

Skills shortages and structural changes in the labour market during COVID 19 and in the context of the digital and green transitions

Thematic Review 2023

Synthesis Report



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**Thematic Review 2023:
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COVID-19 and in the context of the
digital and green transitions**

Synthesis Report

European Centre of Expertise (ECE)
in the field of labour law, employment and labour
market policies

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Key messages

This Thematic Review aims to identify skills shortages that arose during the COVID-19 pandemic, and how digitalisation and the green transition further affect such shortages. The Review also documents policies and employer practices across the EU Member States used to mitigate skills shortages generally, as well as digital skills shortages specifically.

The Review uses two methodologies to identify shortages, yielding coherent conclusions. The first method examines actual and expected wage premia to identify skills shortages. The second method examines changes in vacancy rates between the first and second quarter over three years (2019, 2020 and 2021) to identify where labour shortages exist. Both have some limitations: vacancy data do not consider how quickly vacancies are filled and hence cannot distinguish between labour shortages and skills shortages. The methodology assuming wage premium data asserts that wage increases indicate a shortage in particular skills. For a more thorough examination, we use both methods, as complementary approaches.

In the early pandemic context (data up to 2020), shortages decreased in positions with high and intermediate skills requirements (both general and specific) in manufacturing, transport, finance, health and public administration, as shown by the analysis based on wage premia. Shortages also decreased for intermediate skills in wholesale and public administration. At the same time, the pandemic contributed to increased shortages for high skilled workers in construction, and shortages for intermediate specific skills in manufacturing, construction, transport, and finance. The evidence obtained from the analysis of the wage microdata is also supported via data on vacancies. The recorded increase in vacancies (i.e. recovery of economic activities) was highest in the manufacturing, construction, wholesale, transport, accommodation and restaurant sectors. These findings are broadly consistent with other studies that show the development of labour shortages after the outbreak of COVID-19.

Digitalisation was found to be a key driver of skills shortages, while the green transition was considered of smaller magnitude as a driver of skills shortages at the time of writing, although its effects are expected to increase in the future, based on the analysis of qualitative information from 27 country articles. Digitalisation as a driver of skills shortages has been reported in 19 Member States. Other most frequently reported drivers include population ageing (in 18 Member States) and a mismatch between the education system and labour market demands (in 15 Member States). Cross-sector mobility during the COVID-19 lockdowns was identified in 14 Member States and caused an outflow of labour from some sectors (e.g., restaurants, tourism and catering), followed by a lack of labour once the activities in such sectors resumed.

Most shortages and their drivers were already present before and became more prominent during the COVID-19 pandemic in most sectors. In general, the pandemic was found not to have created new drivers of skills shortages but rather accelerated already existing labour shortages induced by structural factors (population ageing, education mismatches, digitalisation, and only partially the green transition).

Policy responses to address skills shortages during the COVID-19 pandemic can be seen as a continuation of those developed over the last decade, aiming at better matching of education and skills development to the needs of the labour market. During this period, 18 Member States (Bulgaria, Czechia, Cyprus, Germany, Greece, Spain, Finland, France, Croatia, Hungary, Ireland, Latvia, Italy, Malta, Portugal, Romania, Sweden, Slovakia) adopted related measures, including:

1. **promoting access to and participation in all levels of education and training;**
2. **increasing the attractiveness of subject areas in high demand**, especially among female students, as women are often underrepresented in sectors with skills shortages (e.g. sectors related to Science, Technology, Engineering and Mathematics [STEM]);
3. **providing more and better trained teachers and instructors in Vocational Education and Training (VET) and adult learning**, especially in subjects that are in high demand;
4. **increasing the funding and capacity of educational institutions** that prepare specialists which are in high demand;
5. **improving the quality and effectiveness of education and training provision** through, for example, revised curricula in line with labour market needs, work-based learning, innovative methods for teaching and learning based on digital technologies.
6. **PES implementing measures to support the development of skills**, with the challenge of ensuring that they match employer needs, as well as dedicated measures to promote digital skills.

To address skills shortages stemming from the digital and green transitions, EU Member States have adopted a number of policies, including:

- investing in new technologies;
- identifying current and future needs for skills;
- ensuring sufficient numbers of qualified teachers and trainers; and
- providing digital and green skills training to the broader population across the EU, including students, employees, jobseekers, public administration and the economically inactive as part of institutional and workplace training.

Overall, many initiatives are reported to address the digital transition and to provide ICT skills across economic sectors. Ensuring green skills is a relatively new topic and several planned measures are yet to be implemented, but a number of countries are already adopting specific policies to support their development.

Evidence on the coverage and effectiveness of many of the policy responses to skills shortages across the EU is still scarce and should be strengthened going forward. Available evidence relates to a strategy to secure skilled and highly skilled labour in Germany, short vocational training programmes in Denmark, targeted youth programmes in France, the overarching Human Capital Initiative in Ireland, a commission linked to the public employment service (PES) discussing labour market needs in Latvia, a subsidized short-time work scheme in Sweden and a dual vocational training system reform in Slovakia.

The most prevalent response by employers in the EU Member States to address skills shortages has been to train staff. This is done through employers' own on-the-job and off-the-job trainings (usually in large companies) and publicly funded training schemes. Other common ways for employers to tackle shortages is through collaborations with stakeholders: educational institutions (to design courses responding to labour market needs); public employment services; social partners; private employment agencies and other employers. Employers further use a combination of human resource management

approaches, such as enhancing the attractiveness of current jobs (via wage increases, improving working conditions, image campaigns), as well as attracting new labour (hiring foreign workers, workers from under-represented target groups, new apprentices).

The digitalisation of the economy has generated demand for digital skills at all levels. These range from basic digital skills to advanced and high-level expert ones to apply and develop digital solutions. Digital skills have become a basic and transversal competence, increasingly necessary to perform a wider set of jobs. Gaps in digital skills at all proficiency levels are potentially slowing down the digitalisation of the economy and reducing the employability of people, and in a wider context also their access to increasingly digitalised services. Using new technologies to support the greening process may eventually also necessitate increasing digital skills to use those technologies. Therefore, programmes to develop digital skills targeted at the population as a whole and at all stages of the learning life cycle have been developed. Measures and programmes have also been set up to target specific population groups to close the digital divide, for employed persons in a logic of upskilling and skills adaptation, and for the unemployed to make them fit for the labour market.

The promotion of STEM contents and digital skills in schools as well as improving IT infrastructure for education were mentioned as key measures to address digital skills shortages in 10 EU Member States. However, these and similar measures are challenged by digital skills shortages among teachers, also because teachers with relevant skills often leave schools as they can earn more in other occupations. It also appears that more measures need to be implemented along the skills production value chain, starting at pre-school age as well as in the world of work, in order to overcome still existing strong gender stereotypes.

Social partners are involved in various areas of digital skills development. Institutionalisation of their involvement (via institutions such as national councils on VET and commissions to adapt training plans) is comparatively high and well-established in some countries (e.g. Portugal, Sweden, Cyprus, Luxembourg, Bulgaria, Croatia). In other Member States participation of the social partners is either weak or there is no institutionalised structure that is specifically tailored to digital skills detection, planning or provision (e.g. Poland, Romania, Slovenia).

Besides social partners, a wide range of other stakeholders are involved in most countries in the detection of digital skills needs and/or the planning and provision of digital skills, via so-called skills coalitions, also in the context of EU initiatives (e.g. Denmark, Germany, Italy, Estonia, Greece, Czechia, Finland, Ireland, Luxembourg) and the elaboration of digital skills strategies. A number of PES also implement dedicated measures to promote digital skills. One major challenge for PES is to offer training courses that match the current needs of employers. Also triggered by the pandemic context, PES have been increasingly offering online courses to train the unemployed in digital skills. Involving a large number of public and private partners, including from academia, in designing and implementing digital skills development strategies appears an effective way to push towards closing skills gaps and overcoming skills shortages.

Employers in 14 EU Member States report taking measures to mitigate skills shortages related to the digital and green transitions. These measures mainly include digital skills training and adaptation of their business processes as well as offering trainings made necessary by these business process adaptations.

1 Introduction

The aim of the Thematic Review is to map evidence and drivers of shortages in skills, as well as related policy responses, that have been emerging during the COVID-19 pandemic as well as in the context of the digital and green transitions.

It reviews the most recent data and expert knowledge on skills shortages, their drivers, and most importantly, relevant policy responses across the EU Member States. Driven by EU-level data analysis and informed by country-specific evidence on the sectors and occupation groups facing the highest shortages in each EU Member State, this synthesis report considers the effect on shortages of recent structural changes such as the digital and green transitions and their potential acceleration in the context of the COVID-19 pandemic. The report also discusses the emerging situation regarding digital skills. It then examines responses to shortages at two levels: (a) the policy level; and (b) the microlevel, looking at how firms/employers respond to shortages in sectors and occupations as emerging in 2020-2021.

Background to the Thematic Review

Labour shortages and skills shortages are often used interchangeably but they are different concepts. While the general concept of labour shortages refers to demand for and supply of labour without further specification, in reality shortages emerge due to shortages in labour's skills (Zimmermann et al. 2007). **Labour shortages** reflect a market disequilibrium where the demand for labour exceeds the available supply, at the prevailing wages and working conditions, at a particular place and point in time (Barnow et al. 2013). This disequilibrium, however, can adjust through the elastic supply of labour in response to wages until a new equilibrium is reached. In practice, this elasticity may depend on either quick training options, mobility or flexible entry in the labour market.¹ In contrast, **skills shortages** arise where employers are unable to fill a post due to lack of suitably skilled candidates and at the ongoing, possibly high, rate of pay (Quintini, 2011). Table 1 summarises the conceptual differences between labour shortages and skills shortages.

Table 1. Labour and skills shortages

Labour Shortages	Skills Shortages
Market disequilibrium	Market disequilibrium
Demand for labour exceeds labour supply	Demand for labour exceeds labour supply
Skilled labour is available but not willing to work at given wages and/or working conditions	Lack of suitably skilled job seekers
Can be addressed via wage increases and improvements in working conditions	Cannot be flexibly solved by adjusting wages and working conditions; education/training measures are needed to develop skills

Source: Barnow et al. (2013) and Quintini (2011).

Skills shortages are often triggered by causes that are external to the ongoing skills matching process. The issue here is that the workforce with the desired skills is not available and ready to take jobs even if the pay is attractive. Instead, workers with

¹ Reaching an equilibrium may still be a challenge. Labour mobility and migration may alleviate shortages in skills in the receiving countries or regions but may potentially contribute to labour shortages in the country of origin.

these skills need to be first trained, which suggests a longer time required to fill such vacancies. Labour shortages are instead perceived as shorter-term phenomena, which, if wages rise, are resolved as talent enters the relevant labour market and vacancies are quickly filled. This can be due to a sectoral effect and linked to booms and recessions, e.g. when low-paid teachers find jobs as waiters or shop attendants, but in a recession return to teaching.

On the supply side, shortages have also been triggered by external shocks such as the global COVID-19 pandemic and by broader trends such as demographic change. The impacts of the pandemic on population health as well as policy responses to the pandemic restricting people's mobility (e.g. lockdowns) have led to disruptions in work and training arrangements, affecting the provision of relevant skills in the labour market. Ageing and fertility declines are long-term processes that restrict the supply of labour, and possibly that of skills.

The digital and green transitions and increasing demand for health and care, for instance, have been inducing greater demand for certain skills, thereby aggravating structural shortages, since it takes time for the supply of labour to adjust to changing requirements and new occupational profiles. Demand-induced labour and skills shortages emerged in the context of the COVID-19 pandemic in relation to the need for the production of protective equipment, increased requirements for medical staff and administrative staff in epidemiological authorities, changes in the types of services demanded and delivered. Such changes were evident in e.g. the healthcare and hospitality sectors, and through the shift to online consumption. Other factors have also led to labour shortages in specific occupations, e.g. prevailing low wage levels and working conditions for nurses and long-term care services. It is expected that labour market transformations due to automatisisation, digitalisation and the green transition will bring about even more reallocation of economic activity and skills demand between industries and occupations.

In sum, the distinction between skills shortages and labour shortages is relevant due to the different responses they require by policy makers and employers and point at different ways of measurement. If the labour market is sufficiently flexible, firms can respond to labour shortages by adjusting wages and working conditions or by investing in new technologies. Consequently, vacancy statistics are best used for detecting them as wages adjust. In contrast, skills shortages cannot be flexibly solved in a short time frame by e.g. increasing wages and thereby attracting more workers into a certain profession or preventing workers from leaving a specific sector or occupation (e.g. nurses) (Desjardin and Rubenson, 2011). To address them requires changes in education and training policies to secure workers with the desired skills mix. As wages do not adjust rapidly, wage premia not explained by other factors can be used to confirm such shortages, besides vacancy statistics.

Scope and structure of this report

This synthesis report is based on an analysis of available EU-level data as well as qualitative information collected from unpublished country articles prepared by independent experts from the ECE pool of experts. The country experts were asked to identify the sectors facing the highest labour shortages in their country and collect evidence on effective policy responses and employer responses to skills shortages, based on information from qualitative interviews and national literature and information sources. The information contained in the country articles and this synthesis report covers the period up to 31 January 2022

when experts completed their country articles (hence does not include any discussion related to the war in Ukraine and its repercussions).

The report is structured as follows: section 2 discusses trends in skills shortages across the EU Member States while section 3 examines evidence on skills shortages due to structural labour market changes, looking at the effect of the COVID-19 crisis and the drivers of skills shortages across Member States. Section 4 examines policy and employer responses to skills shortages while section 5 focuses specifically on initiatives supporting the development of digital skills.

2 Identifying shortages across the EU

This section discusses methodologies for the assessment of shortages in the EU.

The key question is where skills shortages emerged during the pandemic (2020-up to Q3 2021) compared to the pre-pandemic situation. The data used in the analysis includes wage premia data available from EU-SILC and Eurostat vacancy data for all EU Member States. Shortages are assessed using two methodologies to allow a better estimation, accounting for the extent to which shortages emerge in skills that need to be developed and are not readily available in different segments of the labour market.

Labour shortages can be assessed at the macro- and the micro-economic level.

At the macro level, a shortage can be assessed by comparing the composition of vacancies by qualification or education level (as a proxy for labour demand) with that of the working age population (as a proxy for labour supply). If an existing vacancy with a given requirement (e.g. for skills) exists and there is a corresponding person among those not working with these requirements, then a labour shortage is detected (see Table 1 in the Introduction). Instead of vacancies, one can also compare the composition of employment by education level with that of the population at working age, or the composition of unemployment by education level with that of the labour force. These data pairs are used to compute relative or absolute dispersion measures to reflect mismatches that can be present due to shortages and thus provide a good proxy to it. At the micro level, the logic is the same. Labour mismatches are typically measured by comparing the skills or qualifications of an employed worker with the skills or qualifications required by her or his job. If the worker has skills compatible with the job profile, there is a match, indicating that an employer is able to hire a person with the required qualifications. A worker can also be over- (or under-) skilled in relation to a specific position, both suggesting a shortage, i.e. an appropriately skilled person not being available for the job.

The key difference between skills and labour shortages is the speed at which labour supply can adjust. In the case of skills shortages, increasing the wage level does not help to fill vacancies, as persons with the required skills are not readily available in the local labour market. In case of labour shortages (without skills shortages), short-notice demand for certain professions increases and adjustment is fast as appropriately skilled workers move across sectors within the local labour market.

Distinguishing skills- and labour shortages poses measurement challenges. The literature suggests relying on multiple indicators, such as unemployment and vacancy rates, employment growth, wage growth, and their changes over time, to identify labour market segments with the highest shortages (c.f., Eurofound 2021, Quintini 2011). While the available sources help to conceptualise the differences between labour and skills shortages, measuring their difference empirically remains challenging and underexplored. This report applies two methodologies to estimating these shortages and assessing to what extent skills shortages were driven by the digital and green transitions and accelerated by the COVID-19 pandemic. The two methods build on wage and on vacancy data, respectively. They are further supplemented with qualitative evidence on skills shortages provided by country experts.

First, this report establishes that data on changes in wage premia in particular occupations and sectors can usefully supplement the methodology based on changes to vacancy rates per sector. Drawing on Guzi et al. (2018), a quantitative model is established to compare predicted and actual wage premia in sectors and occupations as a proxy of skills shortages. **The skills shortage is indicated by a higher actual**

wage premium exceeding the predicted value for a particular skill level and sector. This methodology is innovative and has not yet been used elsewhere for a similar analysis. In contrast to the methodology based on vacancy rates, it allows to assess skills shortages at distinct skills levels, e.g. high-skilled vs. low-skilled jobs, thus not limiting the analysis only to sectors. The calculations use EU-SILC data and also allow an assessment of changes in wage premia over the period before the outbreak of the COVID-19 pandemic with the period of the pandemic itself. At the time this report had been completed, 2020 data were the latest available.

Secondly, **changes in vacancy rates, which are used as a proxy for excess labour demand, are examined.** This approach shows the number of jobseekers per job opening for different segments of the labour market, data available from Eurostat for all EU Member States. Data on the extent of vacancies across sectors are used e.g. in Eurofound (2021) to identify shortages in general, without distinguishing whether shortages are labour or skills shortages or e.g. in the Business and Consumer surveys where companies indicate particular difficulties to fill (certain) vacancies. To link vacancy data with skills shortages, one would need evidence on how fast these vacancies were filled. Such data are not available. Eurofound (2021) examines the extent of vacancies, while this report applies the vacancy rate methodology to uncover trends in vacancies within specific sectors across time. A change in vacancy rates serves as an indicator of rising or declining labour shortages.

Identification of skills shortages using the wage premium approach

The wage premium approach identifies skills shortages through comparing estimated wage premia in 2020 to a reference value. The wage premium represents the part of wages that remains unexplained after compositional differences across types of workers are accounted for. The state of shortage is indicated by these premia being above a certain level. The estimation of premia accounts for individual or institutional factors (e.g. unionisation rate and collective bargaining) in a multivariate regression framework.² Firstly, trends in wage premia for occupational groups in particular sectors in each Member State rely on a series of estimates for 2016, 2017, 2018 and 2019 (Guzi et al. 2018).³ Secondly, the value linearly extrapolated from these estimates to 2020 is compared to the actual estimate for 2020. When we observe a deviation from the extrapolated trend in 2020, we attribute it to an increased shortage due to COVID-19.

The percentage gaps between predicted values and actual wage premium values in 2020 and aggregated by sector and skill level are shown in Table 2.⁴ **Negative values indicate the increasing shortage of workers in 2020 against expectations and positive**

² In particular, for each year separately we estimate a log-wage regression of the form $W_{ikc} = X_{ikc} \beta + \gamma_{kc} + \varepsilon_{ikc}$, where W_{ikc} is the log wage of worker i who belongs to occupation-industry group k in country c , X_{ikc} is a vector of individual characteristics including gender, education, work experience and work experience squared, and ε_{ikc} is the error term. The wage and all variables in vector X_{ikc} are normalized to have zero means. The vector γ_{kc} can be then interpreted as the (adjusted) percent wage differential between the average wage of individuals in the particular occupation-industry-country cell and the mean wage for a given year in the EU. The vector γ_{kc} is the indicator of skill shortage.

³ The estimation uses EU-SILC data for the outcome variable being gross wage [SILC py010g]. Unlike most income variables in the dataset, this refers to the survey year. Because we normalize the wage variable to have zero mean in each country and year the wage premium can be interpreted as the (adjusted) percent wage differential between the average wage of individuals in the particular skill-industry-country cell and the mean wage for a given year in a given country (adjusted for any differences in the individual characteristics listed above).

⁴ Table 2 averages country estimates. The gap is calculated as $100 * (\text{predicted} - \text{actual}) / \text{actual}$.

values indicate the opposite - an excess supply of workers in 2020 against expectations, hence a drop in shortage.

Table 2. The gap (%) between predicted and actual wage premium in 2020 by industry and skills levels.

Industry	ISCO high skill level	ISCO inter-mediate general skill level	ISCO inter-mediate specific skill level	ISCO low skill level	Total
a: agriculture	-293		8	42	-81
b - e: manufacturing+industry	30	-14	-89	-24	-24
f: construction	-67	24	-40	8	-19
g: wholesale and retail	-5	-6	108	-20	19
h+i+j: transport, hotels and restaurants	52	-4	-31	-11	2
k,l-n: finance and estate	-13	370	-30	19	86
o, r-u: public administration and social work	-8	107	31	-7	31
p: education	12	19		-14	6
q: health	29	20		-14	12

Source: ECE, own calculation based on EU SILC 2016 - 2020

Notes:

The table shows the % gap between predicted wage premium in 2020 and actual wage premium in 2020. The predicted wage premium in 2020 is based on the linear trend over 2016-2019. A negative number indicates the increasing shortage of workers in 2020 against expectations (including i.e. the impact of the pandemic). A positive number indicates the opposite - an excess supply of workers in 2020 against expectations and a drop in skill shortages.

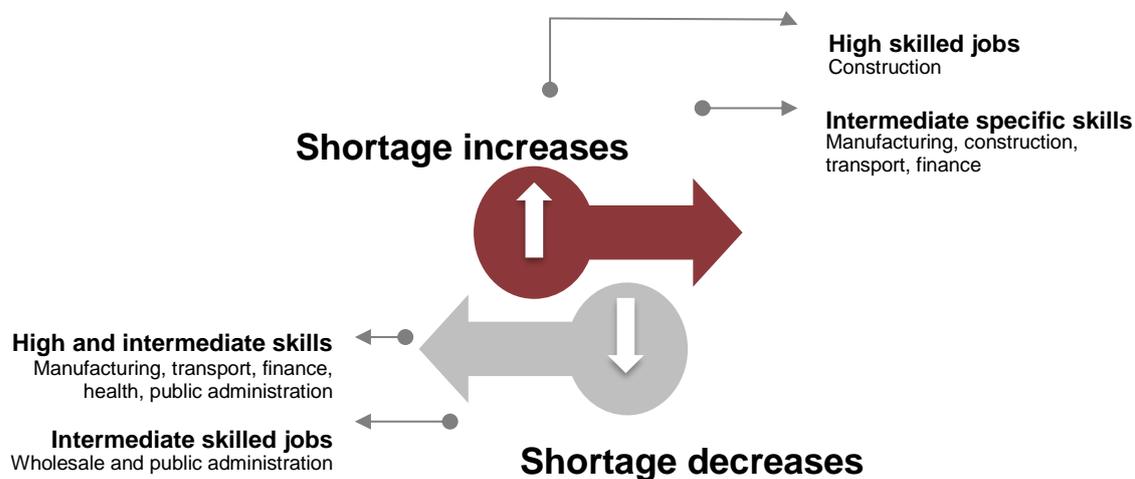
The four skills levels are based on the ISCO classification: high (ISCO 1, 2, 3), intermediate general (ISCO 4, 5), intermediate specific (ISCO 6, 7, 8) and low (ISCO 9).

Empty cells indicate that the latest data is not available or that cells are too small for calculation. For the agriculture sector, data is not available or is too small for calculation for 13 Member States, hence findings should be read with caution.

Table 2 above indicates that the pandemic (in the early pandemic context, using 2020 data) increased shortages for high-skilled workers in construction, for intermediate specific skills in manufacturing, construction, transport, and finance and for low-skilled in manufacturing and wholesale and retail trade.

Skills shortages decreased in high-level occupations in manufacturing and transport and for intermediate general skills in finance and in public administration and social work. Shortages also decreased for intermediate skills in wholesale and public administration. These findings are summarized in Figure 1.

Figure 1. Findings on skills shortages increase and decrease in the early period of the COVID-19 pandemic (data up to 2020)



Source: authors' elaboration using the wage premium methodology applied to EU-SILC data (2016 – 2020).

Identification of labour shortages using job vacancy rates

Under the second approach, **we measure labour shortages by examining changes in the labour demand using Eurostat statistics on quarterly job vacancy rates.**⁵ The job vacancy rate measures the proportion of total job posts that remain vacant in each quarter on the total number of job posts. We examine the changes in vacancy rates between the first and second quarter over three years: 2019, which is the pre-pandemic year, 2020, which captures the drop of economic activity due to the outbreak of COVID-19 in the second quarter, and 2021, which represents the recovery phase in the post-pandemic period.

An examination of vacancy rates across sectors and EU Member states in the second quarter of 2021, shows that at the country level, the vacancy rates vary between 2% (Bulgaria) and 10% (Czechia) and that:

- High vacancy rates persisted in accommodation and food, information and communication, and activities that support general business operations.
- Vacancy rates are considerably high in most EU Member States also in construction, professional activities and public administration.
- The smallest vacancy rates observed in most countries are in agriculture, education, finance, real estate and entertainment and recreation.

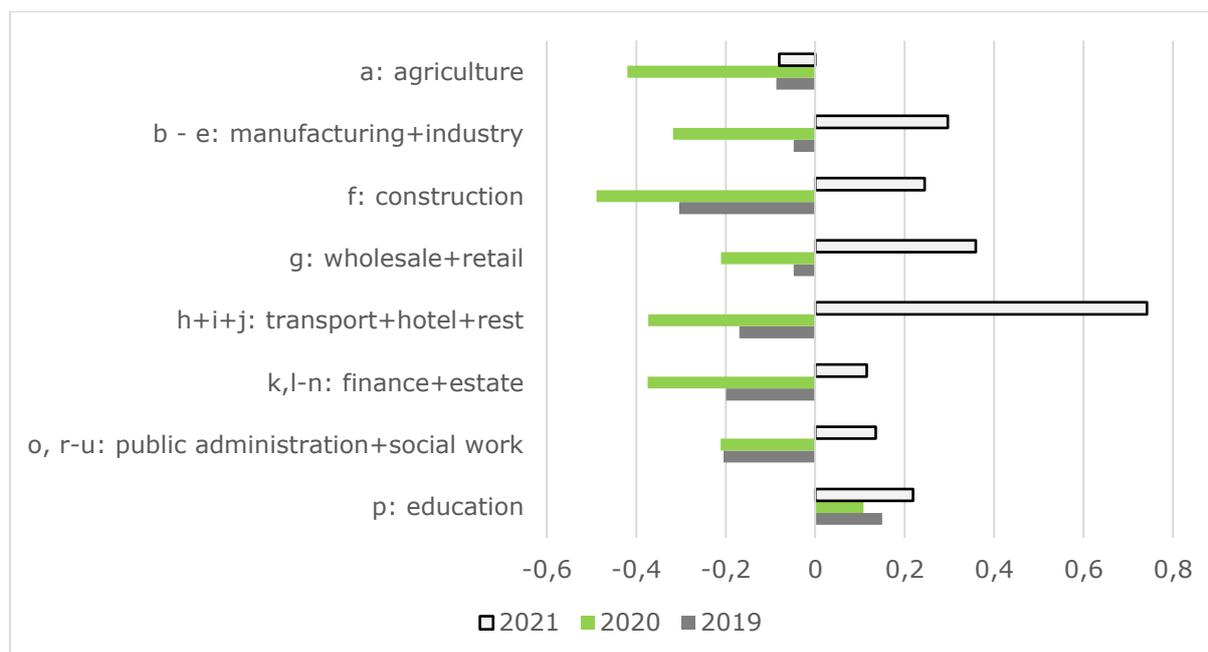
⁵ Job vacancies represent unfilled job positions. Eurostat defines a job vacancy as 'a paid post that is newly created, unoccupied, or about to become vacant and for which the employer is taking active steps and is prepared to take further steps to find a suitable candidate from outside the enterprise concerned'.

To illustrate the impact of the COVID-19 pandemic on the dynamics of the labour market, we present the difference between job vacancy rates in the first and second quarters for three consecutive years.⁶ The 2019 values represent the situation before the outbreak of COVID-19, the 2020 values reflect changes due to it and the 2021 one illustrates adaptations to the pandemic situation.

Figure 2 below shows negative values in 2019, meaning more vacancies being available in the first than in the second quarter. This reflected a “normal” pre-pandemic situation when many employment contracts terminated by the end of the year and firms sought to hire new employees in the first quarter of each year. The reduction was more pronounced in construction, transport, restaurant, finance and public administration.⁷

The outbreak of the pandemic in the second quarter of 2020 caused a drop in the number of available vacancies compared to the first quarter. Differences between the second and first quarter in all industries in 2020 were lower than in 2019. This means that there were fewer vacancies posted in 2020 relative to the situation in the previous year in all industries. **The largest drop is visible in manufacturing, wholesale, construction, transport and agriculture. The milder drop in 2020 relative to 2019 is visible in finance, while labour supply changed slightly in education and public administration.**

Figure 2. Job vacancy rate differences between the second and first quarter, 2019-2021



Source: Authors' elaboration based on Eurostat data (table jvs_q_nace2).

Note: Quarterly job vacancy rates, not seasonally adjusted. A – Agriculture, B – Mining, C – Manufacturing, D – Energy supply, E – Water supply, F – Construction, G – Wholesale and retail trade, H –

⁶ We prefer comparing quarterly changes across the years, rather than levels, to capture the immediate impact of the pandemic on skill shortages. The pandemic started in the second quarter of 2020. The milder drop in 2020 relative to 2019 is also visible in construction and finance, while labour supply changed slightly in education and public administration.

⁷ Education is an exception, because of the seasonality in school hiring.

transportation and storage, I – accommodation and food service activities, J – Information and communication, K – Financial activities, L – Real estate, M – Professional and scientific services, N – administration service, O – Public administration, P – Education, Q – Health, R – Arts, S – Other services

Discussion of skills shortage estimates

The findings on the extent and changes in skills shortages across the EU Member States, based on comparing the findings of the two different methodologies, indicate that according to data up to Q2 2021, **shortages mostly decreased in positions with high and intermediate skills requirements (both general and specific) in manufacturing, transport, finance, health and public administration. Shortages also decreased for intermediate skills in wholesale trade and public administration and for low skills in agriculture.** At the same time, **the pandemic contributed to increased shortages for high skilled workers in construction and agriculture, and shortages for intermediate specific skills in manufacturing, construction, transport, and finance.** The evidence obtained from the analysis of the microdata is also supported via data on vacancies. The recorded increase in vacancies (i.e. recovery of economic activities) was highest in the manufacturing, construction, wholesale, transport, accommodation and restaurant sectors.

Our findings are broadly consistent with other studies that show the development of labour shortages after the outbreak of COVID-19. By looking at the vacancy rates in the third quarter of 2020, Eurofound (2021) concludes that labour shortages remain visible particularly in the information and communications sector, administrative and support service activities, human health and social work activities, accommodation and food service activities and professional, scientific and technical activities. The authors find labour shortages in the majority of EU Member States. Their results align with our findings from examining wage premia, while the wage premia approach provides a finer identification of skill shortages for occupational groups in particular sectors (as per Table 2 above). We find labour shortages increased the most in high skilled occupations in agriculture, construction, and finance, for intermediate specific skills in manufacturing, construction, transport, and for low skilled occupations in wholesale, transport, administration, education and health.

Results from the two empirical approaches used add more confidence to our conclusions that demand for employment decreased in manufacturing, sales, and services in 2020 and a subsequent recovery took place in 2021. The demand for workers in occupations characterized by intermediate specific skills was less affected during the pandemic relative to other occupations. There are limitations to our approach that should be mentioned as well. The vacancy rate approach depends on the quality of vacancy data, which may be focused on low-skilled positions and thus underestimate more skilled segments. In the second approach, we use unexplained wage premia (at the level of occupation-industry-country cells) as an indicator of skill shortage. The wage-growth approach is also limited as it does not include non-financial incentives (e.g. working conditions, training opportunities). The analysis is also limited by the availability of microdata (the most recent data is from 2020), hence it only includes the early stage of the pandemic. The labour market situation over this period is influenced by restrictions on economic activity but reflects the impact of job retention schemes as well. The findings should be therefore interpreted with caution until more recent data are available for the analysis.

The findings presented above refer to the overall picture based on aggregate level data covering the EU-27. There is, however, heterogeneity in the situation of individual Member States. The next section examines the situation in individual countries as well as the drivers of skills shortages in more detail.

3 Skills shortages due to structural labour market changes

This section looks at skills shortages in specific sectors and occupations and analyses the extent to which they are a consequence of structural labour market changes related to the digital and green transitions. The analysis is embedded in the context of the COVID-19 pandemic, which represents an external shock to the labour market. The section is divided into two sub-sections, first looking at challenges linked to skills shortages due to structural changes, and second, investigating the drivers of these shortages.

This section offers an insight into the differentiated picture across the EU Member States based on unpublished country articles prepared by experts from the ECE pool of experts. The analysis adds to the aggregate-level evidence and analysis presented in Section 2, which was based on EU-level data. Although this part is not fully comparable across countries, as different methodologies and data are used at the national level, it provides examples and evidence on particular developments in skill shortages in specific Member States.

The country articles, which are the main source of evidence presented here, draw on a number of data sources. Aside from Eurostat data, additional national data sources used include national surveys, administrative data, qualitative evidence as well as expert knowledge. In particular, national surveys provide systematic and detailed evidence that complements Eurostat vacancy data. For example, employer surveys conducted by the Public Employment Service (PES) in **Sweden** showed an increasing shortage of workers in the private sector during 2021. In **Greece**, the Hellenic Federation of Enterprises (ΣΕΒ) implemented a survey of 831 firms employing over 30 workers, conducted in 2018, to assess vacancy rates. In **Poland**, a Sectoral Study of Human Capital analysed the match between supply and demand for competencies in particular industries. Similar country-specific data sources can also be found in other Member States.

In addition to the methodologies used in section 2 above – calculating wage premia and examining vacancy rates as indicators of skills and labour shortages respectively – this Review also examined additional, mostly qualitative, data sources across the EU Member States.⁸ National data sources complement the EU-wide analysis based on the wage premia and vacancy rate methodologies presented in the previous section. Since each of the two methods have benefits and shortcomings, the qualitative evidence from the country articles help to contextualise the findings presented in the previous section. Based on all the above, this section summarises key developments in relation to:

- **The digital transition** and the skills shortages it has induced, as well as the occupation groups and sectors affected;
- **The green transition** and the skills shortages it has induced, as well as the occupation groups and sectors affected (although these are not straightforward to identify, due to a lack of common definitions of green skills and jobs⁹);
- **The effects of COVID-19** on skill shortages, as integrated to the above.

⁸ These additional national sources were identified by country experts and elaborated in the country articles that served as a background for this Synthesis Report. These data are mostly qualitative and include findings from interviews the experts conducted.

⁹ During the time of writing, a commonly used EU definition of green skills and jobs was not yet available. On 25 March 2022, the European Commission published a new taxonomy of green skills in European Skills, Competences, Qualifications and Occupations (ESCO).

3.1 Where skills shortages emerge

The country articles show that, in the majority of Member States, skills shortages were perceived as being driven by factors on both the demand and the supply side. Inadequacy of supply and demand may be perceived as structural, related to wages, working conditions, worker preferences but also connected to challenges in relation to decarbonisation and digitalisation.

Supply side features relate to skills mismatches and employability challenges, including:

- **structural and long-term unemployment** leading to skills depletion, accompanied by a lack of adequate training of the unemployed (this for example contributes to labour shortages in Spain);
- **vertical skill mismatches**¹⁰ that cause an inefficient allocation of skills, indicating mismatches between qualification levels attained and jobs performed (relevant for example in Romania and Slovenia);
- **horizontal mismatches** with a significant share of those working in different sectors than those implied by their training, causing significant skills gaps and shortages (reported for example in Bulgaria and Slovakia).

Among the structural reasons for labour and skill shortages, rigidities along geographic locations and industrial specialisation play a major part. Shortages were more severe in rural areas, for which examples include healthcare in **France**, or availability of nurses in the majority of Member States that joined the EU after 2004. Countries whose industries relied mostly on cheap labour but are now in need to increase the digital skills of highly specialised positions, e.g. **Slovakia**, expect serious labour shortages mostly among highly specialised positions.

In the recovery from the pandemic, **factors contributing to skills shortages include a situation when the unemployed are no longer able to fill vacancies, because of their small pool and/or their insufficient qualification**, identified e.g. in **Slovenia**. In **Italy**, high skilled occupations are hard to fill because of a lack of appropriate skills (but not lack of applicants), while low and medium skilled positions suffer from a lack of candidates and partially a lack of skills.

Demand-side features include quality of jobs offered and quantity of demanded workers by skills type, which cannot be filled flexibly due to a lack of desired skills mix:

- **a worsening in the quality of employment in the post-pandemic period** is reported, for instance, in Finland as preventing the unemployed from taking up some jobs;
- **projections mostly predicting an increase in demand for high skilled workers, while the opposite is expected for low qualified positions**, as for instance in Denmark and Hungary;
- **skills shortages in medium-qualified positions** reported in countries where the manufacturing sector is dominant (e.g. Czechia and Hungary), but with the

¹⁰ The EUROSTAT Database on qualification mismatches defines two skills mismatch indicators: (1) the Over-qualification rate (vertical skills mismatch) and (2) the Job mismatch by field of education (horizontal skills mismatch).

expectation that their number will be decreasing in the future. In Germany, where the manufacturing sector is very strong, a shortage of VET-trained workers has been reported for many years, with supply-side factors playing a role as well (as fewer young people enrol in VET).

Several sector-specific trends have been systematically reported in more than one Member State. These refer to the presence of skills shortages prior to the COVID-19 pandemic, high shortages for ICT specialists, the expected shortages in digital skills due to the transition to green energy sources, and the skills shortage effect of decarbonisation trends across the EU Member States:

- **Healthcare:** shortages were present long before the pandemic; nevertheless, the spread of COVID-19 worsened the situation. Especially in intensive care, labour shortages increased in France, which led to a change of legislation on limiting the number of medical students (*numerus clausus*), valid since the 1970s. This legislation was suspended in 2020. Member States with persisting significant wage differences in healthcare and social care experienced the greatest outflow of professionals over the past two decades. In consequence, healthcare provision is endangered by the lack of workers, but also by the ageing of healthcare professionals, in countries such as Romania. Labour shortages in healthcare are also a reality in many high-income countries where professional organizations and trade unions often point out problematic working conditions due to long hours, overtime, high workload, work-related stress and inadequate salaries. To address some of these issues, solutions around cross-border commuting emerged in some Member States. For example, wage differences between some German regions and neighbouring Luxembourg made the healthcare sector attractive for commuting, though with the travel restrictions introduced due to the COVID-19 pandemic, the trend reverted.
- **Construction: skills shortages have been present for several decades despite large shares of foreigners employed in the sector.** Skills shortages further accelerated during the pandemic, e.g. in **Denmark, Germany and Malta**. In **Denmark**, 49% of recruitments in construction are unsuccessful. This is mostly because of low interest in the sector and a lack of retraining opportunities. Shortages are expected to persist also due to the green transition. In the **Netherlands**, it is expected that skills transformation will be required because of new materials and new energy saving approaches. For instance, occupations like plumbers will need to attain digital skills as heating technologies are becoming more digitalised.
- **ICT: skills shortages among ICT specialists in the majority of Member States accelerated during the COVID-19 pandemic.** This trend is also expected to continue in the future, albeit, in some countries, only specific professionals such as managers, analysts or those working with a specific IT language and software are needed. In **Romania**, the number of ICT graduates is high, but shortages persist due to a high digital mobility of ICT workers working for foreign employers while residing in their home country (mentioned also in the case of **Bulgaria**). Digital skills are also expected to gain importance in sectors such as logistics, retail, education, contributing to increases in skills shortages.
- **Decarbonisation is a structural challenge, with job losses for miners reported in fossil fuel mining regions in Czechia, Estonia, Poland and Slovakia.** In this case, the dominant concern is the availability of retraining for laid-off workers and workers at risk of losing their jobs, while forecasting of skills and

types of jobs that will be needed in the future, as done in some countries such as Germany, to better prepare them for the transition, are crucially important.

- **Additional digital skills shortages emerge due to the transition to green energy sources**, as already reported in **Germany** and **Sweden**. The lack of some specific skills of electric power technicians may cause the insufficient expansion of electricity networks, for example, which may jeopardise the transformation of Sweden’s fossil-free steel production.

In addition to the above broader trends shared by several EU Member States, Table 3 below summarises skills shortages in sectors that are specific to some Member States.

Table 3. Evidence on skills shortages in sectors/occupations specific to individual Member States (MS), beyond overall EU-wide trends

MS	Sector and/or occupation	Description
BE	Hotels and restaurants – management positions	In the accommodation and food service industry, kitchen and hotel occupations are experiencing the highest shortages. The three occupations with the highest shortages are chefs/cooks, hotel and restaurant managers and hotel and restaurant supervisors. The labour market for hotel and restaurant supervisors has become particularly tight since the start of the pandemic.
DK	Tourism Cleaning	Travel agencies and cleaning services experience labour shortages. The demand for cleaning services has increased during the pandemic, and travel agents were reopened in the spring 2021.
EE	Education – specialist occupations in education	Demographic changes, technological developments and the increasing number of children with special needs drive skills shortages in the education sector.
FI	Finance Real Estate	The increased need of labour in the financing sector during 2021 may reflect to some extent the changes in the skills profile of the employees as well as new skills requirements from employers. New employment emerges mostly in high-skilled jobs, with emphasis on transversal skills, self-management, interaction skills, customer service-related skills and digital skills.
EL	Energy	According to the 2018 survey of the Hellenic Federation of Enterprises (ΣΕΒ), shortages were common in sectors such as energy and ICT. Lack of skills and lack of formal qualifications topped the list of main causes of hiring difficulties.
IT	Fashion	Some leading “Made in Italy” sectors, such as fashion, experienced a decline in vacancies during the COVID-19 pandemic, leading to skills shortages and hiring difficulties after the sector resumed operating normally.
IE	Healthcare administration positions Specific construction positions	While shortage in skilled medical staff were an EU-wide trend during the pandemic, Ireland in addition experiences increased health vacancies among registrars, nurse managers and healthcare assistants. In construction, a detailed list of occupations in shortage has been identified, including project/site managers, quantity surveyors, electrical engineers, civil/site engineers, construction design engineers, environmental/health/safety engineers, building information modelling (BIM) special-

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MS	Sector and/or occupation	Description
	Life sciences	ists, planners, safety officers, administrators, construction drivers, carpenters, electricians, steel erectors/fixers, welders, scaffolders, pipe layers, curtain wallers, glaziers/fitters and ground workers. Skills and occupations in life sciences continue to show high levels of shortages, with these shortages being somewhat exacerbated by the effect of the COVID-19 pandemic (e.g. because of the impact of travel restrictions in sourcing skills from abroad).
LV	Commerce	Wholesale and retail trade experiences a vacancy rate of 2.2%, following closely the sectors with the highest shortages across the EU.
LT	Engineering occupations	Skilled workers who are in the shortest supply in the engineering industry are welders, fitters and metal machine operators.
LU	Aviation	Aviation was more impacted by the COVID-19 pandemic in contrast to land transportation. Skills shortages in aviation emerged after resuming operation, in occupations like pilots.
	Agriculture	The agriculture sector belongs to the top three sectors experiencing skills mismatches induced by digitalisation and green technology dynamics. This has for example occurred in the context of 'smart farming' as regards the installation of small meteorological stations, or the 'Datawarehouse', for which the Chamber of Agriculture was commissioned in 2020 by the Ministry of Agriculture to establish an online platform to pool all data and information regarding agriculture in Luxembourg. Digitalisation also penetrated production processes within the agriculture sector.
NL	Education	In the education sector there have been fluctuating labour shortages, with primary and secondary education schools experiencing a particular lack of staff. In 2017 to 2018, 61% of the vacancies in primary education were difficult to fill.
	Energy production	The energy production sector also belongs to sectors with a high rate of unfilled vacancies.
PT	Various, with highest increase in mining and quarrying and textile manufacturing	The largest unmet demand is located in construction, hotels and restaurants, real estate and support service activities, wholesale and retail trade, and public administration, defence, education, human health and social work activities. The occupational groups with the highest unmet demand are personal services workers, sales workers, building and related trades workers (excluding electricians), and labourers in mining, construction, manufacturing and transport. The sectors registering the highest increase (although with low absolute numbers) of unfilled job vacancies were Mining and quarrying and manufacture of textiles.
ES	Tourism – specific subsectors	Main skill shortages in the hospitality sector are manifested in diverse profiles, ranging from cooks to workers in different subgroups of tourism such as winter tourism (labour shortage in ski stations for example), cultural tourism, or rural tourism.
SE	Healthcare – jobs facilitating development and innovation	The increasing productivity in the industry sector through technological development and organisational innovations has not been matched in the health sector, where the organisation of care and working methods lag behind in terms of development and innovations. This leads to a long-term skills shortage in healthcare services.

Source: ECE country articles.

3.2 Drivers of skills shortages across the EU Member States

This section provides a more detailed insight into the drivers of skills shortages and, based on a qualitative assessment, discusses the extent to which skills shortages can be attributed to (a) digitalisation, (b) the green transition, and (c) the COVID-19 pandemic. It also assesses whether skills shortages due to these factors are perceived as short-term or long-term.

Among the **most frequently mentioned drivers of skills shortages** are the following:

- Mismatch between **education and labour market needs** (for 15 Member States)
- **Digitalisation** (for 19 Member States)
- **Green transition** (for 8 Member States)
- Population **ageing** (for 18 Member States)
- **Insufficient mobility**, both geographical and cross-sectoral, within the country (for 14 Member States).

Digitalisation as a driver of skills shortages is closely intertwined with the mismatch between the education system and labour market needs. The rapid changes due to digitalisation trends, significantly accelerated by the COVID-19 pandemic, as the shift towards more sustainable economies, have significant implications on changing skills needs in the labour markets. The demand for qualified workers with a certain new matrix of skills is increasing, while these skills are not immediately available in the labour market. Digital skills are mainly requested in relation to the demand for ICT professionals, such as software analysts and designers, system designers and administrators, but also for energy and mechanical engineers and industrial designers (for example in **Italy**).

Digitalisation has also been identified as the key driver of skills shortages in sectors beyond ICT, i.e. in healthcare, with missing basic digital skills and low digital literacy (**the Netherlands**), banking (**Spain**), education (**Estonia**), and manufacturing (**Sweden**). Digitalisation is expected to require a strengthening of digital skills in the near future, and reaching a balance of skills will depend extensively on the responsiveness of the education and training systems. Skills shortages in digital skills are also related to the education system and the lack of student interest in STEM fields (Science, Technology, Engineering and Mathematics), while industry but also other sectors demonstrate a growing demand for these skills (e.g. for high-skilled jobs in construction and public administration) .

Digitalisation as a driver of shortages is related also to another frequently mentioned driver, i.e. population ageing. Older workers that are not actively taking part in further education and training are expected to face more difficulties in a situation where more modern applications, software and programming skills are in demand, while there is a lack of young workers with these skills (e.g. in **Austria**).

The green transition, in contrast to digitalisation, **is not yet expected to produce a comparable extent of skills shortages.** At the time of writing (early 2022), the country experts had identified that the effect of the green transition on skills demanded in the labour market had not yet been that extensive. Cedefop (2021) found the employment effects of implementing the European Green Deal (EGD) to be concentrated in the sectors directly targeted, such as extraction industries, construction and waste management, with

employment increases forecast in service sectors such as engineering and administration, while in most other sectors, a possible redirection of employment towards cleaner production rather than an employment change is expected. The country experts nonetheless identified cases where the green transition drives skills shortages. For example, the **green energy sector** requires new skills, while employment was expected to shrink in the oil shale production sector (**Estonia, Malta**). In **construction and housing redevelopment** (technicians and civil engineers and plant installers), in the sector for electronics and telecommunications, **technicians and managers of networks and telematic systems are demanded**, as well as chemical technicians (e.g., in **Italy**). Other important drivers of shortages related to the green transition emerge due to the **transformation and growth of particular economic sectors**, such as the waste management sector and an emerging circular economy (e.g. in **Slovakia**), or in technical automobile development and maintenance (e.g., in **the Netherlands**).

Changes related to the green transition are expected to have a more extensive impact on the need for upskilling and reskilling in the construction sector. For example, in **Ireland**, this is due to the ambition to reduce overall greenhouse gas emissions by 51% from 2021 to 2030, compared to 2018 levels, in order to achieve carbon neutrality by 2050. Some traditional occupations are also affected by the green transition, such as roofers in the construction sector (as already seen in **Austria**). This relates to the new skills roofers are expected to have, such as skills for the integration of photovoltaic modules into traditional roofs. Higher demand for specific skills in the construction industry is also confirmed in **Germany**, due to energy-efficient building renovation and the ban on oil heating.

Other sectors where the green transition is expected to impact skills needs were also identified in the country articles. These include: the transport sector (due to the promotion of public transport), agriculture (due to the labour-intensive organic cultivation combined with the assumed behavioural changes of private households), as well as education (due to increased investments in research and development and continuous training). Lower demand is expected in the manufacture of motor vehicles and motor vehicle parts, because of an accelerated transformation towards electric drives.

Further factors that contribute to exacerbate shortages in the labour market, as identified in Eurofound (2021), include strong economic growth and high consumer demand. These factors were not prominently highlighted in the country articles, but some associations with the above drivers were identified. The impact of economic cycles as a driver of shortages has been explicitly identified in four EU Member States (**Belgium, Croatia, Greece and Spain**). In this context, the lockdowns during the COVID-19 pandemic led to a relocation of the workforce into different, less impacted sectors. However, once economic activity resumed in those sectors, the suddenly increasing demand for labour faced shortages, as the structural relocation back from other sectors takes time. Thus, resuming operations that were put on hold during the COVID-19 pandemic led to shortages in some sectors, including accommodation, hotels and restaurants, and partly in construction. High consumer demand as the driver for shortages was not directly mentioned in any country articles, but indirectly relates to the above-presented drivers. These shortages can be expected to be addressed in time and do not necessarily demonstrate long-term skills shortages to be tackled via education and training measures.

The mobility of workers was also reported as a driver of shortages in some areas/sectors (in **Slovenia, Luxembourg, Lithuania and Bulgaria**). This relates for instance to migrants having returned home during the COVID-19 pandemic, with employers located in their host countries unable to find skilled workforce when economic activity resumed after the pandemic. It is not yet clear how permanent these effects will

prove to be. The geographical spread of vacancies and labour supply is mentioned more broadly as an important factor of skill and labour shortages in a number of Member States, and notably in relation to:

- **Migration of young cohorts to urban areas**, country capitals and biggest cities, leaving other regions more frequently exposed to labour shortages, especially in relation to public services such as healthcare and education;
- **Outflow migration**, for instance from Member States like **Romania, Bulgaria, Slovakia**, though in the majority of countries the intensity of outflows has been decreasing;
- **Regional disparities and internal mobility within a country.**

All in all, the most frequently identified structural driver of skills shortages remains the mismatch between the education system and labour market demands. Digitalisation is also one of the most frequently mentioned drivers of skills shortages. The green transition plays a less important role in this respect currently but its weight is expected to increase in the future. Among other drivers, population ageing was referred to frequently, while migration and cross-sector mobility was mentioned for some Member States in relation to the effects of the COVID-19 pandemic.

Most shortages and their drivers were already present in the pre-pandemic period, except for those related to healthcare and the hospitality sector. The pandemic did not create novel distinct drivers of skills shortages but has rather accelerated already existing shortages induced by other structural factors (population ageing, education mismatches, digitalisation, and partially the green transition). The only sectors where the COVID-19 pandemic is perceived as having directly induced skills shortages where they did not exist before, or not for the same reasons, are the healthcare sector, and to a lesser extent, the hospitality sector.

4 Policymakers' and employers' responses to labour and skills shortages

This section reviews measures and practices to address skills shortages put in place by national governments and employers, as identified in the country articles. Effective measures or practices are those for which evidence can be found that they alleviate skills shortages. However, such evidence on the impact of the collected policy responses on reducing skills shortages is scarce, indicating a need to better articulate the goals of policies and measures in terms of reducing skills shortages and to evaluate them in this respect. This section is divided into two sub-sections, with section 4.1 analysing the policy responses (the policy-level) and section 4.2. the responses by firms/employers (the micro-level).

4.1 National policy responses to skills shortages

This section reviews policies that address skills shortages, as well as some approaches addressing labour shortages that are of relevance. The EU Member States primarily tackle skills shortages through policies and measures aimed at overcoming mismatches between skills demand and supply and at developing the skills needed. Labour shortages can primarily be addressed by activating under-represented groups through active labour market policies (ALMPs) and by measures improving the quality and attractiveness of jobs. Having said this, the distinction between policies and approaches used to address skills and labour shortages is not always clear-cut, and there are sometimes overlaps. Some approaches, for example, supporting the reskilling or upskilling of the inactive could be categorised as addressing either skills or labour shortages.

Overall, there is a lack of systematic evidence on the coverage and effectiveness of many of the collected policy responses to skills shortages across the EU, while some measures are yet to be fully developed and/or implemented. Nevertheless, emerging evidence from several EU Member States suggests that there are some promising initiatives for addressing skills challenges, both at the system/governance level and at the level of individual policy measures addressing specific skills challenges. At the system level, examples of successful practices include a global strategy and successful institutional governance approach to skills challenges. An overarching strategy to secure skilled and highly skilled labour has been in place in Germany since 2011. A successful institution has been established in Latvia to discuss and address issues related to matching the demand side of the labour market with the training and other services offered by the PES to the registered unemployed. Looking at the individual measure level, available evaluations show successful measures in addressing skills challenges through short vocational training programmes (in Denmark), targeted youth programmes (in France), subsidised short-time work schemes (in Italy and Sweden) and a reform of the dual vocational training system (in Slovakia).

Policy responses to both labour and skills shortages involve the continuation of long-term policies and strategies to support the matching between the supply and demand for labour and skills, and also some policy responses focused on specific sectors. Addressing skills shortages originated during the pandemic can mainly be seen as a continuation of policies that were developed over the last decade.

4.1.1 Developing and using skills intelligence to overcome skills mismatches

To improve the matching between the supply and demand for labour and reduce skills shortages, Member States measure and forecast skills needs to inform policies in a number of areas, such as education and training, employment, immigration and job matching and counselling (in Belgium, Bulgaria, Cyprus, Estonia, Finland, Ireland, Poland, Slovenia, Slovakia). Current and likely future skills shortages are identified following a participatory process that in several countries (such as Estonia, Belgium) usually includes representatives of the public authorities, public employment services, employers, social partners, universities and different experts. This leads to revising and updating education and training programmes, better information for the workforce about the needs of the labour market gathered through employer surveys, and more effective public employment services. Experiences in Estonia and Ireland are the best examples, but skills forecasts are extensively used also in Belgium Flanders, where the government focusses on skills development using the skills forecasts. Such forecasts have focussed on mapping the impact of ongoing transformations on future skill needs and are used to identify future skill shortages to be addressed through revising and updating training programmes for students, jobseekers and employees. Here, the government plans to further embed the use of skills forecasts into its processes by introducing a new instrument of skill checks in the near future. Such checks evaluate the extent to which employees within a specific enterprise have the necessary skills to keep pace with the anticipated transformations within their sector.

In particular, skills intelligence is put to use in specific channels by the PES, notably in providing personalised guidance for the unemployed and designing the PES training programmes (as in Cyprus and Luxembourg), or career guidance for young people and their parents (Cyprus). PES may also allocate funding via the educational subsidy to vocational education and training institutions (as in Poland, where the subsidy is higher for training in occupations experiencing significant demand).

4.1.2 Addressing digital and green skills shortages and other key areas of shortages (STEM, transversal skills) through skills development

The digital and green transitions are expected to lead to a more efficient use of resources, and to reduce labour and skills shortages in the longer run, while requiring appropriate upskilling and reskilling of the workforce in the meantime. The digital and green transformations will require stronger efforts in countries where the workforce is insufficiently trained to take advantage of the new technologies and ways of working. Overall, there have been more initiatives reported in the country articles towards the digital transition and to provide ICT skills across economic sectors, while developing green skills is a relatively new topic where policy responses appear to be still emerging with several planned measures yet to be implemented.

To address skills shortages stemming from the digital and green transitions, the EU Member States have adopted a number of policies, some of which are also set out in their National Recovery and Resilience Plans (NRRPs).

Policies specifically strengthening digital skills have been reported in 17 Member States, also with support from the Recovery and Resilience Facility (Austria, Bulgaria, Czechia, Germany, Estonia, Spain, Finland, France, Hungary, Ireland, Italy, Lithuania, Latvia, Portugal, Sweden, Slovakia and Slovenia). The main type of policy measures focus on providing direct training and up-skilling in digital skills. Significant investments into direct digital upskilling programmes aimed at the general population

are taking place in Czechia, Estonia and Spain. There are also training programmes for digital skills aimed at specific target groups such as jobseekers, key specialists and employers, especially SMEs. Further details are provided in section 5.

In comparison to digital skills policies, there seems to be fewer initiatives to strengthen green skills and hence support the green transition; still, 12 EU Member States were reported to have adopted specific measures for green skills (Austria, Germany, Denmark, Estonia, Finland, Croatia, Ireland, Latvia, Malta, Romania, Slovenia, Slovakia). The main types of measures reported included training provision on green skills and reforming VET systems and curricula, as discussed below.

The key policy measure in this area relates to training provision on green skills. Specific training programmes for specialists are provided for sectors and occupations where green jobs are in particular demand (Austria, Ireland, Italy at the regional level, Malta, Spain). For example, in Austria, *klimaaktiv*, the climate protection initiative of the Federal Ministry, introduces innovative content into existing educational programmes and currently offers qualifications for specialists in the areas of building and renovation, energy and building technology, green IT, power saving, energy management, energy advice and mobility. There are also initiatives to incentivise the take up of green skills training by the unemployed. A specific example is Denmark, where unskilled workers and skilled ones with outdated skills are granted the right to higher unemployment benefits (110%) if they begin vocational education in an occupation facing shortages, including training for green jobs.

Reforming existing (vocational) education systems and curricula is the second area of policy measures taken to strengthen green skills. This includes undertaking research to understand skills needs stemming from the green transition (Finland), planning education approaches on how to promote the green transition through vocational education (Austria, Estonia and Romania) and introducing specific green certification schemes for construction workers (Romania).

4.1.3 Using active labour market policies to address skills shortages

ALMPs play an important role in addressing skills shortages (and labour shortages) in the EU. For example, funding from the Just Transition Fund in Slovakia, will be allocated to reskilling and education programmes for former coal mine employees helping them to avoid unemployment and at the same time address skills shortages in newly developing economic areas such as ecological fishing industry or environmental development (Partnerská dohoda 2020). In addition to publicly funded institutional and workplace training, job matching and counselling are commonly used. Less frequent ALMPs include subsidised employment (e.g. Austria, Cyprus, France, Ireland, Italy), promoting entrepreneurship through training of aspiring and existing entrepreneurs and supporting business start-ups (Bulgaria, Cyprus, Croatia, Lithuania, Romania), alongside measures to activate the economically inactive and integrate the jobseekers (e.g. Austria, Belgium, Cyprus, Greece, France, Hungary, Malta, Romania). In relation to the latter, policies have been adopted to provide grants to jobseekers to retrain into professions in demand (Austria), as well as offering targeted support and additional incentives to upskill and retrain to economically inactive people (Belgium). In several countries, this support is focussed on specific groups, such as young people not in education, employment or training (NEETs, in Cyprus and France) or mothers with young children (Hungary).

Promoting labour market participation among members of under-represented groups in the labour market (such as older people, women, ethnic minorities or migrants) can contribute to addressing skills shortages by increasing the

labour supply. Removing barriers to labour market participation among under-represented groups includes measures such as:

- the recognition of qualifications (e.g. Bulgaria, Cyprus, Germany, Spain, Croatia, Italy, Lithuania, Malta, Portugal, Slovakia);
- increasing access to childcare services (Austria, Czechia, Germany, Croatia, Lithuania and Malta);
- reconciling work and family life (e.g. Germany, Malta);
- specific programmes targeting the needs of older workers (e.g. Austria, Bulgaria);
- addressing labour market discrimination (e.g. Belgium).

Measures for attracting and retaining skilled workers in sectors experiencing shortages are present in a number of Member States. These measures also include support for simplified and fast recruitment of foreign workers from non-EU countries (e.g. Austria, Bulgaria, Germany, Denmark, Ireland, Lithuania, Latvia, Malta, Romania, Slovenia, Slovakia). In practice, this involves putting in place specific channels and procedures for simplified recruitment of third-country nationals in shortage occupations and sectors. These include the Red-White-Red Card in Austria; the expanded list of shortage occupations adopted in Ireland, Lithuania, Slovakia; measures to provide transparency and employment protection for seasonal third-country national workers in Latvia. Comprehensive legislative packages are also used to facilitate the migration of skilled labour (Germany, reforms to the legislative framework are also planned in Malta, Romania). Noteworthy is the persisting political debate about the immigration from third countries, indicating the high level of controversy surrounding such policy solutions (Denmark).

New technologies and artificial intelligence have a role to play in increasing the effectiveness of ALMPs, as they can be used to enhance existing matching services. An example of this novel approach is reported in Finland. For some years, its “Labour marketplace” initiative has been at the centre of the efforts to integrate digital platforms to improve matching between skills provision and demand across the labour market. The new customer information system has nationwide coverage and includes a customer data repository and a service platform, which enables creating and publishing a job search profile and the use of artificial intelligence to recognise users to provide a more personalised service. According to early evaluations, the service is estimated to have shortened the duration of open job vacancies and of the entire employer recruitment process without requiring additional spending from the national budget.

4.1.4 Relying on social dialogue to address skills challenges

Collective bargaining and social dialogue support the upskilling and reskilling of workers and influence skills policies at the systemic level in several Member States (e.g. Belgium, Bulgaria, Cyprus, Czechia, Germany, Denmark, Spain, Finland, France, Ireland, Italy, Netherlands, Sweden).

Collective bargaining agreements at the sectoral/company level include provisions on training and upskilling for workers within the sector or company in several countries (Finland, Spain, certain sectors in Germany and Italy). In addition, collective bargaining agreements are used more broadly to address key skills challenges. Interesting examples of this are identified in Belgium (Flanders) and Denmark. In Flanders, existing social dialogue structures at the sectoral level were expanded also to combat discrimination (as a tool to make use of all available human resources) by allocating

sectoral funds managed by social partners to address existing discrimination practices. In Denmark, two collective agreements were concluded on key skills challenges, including an agreement to reduce the drop-out rate from vocational education schools and promote stronger skills among workers. The agreement allocated approximately EUR 65 million (DKK 0.5 billion) a year from 2021. An important part of the agreement is a new division of responsibilities for vocational schools to become more responsible for finding apprenticeships for students (AE Raadet, 2021). The share of dropouts remains high in vocational schools (about 45%) and is related to the lack of apprenticeship places. The agreement was implemented in 2021 and some of the initiatives require new legislation in 2022, making it too early to assess the outcomes of the agreement.

The existing instruments and funds managed by the social partners are also used to address the skills needs and offer training and further actions on skills issues in some countries (Belgium Flanders, Italy).

In some countries, social dialogue contributes to the definition and development of skills policies at a more systemic level. This includes the involvement of the social partners in setting up and amending the VET training curricula (in Germany, Sweden); identifying digital skills profiles and competences for professions (Bulgaria); coordinating the development of life-long learning programmes in line with the actual and anticipated demand for skills (Cyprus, Czechia, Spain). Social dialogue at the sectoral level is also used to build a shared diagnosis of hiring difficulties and to define specific solutions (France) and as an important contribution to research, analysis and 'horizon scanning' in relation to emerging skills requirements at thematic and sectoral levels (Ireland, Netherlands).

4.1.5 Improving the responsiveness of education and training systems to labour market needs

Member States have adopted measures to improve matching of the education and training offer at all levels with labour market needs. Among the adopted measures in this regard are:

- **promoting access to and participation in all levels of education and training;**
- **increasing the attractiveness of subject areas in high-demand** among students, especially among female students, as women are often underrepresented in sectors with skills shortages (e.g. STEM-related sectors);
- **providing more and better trained education professionals,** especially in subjects that are in high demand;
- **increasing the funding and capacity of educational institutions** that prepare specialists which are in high demand;
- **improving the quality and effectiveness of education and training provision** through, for example, revised curricula in line with labour market needs, work-based learning, innovative methods for teaching and learning based on digital technologies.

4.1.6 Challenges related to the policy responses aimed at mitigating skills shortages

The country articles identified a number of policy challenges, based on interviews with stakeholders undertaken at the national level:

- **Low take up of publicly funded training opportunities** (Czechia, Germany, Denmark, Spain, Croatia, Hungary, Italy, Poland, Sweden, Slovenia) which arise as a result of several factors relating to the design and implementation of such policies. These factors include: the lack of information about training opportunities (Germany, Italy); their inappropriateness with regard to labour market needs (Czechia, Denmark, Sweden); difficulties accessing them due to long-lasting bureaucratic procedures (Denmark, Spain, Sweden, Slovenia); and insufficient public funding for upskilling, reskilling and lifelong learning (Lithuania, Poland). Particular challenges for upskilling and using existing training opportunities for SMEs were highlighted in Spain and Italy;
- **Insufficient capacity, cooperation and coordination between the different actors in the process of identifying and addressing current and upcoming skills shortages** (Bulgaria, Czechia, Germany, Spain, Italy, Lithuania, Romania, Slovenia, Slovakia). The lack of an overarching strategic approach to addressing skills shortages was also highlighted as a key challenge in Romania and Slovenia;
- **Persisting mismatches between the education system and the labour market needs** (Bulgaria, Czechia, Denmark, Latvia, Sweden, Slovenia, Slovakia);
- **Obstacles to hiring foreign workers** (Denmark, Hungary); and
- **Failure to address the causes of emigration** (Croatia).

4.2 An overview of employers' views and actions in relation to skills shortages

This section reviews the information from the country articles on how individual employers (and/or employer associations) are responding to identified skills shortages, in particular to those that emerged since 2020 across the EU Member States. The focus is on the sectors and occupations with the highest shortages identified in each country.

4.2.1 Employers' views on national policies to address skills shortages

National policies to tackle skills shortages are seen as insufficient by employers in two-thirds of the EU Member States (Bulgaria, Cyprus, Czechia, Germany, Denmark, Estonia, Greece, Spain, Finland, France, Croatia, Italy, Latvia, Malta, Poland, Portugal, Slovenia, Slovakia). Employers' criticisms relate mainly to inadequate public funding for upskilling and reskilling of the workforce, the disconnect between labour market needs and education and training systems, ineffectiveness of public employment services, legislative barriers to hiring foreign workers and large tax and social security components increasing labour costs which act as barriers to wage increases. These are analysed in more detail below.

Public funds for upskilling and reskilling the workforce are insufficient according to employers in nine EU Member States (Bulgaria, Cyprus, Czechia, Spain, Croatia, Italy, Malta, Poland and Slovakia) while smaller companies may have little capacity to identify skills shortages and address them on their own. As an example, in Germany, most companies are unaware of support measures for vocational training. This is contributing to the small share of small enterprises providing continuous training to their workers compared to larger companies, which have access to more resources, information and experience in providing internal and external trainings.

A disconnect between labour market needs and the education and training systems was reported by employers in seven EU Member States (Bulgaria, Czechia, Greece, Finland, Poland, Portugal and Slovakia). The problems are reported to occur at several levels, including insufficient coordination between the different actors in the system (Bulgaria), insufficient systematic approach to the delivery of adult training (Czechia), insufficient responsiveness to the labour market needs (Finland, Slovakia) and ability to provide graduates with the necessary qualifications (Poland, Portugal) and the need for a general further upgrading of vocational training (Greece).

Discontent with the quality of the public employment services was expressed by employers in Bulgaria and Slovakia. Aspects mentioned for improvement in these two countries include: closer PES cooperation with employers in matching the skills needs; feedback to be sought from employers on the effectiveness of PES; and closer links of PES to the labour market needs.

Restrictions are considered also to unfavourably affect employers' ability to hire workers from third countries (reported in Denmark, Latvia and Slovenia). The key issue here is the complicated and lengthy administrative procedures required before TCN workers can be hired by employers (as reported in all three countries).

In some EU countries, employers identify the large tax and social security components of labour costs as barriers to conceding wage increases (France, Croatia). Specifically in **France**, employers consider that increasing job attractiveness through higher wages is constrained by the conditions of public contracts.

There have also been concerns raised by employers about the lack of overall strategic vision for the green transition (Poland) **and the lack of skills solutions accompanying it** (Estonia).

4.2.2 Measures by employers to address skills shortages

A very wide variety of strategies and approaches taken by employers to address shortages is reported across Member States, as shown in Table 4 below, while employers do not always make clear distinctions between approaches used to address skills and labour shortages. **The most prevalent approach that employers use for addressing skills shortages is through their own on-the-job and off-the-job trainings** (usually in large companies) **and publicly funded training schemes**.

Collaborations between different stakeholders, including employers, educational facilities, public employment services, social partners, private employment agencies, is frequently relied upon to address shortages. Employers in particular often collaborate with vocational schools and universities to address skills shortages. Such partnerships are reported by employers in 15 EU Member States (Austria, Belgium, Germany, Estonia, Greece, Spain, Finland, Hungary, Ireland, Lithuania, the Netherlands, Poland, Romania, Sweden and Slovakia), whereas employers provide students with practical training, recognize and certify skills, and contribute to the quality of education programmes in line with the labour market needs. Companies in 12 EU Member States (Austria, Spain, Finland, Croatia, Ireland, Lithuania, Latvia, Luxembourg, Malta, Portugal, Slovenia and Slovakia) report collaborating with public employment services in the identification of skills and labour shortages and in finding qualified workers to fill open jobs, as well as designing and delivering programmes for upskilling and reskilling of the workforce. Employers in 12 EU Member States (Belgium, Cyprus, Czechia, Estonia, Greece, Spain, Italy, Latvia, Luxembourg, the Netherlands, Sweden

and Slovenia) tackle skills shortages by cooperating with the social partners. whereas the latter (usually employers' organisations) offer sector-specific trainings to workers and jobseekers to ensure better alignment between skills supply and demand, provide quality assurance of education and training programmes, and, together with companies, educational institutions, and other stakeholders, participate in understanding, recognising and certifying skills, mapping skill shortages, defining future needs and formulating national policies to prevent skills shortages.

Other measures that employers deploy mostly to address labour shortages (but that have relevance also for addressing skills shortages) **include a combination of enhancing the attractiveness of current jobs (via wage increases, improving working conditions, image campaigns), as well as attracting new labour** (hiring foreign workers, workers from under-represented target groups, new apprentices). The main groups of measures are:

- **Wage increases** – reported by companies in 12 EU Member States (Belgium, Bulgaria, Germany, Denmark, Spain, France, Croatia, Ireland, Latvia, Portugal, Sweden and Slovenia) up to the end of 2021.
- **Hiring foreign workers** – in 12 EU Member States (Austria, Bulgaria, Germany, Denmark, France, Croatia, Latvia, Malta, Portugal, Sweden, Slovenia and Slovakia).
- **Measures to improve working conditions** – in 10 EU Member States (Austria, Belgium, Bulgaria, Germany, Spain, France, Croatia, Hungary, Ireland, Lithuania), such as additional annual leave, providing opportunities for better work-life balance (e.g. flexible working) and keeping employees healthy, free lunch and reduced prices on company products.
- **Hiring workers from under-represented target groups**, including under-qualified people, long-term unemployed, people with informally acquired skills, persons with disabilities, those aged over 50, refugees, etc., and **in some cases providing training** – in 9 EU Member States (Austria, Belgium, Bulgaria, Germany, Denmark, Finland, Hungary, Poland, Sweden).
- **Taking on apprentices** – in 8 EU Member States (Austria, Germany, Finland, France, Hungary, Ireland, Lithuania, Poland).
- **Outsourcing** – in 8 EU Member States (Belgium, Bulgaria, Germany, Denmark, Croatia, Hungary, Poland, Sweden)
- **Image campaigns** aimed to make companies and industries more attractive to jobseekers – in 7 EU Member States (Belgium, Bulgaria, Germany, Estonia, Spain, France, Slovenia).
- **Less common measures** that employers deploy to tackle labour and skills shortages include **increasing working hours** (Belgium, Denmark, Hungary), investing in **less labour-intensive technologies** (Spain, Hungary and Romania), **recruitment bonuses** for employees who contribute to a new recruitment (Latvia and Sweden) and **sectoral collective agreements** that stipulate the **right to training/education** due to structural labour market changes (Slovakia).

Table 4. Reported measures that employers deploy to address skills shortages (own training, working in partnership) and labour shortages (remaining columns)

MS	Own Training	Working in partnership	Wage in-creases	Importing workers	Better working conditions	Hiring workers from under-represented target groups	Taking on apprentices	Outsourcing	Image campaigns	Other
AT	✓	✓		✓	✓	✓	✓			
BE	✓	✓	✓		✓	✓		✓	✓	✓
BG	✓	✓	✓	✓	✓	✓		✓	✓	
CY	✓	✓								
CZ	✓	✓								
DE	✓	✓	✓	✓	✓	✓	✓	✓	✓	
DK	✓	✓	✓	✓		✓		✓		✓
EE	✓	✓							✓	
EL	✓	✓								
ES	✓	✓	✓		✓				✓	✓
FI	✓	✓				✓	✓			
FR	✓	✓	✓	✓	✓		✓		✓	
HR	✓	✓	✓	✓	✓			✓		
HU	✓	✓			✓	✓	✓	✓		✓
IE	✓	✓	✓		✓		✓			
IT	✓	✓								
LT	✓	✓			✓		✓			
LU	✓	✓								
LV	✓	✓	✓	✓						✓
MT	✓	✓		✓						
NL	✓	✓								
PL	✓	✓				✓	✓	✓		
PT	✓	✓	✓	✓						
RO	✓	✓								✓
SE	✓	✓	✓	✓		✓		✓		✓
SI	✓	✓	✓	✓					✓	✓
SK	✓	✓		✓						
Total	27	27	12	12	10	9	8	8	7	8

Source: ECE country articles.

4.2.3 Employer practices to mitigate skills shortages related to the digital and green transitions

Measures to mitigate skills shortages related to the digital and green transitions were reported by employers in 14 EU Member States (Belgium, Bulgaria, Czechia, Germany, Greece, Spain, Hungary, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Romania, Slovakia). These measures mainly include digital skills training and adaptation of employers' business processes as well as offering trainings made necessary by these business process adaptations.

Digital skills training is provided through a combination of channels, often in cooperation with other stakeholders, such as ICT companies, public employment services, social partners, public authorities, private academies, schools and universities:

- **Employer / business associations** can offer digital training to their member firms (as in Czechia, Luxembourg);
- **Public subsidies** are often used by companies for digital skills training (as in Greece, Ireland, the Netherlands, Portugal, Slovakia);
- Companies themselves can source **digital skills training from external private providers** (as in Bulgaria, Germany, Italy, Romania) **or provide training internally/on the job** (as in Hungary, Italy, Romania).

Continuous digital training is guaranteed under collective bargaining agreements at the sectoral level in some sectors in Belgium and Slovakia. In **Belgium**, the social partners of the information and communication sector recently decided to increase the number of yearly training days in their collective labour agreement. In **Slovakia**, two higher-level collective agreements out of seven in industrial sectors include a stipulation on workers' right to education and lifelong learning induced by structural labour market changes, such as technological changes due to digitalisation.

Current work processes are adapted by some employers exploiting the potential of digital solutions to tackle skills shortages related to the digital and green transitions. This includes seeking productivity gains by adopting technological changes requiring less physical effort and digitalisation of work processes (construction sector in Spain), reducing the need for specialised IT skills by adopting less specialised technologies (Hungary) or putting an emphasis on automation as the main productivity strategy (Romania).

Employers take measures to adapt to the green transition in several EU Member States (Ireland, Italy, Luxembourg, Netherlands, Slovakia). This involves organising training courses for employees and managers on green transition topics (Ireland, Italy, Slovakia – where it is anchored in the sectoral collective agreements); identifying green skills in specific sectors (Luxembourg); and providing networking opportunities for companies facing similar green challenges (the Netherlands).

While extensive evaluations on the success of employers' responses are rare, some examples of successful responses are identified. Successful training centres develop skilled workers, some of whom are retained by the companies in Bulgaria, for instance. A dedicated training programme supporting digital skills has been rolled out across several companies in Ireland. In-house training activities enabled the participating employees to spread their newly gained skills across the organisation and led to a number of work process changes at the company level in Italy.

5 A specific focus on digital skills

This section discusses first government policies to address digital skills shortages and then examines the involvement of social partners and other stakeholders in the detection of digital skills needs and in the development of digital skills specifically.

5.1 Policies to address digital skills shortages

5.1.1 Setting up programmes to develop digital skills at all levels and throughout the life cycle

The digitalisation of the economy, further pushed by the COVID-19 pandemic, has generated demand for digital skills at all levels, from basic to advanced and high-level expert digital skills, to apply and develop digital solutions. Digital skills have become transversal competences, which are increasingly necessary to perform a wider set of jobs. In addition, it is expected that the green transition will bring about further digitalisation, e.g. to increase energy efficiency. A gap in digital skills at all proficiency levels is potentially slowing down the digitalisation of the economy and negatively affects the employability of workers, and in a wider context also the access of the population to services.

Therefore, a number of Member States have set up programmes to develop digital skills targeted at the population as a whole and at all stages of the learning life cycle (e.g. in Czechia, Croatia, Denmark, Finland, France, Greece, Hungary, Ireland, Italy, Latvia, Portugal, Spain). Two examples with a long-term perspective and commitment to develop digital skills are: **Ireland's** new 10-year adult literacy, numeracy and digital literacy strategy and **Portugal's** "National Initiative Digital Competences 2030 - INCoDe.2030" created in 2018 and reviewed in 2021.

The National Recovery and Resilience Plans (NRRPs) support digital skills development in a number of countries. The European Commission (2022) reports that by March 2022, 22 Member States had included digital skills strategies in their National Recovery and Resilience Plans (NRRP). The strategies typically encompass actions to increase the digital skills levels of the general population, public sector workers, SMEs and the unemployed, to digitalise the education system, bridge the gender divide and increase the number of ICT specialists. Measures to increase the digital skills levels of the workforce include providing re-skilling and upskilling opportunities for the employed, unemployed and specifically targeting SMEs.

Transparency on acquired skills is important for signalling the skills workers and jobseekers have. Digital skills are often acquired outside the formal education system. Therefore, some Member States have developed activities for the assessment and certification of digital skills (such as France's PiX platform, the Netherlands' House of Skills and Portugal's Digital Skills Certificate created in August 2021).

5.1.2 Developing digital skills in the formal education system for current and future labour market needs

The importance of promoting digital skills in schools as well as improving IT infrastructure in education was mentioned as a measure to address digital skills shortages by several Member States (e.g. Czechia, Denmark, Greece, Spain, Hungary, Ireland, Italy, Latvia, Portugal, Romania). Examples from Greece and Italy illustrate innovative ways to start developing digital skills early on. In **Greece's** Digital Transformation Strategy for 2020-2025, the digital education action plan includes the revision of curricula, the introduction of a certificate for basic IT skills aimed at 15-year-

olds, and the provision of digital education resources for primary and secondary education. In **Italy**, the National Strategy for Digital Skills launched on 21 July 2020 integrates e-skills within primary and secondary schools, as well as into higher-education curricula.

Skills shortages of teachers with digital skills, however, challenge these and similar measures (as reported in Bulgaria for instance), also because teachers with good digital skills often leave schools to earn more in other occupations (reported in Austria). In **Hungary**, in order to improve teachers' digital pedagogical competences, online training was offered to 40,000 teachers. In 2020, the new national core curriculum was launched for grades 1, 5 and 9 (pupils aged 6, 10 and 14), which introduces elements of algorithmic thinking and information, and media literacy.

In some countries there are concrete plans to increase the number of graduates and/or the number of study places in relevant fields (Austria, Denmark, Spain, Croatia, Italy). In 2020, the **Danish** technology pact funded several projects aimed at enrolling more students in IT education and mentoring support to help students to complete an IT education.

5.1.3 Digital skills for vulnerable groups

Measures and programmes have also been set up to target specific segments of the population to close the digital divide, for the employed to support upskilling and skills adaptation, and for the unemployed to make them fit for the labour market.

The digital divide in the population acts as a main barrier to mitigating digital skills needs in several countries, and a number of measures have been targeted at vulnerable groups (for example in Belgium, Czechia, France, Germany, Ireland, Italy, Latvia, Malta and the Netherlands).

5.1.4 Attracting more (young) women into STEM

The gender gap in digital skills has multiple detrimental effects. It poses a problem from a gender equity point of view, also in relation to the access to jobs in a digitalised labour market, while possibly slowing down digitalisation. According to the European Institute for Gender Equality (EIGE), in the vast majority of Member States women score less well than men on internet user skills, only six Member States (Finland, Slovenia, Lithuania, Latvia, Cyprus and Bulgaria) show women scoring higher than men in this area. The biggest gender gaps (to women's disadvantage) are in Luxembourg, Austria and Croatia, as shown by the EIGE Gender equality report.¹¹ Moreover, the correlation between Gender Equality Index scores and the shares of women with above basic digital skills shows that countries with high shares of digitally skilled women also have higher gender equality in the labour market.

The occupational gender segregation is still high, also in occupations which are in shortage in a number of Member States, requiring an advanced or high level of digital skills. There is a strong gender divide in many STEM fields, and in particular among IT technicians and IT professionals, as only 17% of them are women.¹² As IT-skills become increasingly transversal, there is a risk that women will experience an even higher disadvantage than men on the labour market. Measures to improve the generally low share of women in STEM occupations are being implemented in Austria, Denmark, and Spain.

¹¹ See <https://eige.europa.eu/publications/gender-equality-index-2020-report/digital-skills-and-training>

¹² EIGE (2018), Women and men in ICT: a chance for a better work-life balance, research note.

5.2 Involvement of the public employment services in promoting digital skills

A number of PES implement dedicated measures to promote digital skills. Many of these measures target unemployed persons or vulnerable jobseekers (e.g. in Belgium, Germany, Greece, Spain, France, Ireland). Partnership approaches are also important for their implementation.

Offering training courses that match the current needs of the employers is a major challenge. In **Finland**, training packages are often tailored in close relation to the needs of workplaces, and they include topics such as digital marketing. Currently, new innovative ways of dealing with the mismatches between labour and workplaces are being developed on the municipal level. One of the ALMPs that are continuously conducted in **Croatia** are training programmes for basic digital competences, and in the next more developed phase, training and development programmes for more complex jobs in this industry will be offered. The Croatian PES CES also takes part, in cooperation with employers, in the analysis of occupational standards and sets of competences entered in the Register of the Croatian Qualifications Framework, creating a list of scarce skills with an emphasis on digital and green skills. In **Germany**, the employment agencies are quite active in promoting digital skills and work closely with all network partners at the local level to implement concepts for digitization. The Federal Employment Agency runs a training voucher scheme, which allows jobseekers and workers threatened by unemployment to select training measures from a platform. A plan for training measures for unemployed can include training in software packages of large companies (SAP, Siemens, Microsoft office packages, Microsoft Certified Solutions Associate), or modules for specific occupational profiles.

PES increasingly offer courses to train in (digital) skills online. In **France**, Pôle Emploi provides online training and Massive Open Online Courses (MOOCs), focusing on the needs of the unemployed. In **Spain**, the Public Employment Service (SEPE), together with the State Foundation for Training in Employment (FUNDAE), launched the 'Digitalizate' initiative for online training on digital skills in 2019, where 27 large companies (including Microsoft and Google) create the contents for free online. This measure has been considered as a good practice by the PES Network. In **Lithuania**, the PES was partnering with Coursera.org between July and December 2020 to provide training. Courses greatly sought after included computer programming (JAVA, Python) (Simanauskaitė, 2020¹³). The PES regularly organises free online training (including digital skills training) not only for persons registered with the PES, but also for anyone interested in acquiring new competences.

5.3 Involvement of the social partners in digital skills development

The involvement of the social partners in digital skills development is comparatively high and institutionalised in the majority of EU Member States. Often it is part of the tripartite dialogue or linked to the corporatist structure. For example, in **Cyprus**, the Deputy Minister of Research, Innovation and Digital Policy consulted social partners through established processes to detect digital skills needs and to form the

¹³ Simanauskaitė G. (2020) Užimtumo tarnyba siūlo būdą nemokamai įgyti paklausią profesiją: iki rugsėjo pabaigos prieinama visiems, 2 September. Available at: <https://www.delfi.lt/darbas/darbo-rinka/uzimtumo-tarnyba-siulo-buda-nemokamai-igyti-paklausia-profesija-iki-rugsejo-pabaigos-prieinama-visiems.d?id=85125569>

National Action Plan 2021-2025 on digital skills. In **Luxembourg**, the social partners collaborate at national tripartite level, for example in the context of the Skills Bridge Projects, where the tripartite Conjunction Committee monitors developments at the company level.

The social partners also participate in the detection of digital skills needs, and the planning and provision of digital skills. For example, in **Croatia**, social partners were involved when adopting the new set of around 20 ALMP measures including in relation to detecting digital skill needs as well as defining digital and green jobs.¹⁴ Although social partners were involved in the planning and preparation of the voucher system financing in adult education, this was not the case for medium- or long-term planning regarding future digital skills. In **Bulgaria**, the programme “Development of digital skills” was set up in early 2021 to support through EU-funding seven projects run by all nationally representative employers’ organisations and labour unions. The programme supports the identification of digital skills gaps and needs, among others.

The social partners are often also part of expert groups on digital skills development and agree on implementation principles, but collaboration is not necessarily required by law (such as for example in Lithuania, Finland and the Netherlands). Examples include **Portugal’s** Programme “+ Digital Employment”, based on two agreements signed in October 2020, one between the Public Employment Service IEFP, the governmental Mission Digital Portugal (EMPD) and the employers’ confederation CIP (cross-sector), and the other between the IEFP, the EMPD and the employers’ confederation CCP (services). These agreements determine the processes and operating rules governing a training programme for the (re)qualification of employees on ICTs and the digital operation of equipment and respective maintenance.¹⁵ The programme consists of specialised training actions in the digital area, that respond to the transversal needs of companies diagnosed by the business associations affiliated to CIP and CCP. Under the programme 42 applications were approved which involved 14,010 trainees (51% of them females) placed in almost 300 companies. In **Sweden**, a collaboration between the Employer Association of Engineering Industries (Teknikföretagen), the trade union federation (IF-Metall), the government research institute RISE, the consulting company Industrial Development Centres (IUC Sweden), and the industry association Swedish Incubators and Science Parks (SISP) aimed at informing firms on digitalisation by illustrating accessibility and practical benefits. According to an evaluation, the programme was based on a well-thought-out mix of support, reached the right companies, and the companies were satisfied with their participation.

In some Member States, only one social partner, mostly the employers’ organisations, are involved in digital skills development. In **Czechia**, only employers as a representative of social partners had a consultative role in addressing digital skills in the Strategy of digital literacy 2015-2020, while trade unions were not involved. In **Lithuania**, employers’ organisations are actively involved in the detection of digital skills needs, and the planning and provision of digital skills. They work closely with the Ministry of Education, Science and Sport, regularly providing suggestions for curriculum renewal, vocational guidance and non-formal education issues. The situation is similar in **Slovakia**, where the Trade Unions’ contribution to the development of digital skills is

¹⁴ See <https://mjere.hr/katalog-mjera>

¹⁵ CIP registered the direct involvement of 22 of its affiliates. See <https://cip.org.pt/emprego-maisdigital/participar/>

currently underdeveloped and is mostly limited to the participation in the Digital Coalition. The active promotion of digital competencies by sectoral Trade Unions might be limited as the most frequent occupations of trade union members may not traditionally require digital skills development (as reported in Czechia), but there are indications that awareness is increasing (e.g. in **Slovakia**).

In some countries, participation of social partners is either weak or there is no institutionalized structure that is specifically tailored to digital skills detection, planning or provision (e.g. Poland, Romania, Slovenia). In these countries, the social partners do not have a strong position for regulating working conditions and skills development. In the case of **Ireland**, there is also no dedicated public policy architecture for the detection, planning, and provision of digital skills needs. Social partner/other stakeholder engagement in the development of digital skills is facilitated through other channels (the National Skills Council (NSC), the Expert Group on Future Skills Needs (EGFSN), or the nine regional skills forums).

At company, or sector levels, training in digital skills is part of the collective bargaining agenda in a number of Member States. For example, in **Denmark**, in collective negotiations among the social partners, there has been an increasing interest and priority put on digital skills in training policies. Funding for adult vocational training is distributed by so-called "competency funds". Employees covered by collective agreements have the right to 10 days of vocational training every year and the employers are refunded for expenditures during training.

Improving the working conditions of IT specialists may play a role in attracting more workers to train or retrain into IT occupations in some cases. Poor working conditions can exacerbate skills shortages. The example of **Spain** shows how skills shortages in the ICT sector are reinforced if the working conditions deteriorate. Here, ICT specialists often lack upskilling or reskilling opportunities financed by their employers, and young professionals are often paid a low wage. A lack of up- and reskilling opportunities and low entry wages might therefore contribute to shortages of ICT specialists in Spain in the future.

The ICT sector is often not well covered by collective agreements. This is linked to the fact that it is an emerging sector, with most workers not belonging to the traditional trade union members. In **Germany** for example, only a few collective agreements with companies in this sector have been concluded recently.¹⁶ ICT specialists working outside the ICT sector are more likely to be covered by a collective agreement than those working within the ICT sector. With a view to improving the working conditions of freelancers, the German trade union IG Metall participated in the Frankfurt Declaration on Platform-Based Work¹⁷, with a call for "transnational cooperation between workers, worker organizations, platform clients, platform operators, and regulators to ensure fair working conditions and worker participation in governance in the growing world of digital labour platforms". However, according to the Federal Government, no information on

¹⁶ See <https://www.igmetall.de/tarif/besser-mit-tarif/tarif-wirkt-it-ler-bekommen-erstmal-einheitlich-mehr-gel>, <https://www.verdi.de/themen/nachrichten/++co++011c9d2c-4c4c-11e3-9ca7-52540059119e>, accessed 10 March 2022.

¹⁷ See <http://faircrowd.work/unions-for-crowdworkers/frankfurt-declaration/>

precarious employment of self-employed ICT specialists without employees (freelancer) is available (Bundestag 2019¹⁸).

5.4 Involvement of other stakeholders in digital skills development

In most countries, a wide range of stakeholders are involved in the detection of digital skills needs and/or the planning and provision of digital skills via so-called skills coalitions. Coalitions, and other forms of partnerships initiated by governments, included a wide range of different actors. Cooperation and exchanges have played a role at different stages, from dialogues on conceptual work up to concrete implementation of skills development measures. For example, in **Germany**, the *Arbeiten 4.0 Dialogprozess* (Work 4.0 dialogue process) had been initiated by the Federal Ministry of Labour and Social Affairs as early as April 2015 and concluded in November 2016. One aim of the measure was to identify challenges in the future labour market (on job gains and losses due to digitization, changing skills needs, working conditions, company structures and work organization) by encouraging cooperation between actors from business and industry, unions, civil society, research, and political authorities. The process led to the publication of the White Paper Work 4.0 in 2016 (*Weißbuch Arbeiten 4.0*¹⁹) that identified needs for reform (e.g. improving social security for solo self-employed workers in ICT sectors) and included recommendations for political action.

A wide variety of actors have also been involved in the detection of specific skills needs and the elaboration of digital skills strategies (for examples from Denmark, Estonia, Greece, Czechia, Finland, Ireland, Luxembourg). Involving many public and private partners, including from academia, in designing and implementing digital skills development strategies is a good way to push towards closing skills gaps and overcoming skills shortages. The members of the **Italian** Coalition for Digital Skills and Jobs (Coalizione Nazionale per le Competenze Digitali) are public and private organisations. Since its launch in 2019, more than 180 organisations have joined the Italian coalition and contributed with more than 220 projects. In 2020, the Coalition's initiatives trained more than 2.7 million students, about 70,000 teachers, over 900,000 other people, and more than 250,000 workers in the private and public sectors. A number of projects specifically addressed the gender digital gap. The National Coalition for Digital Skills plays a central role in the implementation of the Strategy. **Greece** is another example of a country where the National Coalition for Digital Skills supports measures that are assessed as successful by the stakeholders involved.

Despite examples of partnerships and coalitions in a range of Member States, there seems to be room for improvement and a need to foster cooperation and overcome split responsibilities for the development of digital skills. Information from Belgium, France, the Netherlands, Romania, and Sweden indicates that unclear responsibilities for digital skills development and/or monitoring creates the risk of uncoordinated or inefficient policy-making, as programmes are often provided by several actors. These examples can show avenues for advancing in a partnership setting for developing digital skills at all levels.

¹⁸ Bundestag 2019d: Antwort der Bundesregierung auf die Kleine Anfrage der Abgeordneten Dr. h. c. Thomas Sattelberger, Johannes Vogel (Olpe), Michael Theurer, weiterer Abgeordneter und der Fraktion der FDP – Drucksache 19/6351 – Staatliche Regularien für IT-Freelancer. Online: <http://dipbt.bundestag.de/dip21/btd/19/069/1906936.pdf>

¹⁹ BMAS (2017). Weißbuch Arbeiten 4.0. Online: https://www.bmas.de/SharedDocs/Downloads/DE/PDF-Publikationen/a883-weissbuch.pdf?__blob=publicationFile

5.5 Involvement of private sector/industry in digital skills coalitions

Private sector organisations are often part of digital skills “coalitions” or frameworks that have been set up in several Member States. In addition, private actors have set up their own initiatives. In several EU Member States, the private sector reacted to skills shortages by setting up training programmes that are not linked to ALMPs – e.g. in **Lithuania**, in autumn 2021, where the multinational IT company Accenture organised a training course for people who wanted to change their career direction and obtain qualifications as an IT professional (Delfi.lt, 2021²⁰). In **Greece**, the Hellenic Federation of Enterprises (ΣΕΒ) supports current government initiatives to strengthen vocational education and training and lifelong learning. In June 2021, it joined SAS, the analytics, artificial intelligence and data management software and services firm, in setting up AI Minds, an Artificial Intelligence and Data Science Academy for students, and (from June 2022) for employees of the employer federation’s member enterprises. The Institute of Small Businesses (IME), affiliated to the Hellenic Confederation of Professionals, Craftsmen and Merchants (ΓΣΕΒΕΕ), has created a Foresight Lab in order to monitor drivers of change in 20 occupations. In **France**, before the COVID-19 crisis and the spread of teleworking, some large firms signed agreements on digital transformation that included training to provide digital skills to all. In the telecommunication sector, the Orange agreement (signed in September 2016) proposed a digital academy on computer and smartphone, a digital skills self-assessment tool, and specific training for managers. At the same time, it also included recommendations to respect the right to disconnect and time outside working time and internal studies to analyse the risks associated with an excessive use.

²⁰ Delfi.lt (2021e) Planuoja nemokamai apmokyti 220 žmonių, norinčių pradėti karjerą IT srityje – kai kurie sulauks ir darbo pasiūlymo, 30 September. Available at: <https://www.delfi.lt/darbas/darbo-rinka/planuoja-nemokamai-apmokyti-220-zmoniu-norinciu-pradeti-karjera-it-srityje-kai-kurie-sulauks-ir-darbo-pasiulymo.d?id=88261951>

6 Conclusions and policy recommendations

As discussed throughout the report, measures and responses to shortages can be:

- categorised by their design/implementation level (government measure, or adopted by employers, or adopted in specific sectors); and
- broadly distinguished by whether they target labour shortages or skills shortages.

Using the typology of measures to address different drivers of labour shortages developed by Eurofound (2021) as a starting point, Table 5 below summarises the types of responses by policy makers and employers identified through this Review. The table includes both measures to tackle skills shortages (mainly through training provision, monitoring of labour market needs and forecasting, better matching of education and training with the demand for skills) and those addressing labour shortages (mainly via attracting and retaining labour and activating resources). As noted earlier, there is some overlap between the types of policies used to address skills and/or labour shortages, thus the distinction is imperfect by definition.

This Review zooms into approaches used to address skills shortages, as Table 5 summarises:

- Member States are adopting and implementing measures to better match the labour market changes for students, employees, jobseekers and the inactive. 17 Member States roll out digital skills initiatives and 12 Member States put forward initiatives on green skills development. The majority (18) are taking action to promote access and participation in education while one third of EU governments (9) put the emphasis on improving forecasting mechanisms.
- The dominant approach that employers use to address skills shortages, reported in all Member States, is through their own on-the-job and off-the-job trainings (often used by large companies) or through publicly funded training schemes.
- Cooperation with a wide range of labour market and education and training actors is also seen by employers in all Member States as key to improve matching between the workforce skills and labour market needs.

The Review also confirms the findings of existing literature (Eurofound, 2021) that the prevalent policies used by governments to resolve labour shortages are through active migration policies to attract foreign labour (11 Member States) while employers mostly use wage increases (recorded in 12 Member States) and improving working conditions (12 Member States) as key tools.

Table 5. Typology of measures to address labour shortages and skills shortages

	Labour shortages: attracting workers with specific skills	Labour shortages: activation of under-represented resources and retaining labour	Skills shortages: enhancing the use of existing labour and retaining labour
Policy-makers	<ol style="list-style-type: none"> Enhancing the attractiveness of living conditions in the country/region (few examples identified). Creating an active migration policy (simplifying recruitment procedures for foreign labour reported in 11 MS). 	<ol style="list-style-type: none"> Addressing labour market barriers for different groups currently unemployed or inactive: <ul style="list-style-type: none"> measures for the recognition of qualifications (in 10 MS); measures increasing access to childcare services (in 4 MS); programmes targeting the needs of older workers (in 5 MS) and addressing labour market discrimination. Increasing working hours for those in involuntary part-time employment (few examples identified in this Review). 	<ol style="list-style-type: none"> Improving matching between supply and demand through better foresight (skills forecasts identified as key tool in 9 MS). Addressing skills mismatches through enhancements of different education and training routes (e.g. promoting access and participation in education in 18 MS, improving apprenticeships in 8 MS), including: <ul style="list-style-type: none"> improving the quality and effectiveness of education and training provision through, for example, revised curricula in line with labour market needs, work-based learning, innovative methods for teaching and learning. increasing the attractiveness of subject areas in high demand among students, especially among female students; increasing the funding and capacity of educational institutions that prepare specialists which are in high demand. Enhancing preparations for labour market change for students, employees, jobseekers and the inactive (measures investing in new technologies, identifying current and future skills needs, ensuring sufficient number of qualified teachers and trainers, and providing digital and green skills training to the broader population in 17 and 12 MS respectively).
Employers	<ol style="list-style-type: none"> Enhancing the attractiveness of certain sectors or professions by improving wages and/or working conditions through collective bargaining (increasing wages in 12 MS, improving working conditions in 10 MS). Improving recruitment strategies at company level and enhancing working conditions (12 MS), using recruitment bonuses (2 MS). 		<p>Own on-the-job and off-the-job trainings (usually in large companies)</p> <p>Digital skills training measures by employers in (13 MS)</p> <p>Continuous digital skills training stipulated by collective agreements (in 5 MS)</p> <p>Process adaptation and associated training (3 MS)</p>

	Labour shortages: attracting workers with specific skills	Labour shortages: activation of under-represented resources and retaining labour	Skills shortages: enhancing the use of existing labour and retaining labour
Sectoral	Enhancing the attractiveness of certain sectors or professions through image campaigns (in 7 MS)		Social partner involvement in collaborations to provide opportunities for sector-specific trainings to workers and jobseekers, to ensure better alignment between skills supply and demand, provide quality assurance of education and training programmes, participate in recognizing and certifying skills, mapping skill shortages, defining future needs and contributing to the design of future policies*

Source: Typology adapted from Eurofound (2021); Own elaboration based on ECE country articles

Note: * Examples of sectoral training measures to develop STEM skills and transversal skills include developing digital skills in SMEs in Austria; digital skills in the Public Sector in Greece and in the ICT sector in Belgium, in the construction sector in Luxembourg and the technical sector in the Netherlands.

Based on the findings of this Review, recommendations to governments, training institutions, social partners and other relevant stakeholders about measures addressing skills shortages generally, as well as the development of digital skills specifically, follow below.

National policies to tackle skills shortages are often seen as insufficient mainly due to inadequate public funding for upskilling and reskilling the workforce and/or a disconnect between labour market needs and education and training systems. In light of these, **it is recommended that policy makers take action to:**

- **Increase the take up of publicly funded training opportunities** by providing adequate information about training opportunities, including to employers and particularly SMEs, matching them more closely to labour market needs and simplifying bureaucratic procedures for accessing them.
- **Increase public funding for upskilling, reskilling** and lifelong learning opportunities, as well as increasing participation in such training.
- **Improve the capacity, cooperation and coordination between the different actors to quickly identify current and upcoming skills needs.** At the micro-level, many companies lack the capacity to identify their skills needs and need support to do so.
- **Provide specific support to SMEs** since they have few HR resources at their disposal. Also, social dialogue addressing skill issues in SMEs is often weaker than for larger companies, also as trade unions are less well represented in SMEs.
- **Improve the response of the education and training systems to labour market needs.** Particular attention needs to be given to identifying needs for transversal skills and to developing these skills, which are applicable to several occupations.

- **Take measures to attract more young girls into IT-related study fields, both at VET and university education level.** Overall, there is a strong gender divide in many STEM fields, and in particular among IT technicians and IT professionals. Effective measures are thus key to raise the supply of workers in such professions. These are already in place in some Member States (for example in Austria, Denmark, Germany and Spain) but more of these need to be implemented along the skills production value chain, starting at pre-school age as well as in the world of work.
- **Involving a large number of public and private partners,** including from academia, within the framework of specific institutions such as skills coalitions, in designing and implementing digital skills development strategies is a good way to push towards closing skills gaps and overcoming skills shortages.
- **There seems to be room for improvement and a need to foster cooperation and overcome split responsibilities for the development of digital skills,** despite examples of partnerships and coalitions in a range of Member States. Some countries find that unclear responsibilities for digital skills development and/or monitoring creates the risk of uncoordinated or inefficient policy-making, as programmes are often provided by several actors. There are examples showing the way forward for advancing in a partnership setting to develop digital skills at all levels.
- Finally, the Review found a scarcity of evidence on the impact of the collected policy responses on reducing skills shortages, implying that **policy designers need to better build in evaluations against the goals of reducing skills shortages.**

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