions in accordance with the approved regulations. The possibility for employees to undertake these refresher courses as part of continuing education programmes will contribute to the attractiveness of employers.

The following measure specification provides this information for each proposed program:

- scope and content of the proposed continuing education programmes;
- estimated costs;
- internships/apprenticeships for students, if relevant;
- multidisciplinary skills and knowledge that will be covered;
- entry requirements and qualification levels.

Table 13

Measure No. 1
Title: Zero-emission buildings, climate neutrality and circularity

Scope of the proposed programmes:	
<ul style="list-style-type: none"> • ZEB - zero emission buildings; • Circularity in construction; • Carbon assessment in the life cycle of buildings; • Resource efficiency supported by digitalisation and BIM. 	
Costs: €1,5 mil.	
Apprenticeships included: No	
Multidisciplinary skills and knowledge:	
<ul style="list-style-type: none"> • Digitization; • Information model, digital model. 	
Target group:	Time frame:
Specialists (EKR/EQF 4-5)	2024-2026
Entry requirements, qualification levels:	
Completed 4-year construction study programme	

Table 14

Measure No. 2
Title:
Integration of decentralised energy assets/resources with flexibility management
Scope of the proposed programmes:
<ul style="list-style-type: none"> • Decentralised electricity generation from RES integrated in or near buildings; • Energy storage in or near buildings; • Electro-mobility integrated in or near buildings; • Demand response and flexibility management; • Smart energy services and complete energy solutions for buildings; • Smart grids - planning and management; • Integration of heat pumps in smart energy services with flexibility management; • Buildings as active nodes of the network; • SRI (Smart Readiness Indicator) - building readiness for smart functions; • PED - neighbourhoods with a positive energy balance.
Costs: €1,5 mil.
Apprenticeships included: No

Multidisciplinary skills and knowledge:	
<ul style="list-style-type: none"> Digitisation. 	
Target group:	Time frame:
<ul style="list-style-type: none"> Specialists (EKR/EQF 5); Operators (EKR/EQF 3-4). 	2026-2028
Entry requirements, qualification levels:	
Completed construction or electrical 4-year study programme	

Table 15

Measure No. 3	
Title:	
XR integration on site and in education	
Scope of the proposed programmes:	
<ul style="list-style-type: none"> XR site navigation, work briefing; XR in the inspection and monitoring of site procedures; XR integration with BIM, digital twin, generative AI and robots; XR in education - outside the workplace, on the workplace; XR in reviewing staff and assessing the maturity of skills and knowledge in teams. 	
Costs: €1,5 mil.	
Apprenticeships included: No	
Multidisciplinary skills and knowledge:	
<ul style="list-style-type: none"> Digitisation; XR – Extended Reality; Information models; Digital models and digital twins. 	
Target group:	Time frame:
<ul style="list-style-type: none"> Specialists (EKR/EQF 5); Operators (EKR/EQF 3-4). 	2027-2029
Entry requirements, qualification levels:	
Completion of a 4-year construction or IT study programme	

Table 16

Measure No. 4	
Title: Industrial production and Industry 5.0	
Scope of the proposed programmes: <ul style="list-style-type: none"> Automation and robotization in industrial construction production; Generative AI integrated with robotics; Human-robot collaboration in industrial construction production; AI in logistics; Sustainability and circularity in industrial construction production; 	
Costs: €2 mil.	
Apprenticeships included: No	
Multidisciplinary skills and knowledge: <ul style="list-style-type: none"> Digitisation; Robotization; Use of AI; Industry 5.0 concept. 	
Target group: <ul style="list-style-type: none"> Specialists (EKR/EQF 5); Operators (EKR/EQF 4). 	Time frame: 2029-2031
Entry requirements, qualification levels: Completion of a 4-year construction, electrical or IT study programme	

Table 17

Measure No. 5	
Title: Adaptation of fields of study for cross-cutting crafts	
Scope of the proposed programmes: <ul style="list-style-type: none"> Construction production; In-depth renovation of buildings; Energy efficiency and use of RES in buildings; Integrating buildings with energy systems; Efficient technologies for heating (hot water) and cooling of buildings; 	

<ul style="list-style-type: none"> Installation of heat pumps, RES, chargers for e-mobility. 	
Costs: €5,0 mil.	
Apprenticeships included: Yes	
Multidisciplinary skills and knowledge: N/A	
Target group: Applicants for construction and electrical courses at vocational secondary schools	Time frame: 2024-2025
Entry requirements, qualification levels: Completed primary education	

Table 18

Measure No. 6	
Title: Updating the fields of study to the latest technologies of digitalisation in construction and the regenerative cycle of buildings	
Scope of the proposed programmes: <ul style="list-style-type: none"> ZEB – Zero Emission Buildings; Circularity in construction production, circularity of buildings; Modular construction, prefabrication, sensorization; Working with BIM and digital twin on site and facility management; Servitization of energy services; Smart grids and smart energy services in buildings; Regenerative life cycle of buildings and support from modularization, digitalization and information models. 	
Costs: €5,0 mil. (does not include necessary school equipment)	
Apprenticeships included: Yes	
Multidisciplinary skills and knowledge: <ul style="list-style-type: none"> Digitisation; Information models; Digital twins; Regenerative life cycle. 	
Target group:	Time frame:

Applicants for construction programmes at vocational secondary schools	2026-2029
Entry requirements, qualification levels: Completed primary education	

Table 19

Measure No. 7	
Title: Updating the fields of study to Industry 5.0 and industrial building production	
Scope of the proposed programmes:	
<ul style="list-style-type: none"> • Complete digitalisation of construction production and logistics; • Integrating BIM, digital twins, generative AI and robotics in industrial construction production; • Environmental and social sustainability in the construction sector; • Industrial construction production technologies; • 3D printing in construction production; • Symbiosis of humans and robots in construction; • Use of AI in planning and logistics. 	
Costs: €5,0 mil. (does not include necessary school equipment)	
Apprenticeships included: Yes	
Multidisciplinary skills and knowledge:	
<ul style="list-style-type: none"> • Digitisation; • Information models and digital twins; • AI; • 3D printing; • Industry 5.0 concept. 	
Target group: Applicants for construction and electrical courses at vocational secondary schools	Timeframe: 2029-2031
Entry requirements, qualification levels: Completed primary education	

Table 20

Measure No. 8

<p>Title:</p> <p>Launch of updated curricula - first phase</p>	
<p>Scope of the proposed programmes:</p> <ul style="list-style-type: none"> • ZEB - zero-emission buildings; • Circularity in construction production and building circularity; • Regenerative life cycle of buildings; • Integrating BIM, digital twins, generative AI and robots in industrial construction production and on site; • Buildings as active energy nodes on the network; • Integrated smart energy systems with flexibility management in buildings; • Integration of energy sectors with flexibility for energy systems; • Full digitalisation of construction production. 	
<p>Costs: €5,0 mil. (does not include necessary school equipment)</p>	
<p>Apprenticeships included: Yes</p>	
<p>Multidisciplinary skills and knowledge:</p> <ul style="list-style-type: none"> • Digitisation; • Information models; • Digital twins; • Regenerative life cycle. 	
<p>Target group:</p> <p>Applicants for construction and electrical courses at vocational secondary schools</p>	<p>Timeframe:</p> <p>2028-2031</p>
<p>Entry requirements, qualification levels:</p> <p>Completed primary education</p>	

8. Stakeholders endorsing the Roadmap

The following stakeholders endorsed this Roadmap by providing a Letter of Support:

Table 21

Name of the stakeholder's organisation	Abbreviated name used in Action Plan
Competent Authorities – national, regional, local	
Ministry of Education, Research, Development and Youth of SR	MSVVM
Ministry of Transport of SR	MD
Ministry of Economy of SR	MH
Ministry of Environment of SR	MZP
Prešov Self-Government Region	POSK
Žilina Self-Government Region	ZASK
Košice Self-Government Region	KESK
Union of Cities and Municipalities	ZMOS
Secondary and tertiary education institutions	
Secondary School of Electrical Engineering, 85101 Bratislava	SPSBA1
Secondary School of Electrical Engineering, 84102 Bratislava	SPSBA2
Secondary Industrial School Lučenec O. Winklera	SPSLC
Secondary School of Civil Engineering and Geodesy, Košice	SPSSKE
Secondary School of Civil Engineering, Prešov	SPSSPO
Secondary School of Civil Engineering of Emil Belluš, Trenčín	SPSSTN
Secondary School of Civil Engineering, Žilina	SPSSZA
Secondary Vocational School of Crafts and Services, Poprad	SOSPP
Secondary Vocational School of Crafts and Services, Bratislava	SOSBA
Secondary Vocational School of Construction, Nitra	SOSSNR

Name of the stakeholder's organisation	Abbreviated name used in Action Plan
Secondary Vocational School of Construction, Žilina	SOSSZA
Technical Secondary Vocational School, Prešov	SOSTPO
Integrated School, Banská Bystrica	SSBB
Technical University Košice	TUKE
Employers	
Strabag Pozemné staviteľstvo s.r.o.	STRABAGPS
Chemkostav a.s.	CHEMKOSTAV
Proma s.r.o.	PROMA
BALA a.s.	BALA
HORNEX a.a.	HORNEX
Koga Bau s.r.o.	KOGA
STRABAG s.r.o.	STRABAG
Metrostav a.s. - organizačná zložka Bratislava	METROSTAV
VÁHOSTAV-SK a.s.	VAHOSTAV
Representatives of Employees	
Integrated Trade Union	IOZ
Associations of employers	
Confederation of Industry Associations and Transport	APZD
National Confederation of Employers	RUZ
Professional Associations, Guilds, Clusters, and other stakeholders	
Friends of Earth-CEPA	PZCEPA
Slovak Green Building Council	SKGBC
Roofers' Guild	CS

Name of the stakeholder's organisation	Abbreviated name used in Action Plan
Energy cluster	EKL
Chamber of Geodesy and Cartography	KGK

9. Action plan

Recommendation/ Measure number	Title (focus) of the recommendation or measure/action	Time plan for implement ation	Stakeholders leading the efforts aimed at implementing the recommendation or measure/action	Stakeholder to be involved					
				Employers	Sector Skills Councils	VET providers	Government	Regional	Accreditation bodies
1	Updating of existing and creation of new fields of study to adapt the fields to technical progress and the needs of the transformation of the construction sector (The transformation of the construction sector towards industrial building production, which will be largely carried out off-site with buildings being assembled on site, places new demands on skills, knowledge, and competences).	2024-2026	ZSPS, SIEA, UVS, RUZ, MSVVM, MD, SOSPP, SOSBA, SPSLC, SPSSKE, SPSSPO, SPSSZA	✓	✓	✓	✓	✓	✓
2	Support scholarships for pupils in disciplines that are in short supply in the country and needed to cope with the current changes resulting from European agreements (To increase the percentage of graduates who remain in the construction sector after secondary vocational training, it is necessary to motivate pupils already during their vocational training in the form of scholarships).	2024	ZSPS, APZD, SOSBA, SPSLC, SPSSKE, SPSSPO	✓		✓	✓	✓	

Recommendation/ Measure number	Title (focus) of the recommendation or measure/action	Time plan for implement ation	Stakeholders leading the efforts aimed at implementing the recommendation or measure/action	Stakeholder to be involved					
				Employers	Sector Skills Councils	VET providers	Government	Regional	Accreditation bodies
3	Government support for the creation of new educational programmes for pupils and adults (The transformation of the construction sector will require a major change in existing study programmes and the creation of new ones. These programmes not only concern pupils in preparation for the profession but also the retraining of adults in continuing education programmes).	2024-2026	MSVVM, POSK, EKL, SOSBA, SPSSKE, SPSSPO, SPSSZA	✓		✓	✓	✓	✓
4	Government support for companies involved in the education process (The construction sector is characterised by a high proportion of micro, small and medium-sized enterprises, which do not have the opportunity to engage in the training process without financial support from the government).	2024	ZSPS, RUZ, APZD, EKL, SPSSPP, SPSPO, SPSSZA	✓		✓		✓	
5	Providing additional training for teachers on new requirements (The adaptation of existing and the creation of new curricula and continuing education programmes must go hand in hand with intensive training of trainers - teachers in secondary vocational schools. This training should be recognised as part of the professional education/professional development of teachers).	2024	ZSPS, UVS, VIAEUROPA, POSK, MD, SOSPP, SOSBA, SPSLC, SPSSKE, SPSSPO, SPSZA	✓		✓	✓	✓	

Recommendation/ Measure number	Title (focus) of the recommendation or measure/action	Time plan for implement ation	Stakeholders leading the efforts aimed at implementing the recommendation or measure/action	Stakeholder to be involved					
				Employers	Sector Skills Councils	VET providers	Government	Regional	Accreditation bodies
6	Making the teaching profession more attractive and creating the conditions for a significant increase in the interest of young people and professionals in the teaching profession (Secondary vocational schools are struggling with a shortage of teachers and the rising average age of current staff. It is therefore necessary to attract new young teachers into vocational education so that the age structure of the teaching staff is sustainable in terms of the need to continuously respond to new demands of practice).	2025	ZSPS, SIEA, POSK, SOSBA, SPSLC, SPSSKE, SPSSPO, SPSZA	✓		✓	✓	✓	
7	Change in the method and amount of financing for schools and material and technical provisions, to create a network of schools with a smaller number of schools, which will be supra-regional and specialised in the construction sector, so that they are provided with the required material and technical provisions (The status quo analysis showed that the biggest obstacle to the introduction of innovative educational concepts is the lack of state funding for vocational education schools).	2024-2025	RUZ, ZSPS, MSVVM, KGK, SOSPP, SOSBA, SPSLC, SPSSKE, SPSSPO, SPSZA	✓		✓	✓	✓	

Recommendation/ Measure number	Title (focus) of the recommendation or measure/action	Time plan for implement ation	Stakeholders leading the efforts aimed at implementing the recommendation or measure/action	Stakeholder to be involved					
				Employers	Sector Skills Councils	VET providers	Government	Regional	Accreditation bodies
8	Ensuring effective and sufficient data collection on the education system for its management, including the employability of graduates (Good quality and reliable data are needed for effective planning and programming of education, not only in the construction sector).	2024-2026	MSVVM, ZSPS, POSK, KGK, RUZ, SOSBA, SPSSKE	✓	✓	✓	✓	✓	
9	Creation of national campaigns on the applicability of education in the construction sector and systematic promotion of the sector by the state in the media (The transformation of the construction sector, changes in the nature and conditions of work in the construction sector must go hand in hand with the promotion of employment and career opportunities aimed at the public, primary school pupils and their parents).	2024-2028	ZSPS, SIEA, EKL, MD, KGK, SOSPP, SPSLC, SPSSKE, SPSSZA, TUKE	✓		✓	✓	✓	
10	Government support for continuing education (Construction is becoming a sector in which rapid changes in skills, knowledge and competence requirements will take place. For this reason, continuing education will play an important role, unparalleled in the past when the construction industry has resisted change and innovation).	From 2025	MSVVM, MD, POSK, KGK, RUZ, SOSPP, SOSBA, SPSSKE	✓		✓	✓	✓	

Recommendation/ Measure number	Title (focus) of the recommendation or measure/action	Time plan for implement ation	Stakeholders leading the efforts aimed at implementing the recommendation or measure/action	Stakeholder to be involved					
				Employers	Sector Skills Councils	VET providers	Government	Regional	Accreditation bodies
	Lifelong learning in this sector needs to be systematic, and its stability, quality and accessibility must be improved. For this reason, government intervention and financial support for all forms of lifelong learning is essential).								
11	Developing VET programmes aimed at Zero emission buildings, carbon neutrality, and circularity of buildings.	2024-2026	ZSPS, UVS, EKL, SPSSKE, TUKE, PZCEPA	✓	✓	✓			✓
12	Developing VET programmes aimed at integration of decentralised energy assets and management of flexibility	2024-2028	ZSPS, UVS VIAEUROPA, EKL, SPSSKE	✓	✓	✓			✓
13	Developing VET programmes aimed at integration of XR off and on construction site, and in education.	2027-2029	ZSPS, UVS, EKL, SOSBA, TUKE	✓	✓	✓			✓
14	Developing VET programmes aimed at Industrialised construction and Industry 5.0.	2029-2031	ZSPS, UVS, VIAEUROPA	✓	✓	✓			✓
15	Adaptation of education curricula to cross-trades.	2024-2025	ZSPS, RUZ, UVS, POSK, SOSBA, SPSSZA, SPSLC	✓	✓	✓	✓	✓	✓

Recommendation/ Measure number	Title (focus) of the recommendation or measure/action	Time plan for implement ation	Stakeholders leading the efforts aimed at implementing the recommendation or measure/action	Stakeholder to be involved					
				Employers	Sector Skills Councils	VET providers	Government	Regional	Accreditation bodies
16	Updating education curricula for vocational education at secondary level to technical progress in digital technologies in construction sector and regenerative cycle of buildings.	2026-2029	ZSPS, UVS, RUZ, POSK, KGK, MD, SOSPP, SOSBA, SPSLC, SPSSKE, SPSSPO, SPSSZA, TUKE	✓	✓	✓	✓	✓	✓
17	Updating education curricula for vocational education at secondary level to Industry 5.0 and industrial construction.	2029-2031	ZSPS, UVS, RUZ, KGK, SOSPP, SOSBA, , SPSLC, SPSSKE, SPSSPO, SPSSZA, POSK	✓	✓	✓	✓	✓	✓
18	Launch of the updated curricula for vocational education at secondary level – phase one.	2028-2031	ZSPS, UVS, RUZ, SOSBA, SPSSZA, POSK, MSVVM, MD	✓	✓	✓	✓	✓	✓

10. Monitoring

The progress in implementing the recommendations and measures/actions agreed in the Roadmap will be regularly reviewed by reinforced National Qualification Platform (NQP) and the Stakeholders' Roundtable – signatories of the “Green Deal for Buildings” (SR-GD4B):

- In December 2027;
- In December 2030.

The review will include proposals for new recommendations and measures/actions to be implemented if the stakeholders decide to do so.

Stakeholders in NQP and SR-GD4B may decide to carry out an ad-hoc review if the situation requires it, especially when new challenges or barriers arise in the process of implementing the current Roadmap.

The objective of such review shall be helping the stakeholders in implementing the current Roadmap and update the actions necessary for successful achievement of the objectives of the “Green Deal for Buildings” and/or the “European Green Deal”.

11. Conclusions

The construction industry has so far been little affected by innovation compared to other sectors such as the electrical industry, IT, automotive, which have radically changed the way the sector operates, the quality and the way it meets customer needs, with decreasing prices or little increase compared to the increase in value for the consumer. The main reasons for this are the outdoor-focused nature of the work being done and the fact that most of the actual construction takes place on the site that the building will occupy, with a lot of construction from an assembly of parts and materials on site - this limits the use of manufacturing methods and economies of scale that have long been the norm in other sectors. This has made labour productivity in the construction sector one of the lowest, leading to overpriced construction and unaffordable housing, especially for young people, who are literally being driven abroad by this trend.

This trend must be reversed, and the only way is to increase labour productivity by introducing innovations such as the industrialisation of construction production.

This means that the main skills requirements will be to be more adaptable and digitally focused. The construction industry will need to adapt and attract people from different backgrounds, such as strategists, cognitive and systems thinkers, data analysts, digital operators, and robotic programmers.

We will also see a demand for socially oriented skills, with the environmental and social governance (ESG) agenda of companies driving a focus on sustainability in structural design and manufacturing techniques, as well as a more people-centric skills base. This will mean new team types, new roles and new skills for existing professions that need to be sought from the best available talent. So, we also need to focus on attracting people from more diverse and inclusive backgrounds.

Not only the work environment will change, but also the learning ecosystem. Extended reality (XR) is coming to construction sites along with digitisation, BIM, digital twins, AI and robotics to create a symbiosis in the sense of the Industry 5.0 concept. It will become a powerful tool in guiding and navigating workers of all professions throughout the construction fabrication /assembly process to achieve strict technological discipline and the highest possible quality of work delivered. At the same time, XR has found its way into the education sector providing Virtual Reality (VR), Augmented Reality (AR) and Mixed Reality (MR) to create learning environments enabling the delivery of engaging educational programs. The XR family will become the technological link between the workspace and the learning space.

Formal vocational education in secondary schools will exist in symbiosis with continuing education, which will be able to respond rapidly to the needs for skills, knowledge, and competences for the introduction of key innovations and to assist curriculum development in formal education. The Roadmap developed proposals for the focus of new learning programmes and concrete steps for their design and implementation in school practice. The cooperation among stakeholders triggered by the dialogue on the Roadmap in reinforced NQP is a good recipe for a success of the stakeholders' efforts.

12. Authors/contributors

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13. Glossary

acquis EÚ	Level of regulation achieved in the EU
AI	Artificial intelligence
AR	Augmented reality
CDE	Common data environment

COVP	Vocational education and training centre
CZ	Czech Republic
CZT	Central heating
CŽV	Lifelong learning
EE	Energy efficiency
EHB	Energy performance of buildings
EHPA	European Heat Pump Association
EKR	European Qualifications Framework
EP	European Parliament
EPC	Energy Performance Contracting
EQAVET	European Quality Assurance Reference Framework for Vocational Education and Training
EQF	European Qualifications Framework
ESCO	Energy Services Company
ESG	Environmental, Social, Governance
EŠIF	European Structural and Investment Funds
ETS	Emissions Trading System
EÚ	European Union
IOT	Internet of Things
ISCO	International Standard Classification of Occupations
IVU	Individual education accounts
KEKS	Cluster of Energy Communities of Slovakia
MD SR	Ministry of Transport of the Slovak Republic
MDaV SR	Ministry of Transport and Construction of the Slovak Republic
MDV SR	Ministry of Transport and Construction of the Slovak Republic
MF SR	Ministry of Finance of the Slovak Republic
MPSVR SR	Ministry of Labour, Social Affairs and Family of the Slovak Republic
MR	Mixed Reality
MSP	Small and medium sized enterprises
MŠVVaŠ SR	Ministry of Education, Science, Research and Sport of the Slovak Republic
MTZ	Material and technical provision
MV SR	Ministry of the Interior of the Slovak Republic

NACE	European classification of economic activities from French Nomenclature statistique des activités économiques
nD BIM	n-dimensional BIM
NQP	National Qualifications Platform
NQF	National Qualifications Framework
NSP	National occupation framework
nZEB	Nearly zero-emission building
OVP	Vocational education and training
RES	Renewable energy sources
PED/PEDs	Positive Energy Districts
RRP	Recovery and Resilience Plan
PV	Industrial construction production
SIEA	Slovak Innovation and Energy Agency
SK	Slovak Republic
SKKR	Slovak Qualifications Framework
SOŠ	Secondary Vocational School
SQA	status quo analysis
SR	Slovak Republic
SRI Upgrade	Update of the smart readiness indicator
SSTP	Slovak Society for Environmental Technology
SZČO	self-employed person
ŠIOV	State Institute of Vocational Education
ŠR	National budget
ŠÚ SR	Statistical Office of the Slovak Republic
ULOs	Unit of Learning Outcomes
ÚOŠS	Central government authority
VA	Educational activity
VET	vocational education and training
VR	Virtual reality
VŠ	College
VÚC	Higher territorial unit
XR	Extended reality
Z. z.	Collection of Laws of the Slovak Republic



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ZEB Zero-Energy Building



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