European Network of Public Employment Services

Skills and labour market intelligence

Thematic Paper

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EXECUTIVE SUMMARY

This Thematic Paper builds on the Thematic Review Workshop that took place in Greece in October 2024 as part of the PES Network activities exploring the critical role of labour market and skills intelligence (LMSI) for PES. It highlights the importance of understanding the dynamics between skill demand and supply to address mismatches and enhance workforce development. It emphasises the need for PES to be both producers and consumers of LMSI, using various forms of data to match jobseekers with employers and inform training and policy decisions. In Europe's rapidly evolving labour markets, anticipating future skill needs is required to prepare jobseekers and employers to address emerging challenges. The digital and green transitions and the ageing population are causing shifts in job requirements and qualifications. Many European Public Employment Services (PES) recognise the importance of upskilling and reskilling to address labour market shortages and are creating innovative tools to anticipate future skill needs.

The role of PES and labour market and skills intelligence

The employment ecosystem relies on LMSI to inform policy decisions. PES depend on LMSI to deliver relevant career guidance and to plan adequate training which help to address skills mismatches and enhance workforce development. The collection and use of skills and labour market intelligence has been discussed by the European Network of Public Employment Services for some time. Several national PES attending the event have developed and used new artificial intelligence (AI) tools to analyse large data sets and shift labour market and skills forecast to be focused more on skills than only occupations. These advancements provide opportunities for all PES to enhance their tools towards skills intelligence. Ideally, PES use or enable several elements from the LMSI toolbox along with multiple data sources to develop a comprehensive strategy on forward looking LMSI.

Skills intelligence involves understanding the relationship between skill demand and supply in a dynamic labour market, necessitating the monitoring of employment, education, and training trends. LMSI encompasses information from various sources and analytical methods. Tools used in LMSI include labour market forecasts, qualitative foresight and skills surveys, as well as Big Data approaches that use online job advertisements (OJA) and administrative employment data.

PES are a key player in skills intelligence, both as producer and as consumer. PES bring together jobseekers and potential employers with job openings via many forms of skill information, explicitly or implicitly. In many countries, PES play an important role in producing and analysing skills intelligence.

Forecasting in LMSI

National PES are important in enabling or implementing labour market forecasts in the member states. Such **labour market forecasts** use economics and statistical modelling techniques to generate quantitative predictions that guide the understanding of future skills and labour market trends. Short-term forecasts concentrate on employment dynamics and trends in the next one to two years, usually in the form of employment by sector. These predictions help stakeholders react to immediate changes in the job market. Medium-term skills forecasts provide a 5-10-year projection of labour market forecasts, by occupation and qualification, using a modular approach. Usually based on an underlying macroeconomic model, they also include sectoral shifts, occupational changes and evolving qualification requirements to yield total demand. This total demand results from employment changes (expansion demand) and replacement demand. The limiting factor of such models is usually the available time-series of data on the evolution of employment across sectors, occupations, qualifications, and skills. A detailed analysis of future shortages is usually provided by examining supply against demand. Many PES have developed or are using – sometimes external – medium-term skills forecasts.

Identification of skills

Medium-term forecasts traditionally could not **identify skills** but used occupations and qualifications as a proxy. Recent new approaches link skills to these medium-term forecasts. One potential approach uses the European Skills/Competences, Qualifications and Occupations (ESCO) classification system, which connects specific ESCO codes to occupations and qualifications. Some PES are integrating these skills identified through ESCO into their forecasts. Other PES use a combination of ESCO skill mapping with sector-specific, qualitative evaluations of skills needed based on stakeholder, expert or employer evaluations of upcoming or missing skills in the existing workforce.

Alternative sources of identifying skills are Big Data approaches that extract skills information by analysing OJA descriptions and requirements. These AI tools can also be applied to administrative job matching data, i.e. to analyse jobseekers' CVs and administrative job advertisements within PES to identify skills on the supply and demand side to facilitate matching.

Practical lessons on skills anticipation and LMSI

PES use a combination of data sources to analyse labour markets, including statistics, job vacancies, and administrative data on employment, unemployment, job seekers, and graduates. In generating LMSI, PES combine tools such as surveys, foresights, forecasts and background information to gain detailed and granular insights into the skills landscape and labour market dynamics.

Effective use of skills intelligence requires a tailored approach for different user groups within and outside the PES. While labour market analysts can use detailed data, PES counsellors, employers and jobseekers need simplified and accessible information.

LMSI is important for PES to provide effective services in dynamically changing labour markets. While various tools exist, a **combination of methods, including medium-term forecasting, survey-based forecasting, and Big Data applications, is recommended as a comprehensive approach**. Key success factors for effective skills forecasting and LMSI include the regular and repeated use and analysis of the outcomes, the inclusion of reliable and timely data; the inclusion of qualitative data along with quantitative outcomes; as well as the involvement of stakeholders. Collaboration on the tools with already active actors such as ministries, national statistical offices, research institutions, and sector councils while continuously improving data and methods will help PES meet evolving labour market needs.

Integrating skills into medium-term forecasts remains a challenge, as most statistical data are measured at occupation, rather than skill level. Big Data approaches such as OJA have to take into account representativeness to avoid biases. PES can play an active role in enabling partnerships between data collectors and users, advocating also for a skills-based approach which is crucial for effective LMSI.


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EUROPEAN PUBLIC EMPLOYMENT SERVICES
LABOUR MARKET AND SKILLS INTELLIGENCE (LMSI) FOR PUBLIC EMPLOYMENT SERVICES
Labour market skills intelligence
LMSI provides an essential basis for employment and labour policies whilst helping to reduce labour market transaction costs. It also informs policy design, implementation, monitoring and evaluation.
Skills intelligence tools used in LMSI
Tools and methods used include: labour market forecasts, qualitative foresights, skills surveys, and "Big Data" approaches.
LMSI can also be presented on dashboards providing access and visualisations.
Skills Forecasts
PES may rely on external organisations to develop and analyse skills forecasts.
Skills can be integrated into medium-term forecasting by linking to the ESCO classification system or by combining ESCO skill mapping with sector-specific evaluations of skills.
Data availability can limit the level of data made available with trade-offs needing to be made at occupation, qualification and regionalisation dimensions.
Combining various data sources and tools can lead to obtaining detailed insights into the skills landscape and labour market dynamics.
Effective Use of Skills Intelligence
The outputs of LMSI should be tailored to cater for different users.
Collaboration between data collectors and users is necessary for continuous improvement of data quality and methods.
The value and benefit of LMSI for PES
LMSI facilitates informed decision-making and targeted interventions to address skills mismatches and enhance workforce capabilities.
Workforce capabilities can be improved by understanding the dynamics between skill demand and supply.

1. Introduction and background

Public employment services (PES) are important producers and consumers of skills intelligence. Their work to bring together jobseekers and employers with job openings uses many forms of skill information, whether explicitly or implicitly. Matching jobseekers to jobs also involves training activities, with upskilling and reskilling being central activities for PES. Information on the skills required in current and future labour markets, together with potential shortages, is crucial to the matching process. Making policy decisions, advising jobseekers and providing career advice should be based on well-grounded information and evidence. Labour market and skills intelligence (LMSI) is the term for the process of collecting different forms of information, data, and tools intended to be useful for making various decisions in and around the labour market.

Key definitions

Skill: A skill is understood as the ability to carry out a mental or manual activity, acquired through learning and practice. It is an overarching term that includes knowledge, competency and experience, as well as the ability to apply these in order to complete tasks and solve work-related problems (Education and Training Foundation (ETF), Cedefop, ILO, *Developing skills, foresights, scenarios and forecasts*, 2016). Skills are described as cognitive (involving the use of logical, intuitive and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments) (Council Recommendation of 22 May 2017 on the European Qualifications Framework for lifelong learning and repealing the recommendation of the European Parliament and of the Council of 23 April 2008 on the establishment of the European Qualifications Framework for lifelong learning, Annex I definition (g)).

Qualification: Qualifications are the formal outcome of an assessment and validation process by a competent authority and typically take the form of documents such as certificates or diplomas. They determine that an individual has achieved learning outcomes to given standards. Those learning outcomes may be achieved through a variety of paths in formal, non-formal or informal settings, whether in national or international contexts. Information on learning outcomes should be easily accessible and transparent (EQF Recommendation of 2017).

Skills intelligence: Outcome of an expert-driven process of identifying, analysing, synthesising and presenting quantitative and/or qualitative skills and labour market information. This may be drawn from multiple sources and adjusted to the needs of different users (Cedefop). As skills are not easily measured, they are often proxied, for example, by qualification (e.g. International Standard Classification of Education (ISCED)) on the supply side and occupations (e.g. International Standard Classification of Occupations (ISCO)) on the demand side (Cedefop).

Labour market skills intelligence (LMSI): LMSI provides an essential basis for employment and labour policies and informs the design, implementation, monitoring and evaluation of policies that are better focused and targeted. LMSI also contributes to reducing the transaction costs of labour markets by helping to overcome incomplete information of labour market agents (Cedefop).

Source: Cedefop Glossary (original source in brackets)

In Europe's rapidly evolving labour markets, anticipating future skill requirements and effectively preparing jobseekers and employers to address emerging issues presents a considerable challenge. The digital and green transition lead to shifts in the occupational composition, the skills required within specific jobs and occupations, and the information value of qualifications in the labour markets. The population's ageing has significant consequences on the labour market, affecting workforce size and productivity and potentially leading to labour shortages that are partially addressed by cross-border mobility

and nationals from third countries joining the EU labour market. Recognising the importance of upskilling and reskilling to address labour market adaptability and competitivity issues, many European PES are creating innovative tools to anticipate future skill needs. The focus is shifting from occupational dynamics to skills-based analysis, aiming to develop tools for better matching and integrating skills for effective skills forecasting across Europe.

PES must be able to monitor trends in employment, education, and training, and, ultimately, collect skills intelligence. These insights should be processed and translated into useful instruments and information for use within PES and for the PES' clients. The insights gathered facilitate informed decision-making and targeted interventions to address skills mismatches and enhance workforce development. Currently, anticipating future skills requirements and effectively preparing jobseekers and employers presents a considerable challenge.

The key concept of 'skill' is generally understood as the ability to apply knowledge and use know-how to complete tasks and solve problems[1]. Skills intelligence is then derived information that condenses certain aspects of skills. It can take forward-looking information on dynamic development, the current situation, or the difference between available skills and skills requirements. LMSI feeds into training and education policy by providing the basis for updating qualification frameworks, developing and updating the content of vocational education and training (VET), targeting key skills in training and retraining, and career guidance, often also provided by PES.

LMSI can be usefully presented on dashboards[2] that condense key information or indicators, allowing easy or quick understanding of a labour market context. It can also take the form of more complicated tables, graphs, or outputs that require careful study to fully understand its implications. PES commonly seek to make LMSI in a country or region more transparent.

LMSI brings together information and analysis from many institutions. While responsibilities for certain parts are usually assigned, many countries involve the actors that produce, analyse and use LMSI, at least from the public sector. Alongside PES, typical actors include Ministries for Labour, Social Affairs, or Education, national statistical offices, sectoral councils, and research institutions.

The ILO Toolbox on Labour Market Information Systems[3] suggests three layers of information:

1. A set of core indicators on the labour market, continuously collected and updated, usually based on European Union Labour Force Survey (EU-LFS) data.
2. A second, more advanced layer consists of additional analysis and interaction between the labour market and the economy. It includes a broader set of background indicators. Analysing these interactions leads to a more accurate understanding of the labour market.
3. A third, most advanced layer includes deeper statistical modelling and analysis of the labour market and skills, e.g. forecasting models.

The modern LMSI toolbox emphasises skills anticipation and includes a forward-looking element of measuring and reflecting on skills supply and demand. Several instruments are used to generate forward-looking outcomes, both by PES and other actors providing labour market information:

[1] See box on key definitions above.

[2] One example of a skills intelligence dashboard is the one by Cedefop for all 27 Member States (EU-27), available here.

[3] ILO (2023), *LMSI - Brief Description and Toolkit*, Geneva, Section 1.2.

- Labour market forecasts: Using economic and statistical modelling to identify past trends and current developments and developing these into short- or medium-term quantitative labour market forecasts;
- Foresights: Qualitative (labour market or skills) foresight combines quantitative and qualitative information to develop scenarios or likely future outcomes for specific sectors, occupations, or economies;
- Skills surveys.

Big Data approaches use available or automatically collected data to investigate specific aspects of the labour market. In the context of LMSI, the analysis of online job advertisements (OJA) is a key instrument, along with using and analysing administrative sources on employment, education, and PES matching. For example, analysing jobseekers' profiles and training curricula can provide insights into the supply of skills.

LMSI dashboards provide access and visualisations of the LMSI. Ideally, they cater to different target groups by providing information at the level and granularity required by the specific user.

Cedefop - EU skills intelligence tools

Cedefop's skills Intelligence page provides LMSI based on tools and data generated and analysed within and by Cedefop, as well as data collected and provided by other European sources such as Eurostat. It shows how LMSI can be organised and presented along topics rather than tools.

Employment trends include the development of employment and participation, the share of high-skilled jobs, training participation, and sector studies. The data combines information from Eurostat's labour survey data and OVATE, the analysis of online job advertisements at the EU level.

In the context of **digitalisation and technology**, Cedefop's information focuses on how digitalisation impacts jobs and skills. It offers insights into several areas, including the proportion of individuals with advanced digital skills, employment within the high-tech economy, the risk of automation affecting various occupations, employment in the ICT sector, the most sought-after skills for ICT professionals, and the use of ICT in different job roles.

Future Jobs summarises employment by occupation, based on Cedefop's forecasting model. It shows changes in the occupation structure, future demand through these shifts combined with replacement needs, and imbalances between supply and demand.

Skills and Learning combines information from Eurostat's LFS, its survey on ICT usage, Cedefop's medium-term skills forecast, the European Survey on Jobs and Skills (ESJS), and information from OJA using Cedefop's Skills OVATE.

Under **Workplace Trends**, developments in contracts, employment types, and job security tenure are summarised. These indicators help to understand how the nature of jobs in the EU is changing and which occupations are the most affected.

The importance of skills within a European context is reflected by the declaration of 2023 as the European Year of Skills and echoed in the Political Guidelines of the new European Commission 2024-2029, which call for the establishment of a Union of Skills[4]. On March 5

[4] European Commission (2024), Political Guidelines For The Next European Commission 2024–2029.

the Union of Skills was launched[5] which outlines several aspects regarding how addressing skills intelligence will be used to address skills gaps. For one, the identification of skill mismatches at the national and regional level is connected to the work PES provide in matching supply and demand and PES can use such information to collect information on the labour market and skills intelligence. Supporting the learning of missing or upcoming skills matches the training aspect of PES, which is especially strong in the context of upskilling or retraining. For another, the Union of Skills will build the European Skills Intelligence Observatory - a skills and education intelligence platform – that will support timely and accurate skills intelligence.

1.1 Structure of this report

This Thematic Paper is prepared in the context of the Thematic Review Workshop (TRW) on Skills and Labour Market Intelligence, hosted by the Greek PES on 17-18 October 2024 in Athens, Greece. Nineteen PES attended[6], as well as a thematic expert, the PES Network Secretariat and Cedefop. The TRW shared recent strategies and successful practices[7] in labour market information systems to illustrate current trends in skills forecasting. The PES Network stresses the importance of improving the process of collecting and analysing labour market intelligence. This effort aims to actively address skills and labour market shortages, and to develop a common EU standard for measuring these shortages[8].

The Thematic Paper describes the critical role of LMSI in the European PES context. It provides examples of national PES tools and implementation, drawing on the presentations and discussions at the Thematic Review Workshop, supported by additional desk research. Section 2 describes skills forecast, a key instrument in skills intelligence, notably approaches and modules, along with the challenge of missing information, especially on skills. It provides several examples of how the general approach is implemented in various countries. Section 3 discusses the issue of identifying skills in the context of skills anticipation. It then considers the challenge of bringing skills into forecasts, including attempts to extract skills information using Big Data approaches. Section 4 examines PES' approaches to implementing skills anticipation and describes how LMSI instruments are used in various contexts. It also discusses how the tools can be combined to provide more detailed insights, and how PES in Member States are implementing and using LMSI.

2. SKILLS FORECASTS IN, OR USED BY, PES

Labour market and skills forecasts are key tools in skills anticipation work. Generally, there are two main forms of forecast. Firstly, short-term forecasts generally focus on employment (or unemployment) development in general or by sector over a limited period (e.g. one to two years). These are intended to provide an overall picture of the labour market situation at the time of analysis and in the near future.

Secondly, medium-term skills forecasts are broader in scope, in the period of time covered, and output. They usually attempt to forecast the labour market situation in 5-15 years, integrating sectoral, occupational, and qualification developments and combining supply

[5] European Commission (2025), Union of Skills: Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions.

[6] BE-Actiris, BE-VDAB, CY, CZ, DE, EE, ES, FI, HU, IS, LT, LU, LV, NL, PL, PT, RO, SE, SI.

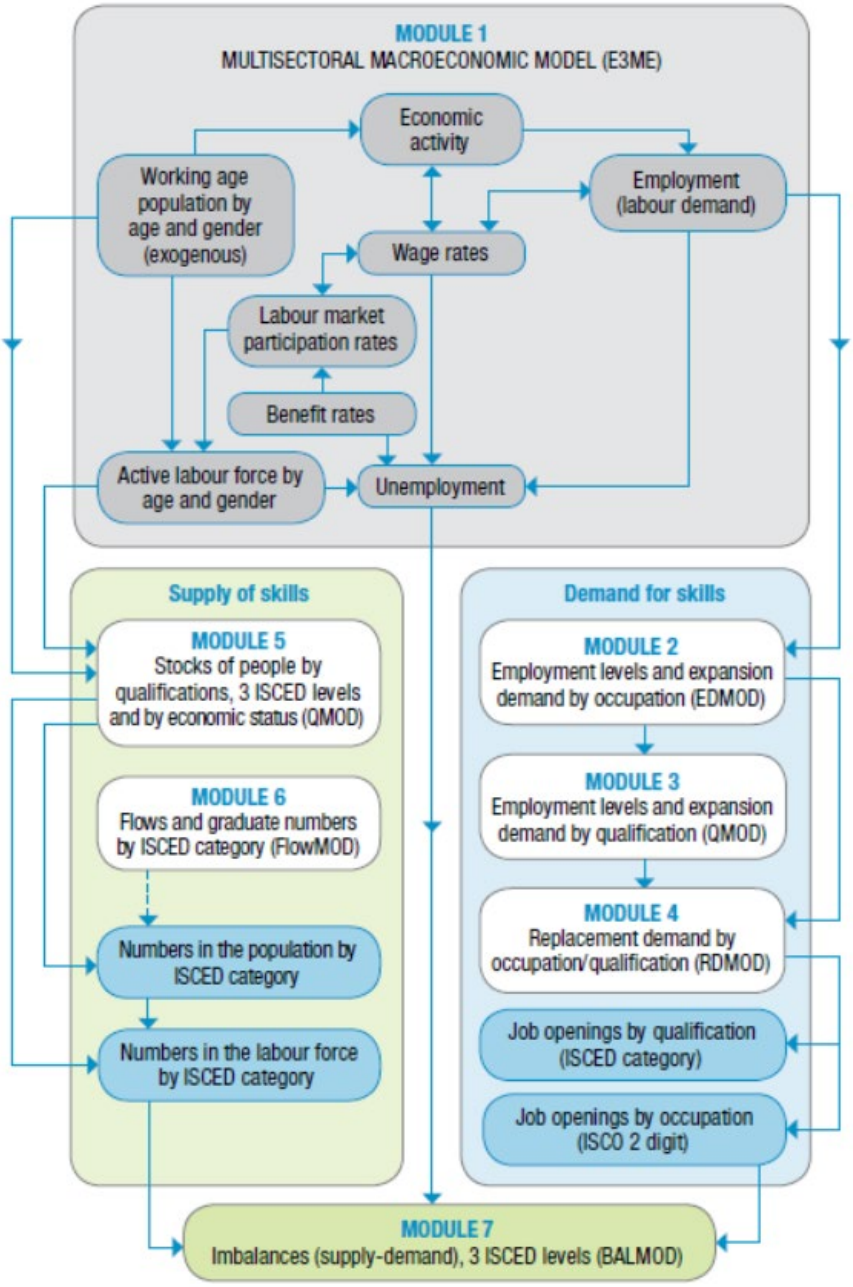
[7] For an overview of the implementation and success factors of skills intelligence within PES, see Sienkewiecz, L. (2022), *Future skills, career guidance and lifelong learning,* PES Network Thematic Paper, Luxembourg, Publications Office of the European Union.

[8] See PES Network Memorandum for the next European leadership.

and demand side forecasts to determine potential and developing future mismatches[9]. While skills forecasts are nominally about skills, they usually proxy the skills aspect through occupations or qualifications, given the frequently poor availability of statistical information on skills.

Most models contain modules looking at specific aspects of the forecast. In general, forecasts centre on a macroeconomic model that determines employment by sector, unemployment, and population, and the economic activity rate showing labour supply. Figure 1 below presents Cedefop's modular approach, which is also typical of national models.

Figure 1: Cedefop model of medium-term skills forecast



Source: Cedefop (2018), Figure 1 on Page 15.

[9] For a more detailed description of medium-term forecasts, see European Training Foundation (ETF)/Cedefop/ILO (2016), *Developing skills foresights, scenarios and forecasts: guide to anticipating and matching skills and jobs,* Luxemburg, Publications Office of the European Union, Chapters 8 and 9.

The first module is the macroeconomic model (E3ME). A complete model of the macroeconomic situation includes circular flows of production, consumption and investment, employment and unemployment that fix the total economic output and thus ensure the overall economy is balanced. The outcome of the macroeconomic model (Module 1) is supply-side information (active labour market population) that needs to be enhanced by establishing the level of skills (Modules 5 and 6) to determine supply by qualification. Most skills forecast models determine a supply by qualification rather than skills. The formal qualification is included in the underlying statistical data used (e.g. EU-LFS). Unlike the Cedefop model, which only identifies broad qualification levels, most national forecasts include a much larger set of qualifications (both in level and specialisations).

On the demand side, employment by sector is refined into demand by occupation (Module 2), employment by qualification (Module 3), and, sometimes, replacement demand (Module 4). The first two elements model the changing occupation structure in sectors. For example, mechanisation and digitisation have led to upgrading jobs, thus, within a sector, higher-level jobs often replace intermediate-level jobs. This modelling is usually done empirically so that past developments influence future expectations. Similarly, the changes in qualification demand by occupations are determined; these changes are forecasted and then used to translate occupation demand into qualification demand.

Module 5 determines the flow of the existing labour force at the level of occupation. It shows outflows by age and gender for each occupation, then forecasts total outflows over the forecasting period. These outflows will need to be replaced and are called 'replacement demand'[10]. Replacement demand is usually the largest demand component, which often contains two-thirds or more of the total demand. The total demand for an occupation or a qualification is often calculated as the change in employment level (often called expansion demand) together with replacement demand.

Separate modules sometimes compare supply and demand, allowing matching with some degree of substitution or flexibility. The gap between supply and demand may be reported, or indicators of tightness or mismatch set.

[10] Willems, E. J. T. A., and A. de Grip (1993), *Forecasting replacement demand by occupation and education*, International Journal of Forecasting, 9(2), 173-185.

Cedefop skills forecast

The Cedefop skills forecast was initiated in 2004 and evolved into its current form in subsequent years. The goal was to provide a common methodology based on common Eurostat data available for all EU-27. The forecast was intended to complement national skills forecasting efforts and provide a comparative view across all Member States.

The basic set-up (see Figure 1) follows standard medium-term skills forecasts, following the example of the United Kingdom and the Netherlands in the initial phase.

Skills are measured in terms of occupations and qualifications, as the standard output is supply and demand by three educational levels and two-digit ISCO occupations. More detailed skills measures could not be introduced, as the underlying EU-LFS data accessible within Eurostat were limited in the level of detail used. The forecast has also been used for scenarios, introducing alternate assumptions on the greening of the economy, the speed of digitisation in the labour market, and economic shocks, for example.

Several indicators of imbalances have been developed, culminating in the recent Labour Shortage and Skills Indicator, which combines the elements of expansion demand, replacement demand, and underlying shortage indicators.

The intended audience spans educational providers (higher education, apprenticeships, VET, lifelong learning), companies (identification of further shortages, in-house training), social partners (protecting the interests of their members), public authorities (designing migration policies), and individuals making career choices.

Source: https://www.cedefop.europa.eu/en/tools/skills-forecast

Several PES attending the event use medium-term skills forecasts. Greece, Germany (through its Institute for Employment Research (IAB)), Slovenia, Sweden, Belgium (VDAB, the Flemish PES), and the Dutch PES are developing or using existing models. Greece has recently developed a quantitative labour forecast using the modular method. While all countries use modular approaches, they are at different stages of maturity. The Dutch model has been used for over 30 years and the German model for over a decade, but the models in Slovenia, Greece and Belgium (Flanders) are more recent. The German model emphasises the wide range of VET qualifications, while the Dutch model (initially developed to inform qualification and study choices) emphasises the translation into simplified indicators of shortages and surpluses. Slovenia and Greece are developing the connection to skills using ESCO linkages by occupation and qualification.

All countries mention data availability as a continuous challenge. Given the level of detail users seek on the types of qualifications or occupations and the availability of such information within EU-LFS data, a trade-off is usually necessary.

Greece - Mechanism of Labour Market Diagnosis

The Mechanism of Labour Market Diagnosis is a systematic approach to analyse and understand the labour market dynamics, run within the Greek Labour and Social Security Ministry's Unit of Experts in Employment, Social Insurance, Welfare & Social Affairs (MEKY). It is a crucial tool for policymakers, employers and educational institutions, offering insights into employment trends, skills shortages, and the overall health of the labour market. The Mechanism of Labour Market Diagnosis operates through a comprehensive data collection and analysis framework, gathering information from various sources, including employment agencies, educational institutions, and industry reports. The data encompass variables such as employment rates, job vacancies, skill requirements, and demographic trends. By synthesising this information, the Mechanism provides a clear picture of the current state of the labour market and identifies emerging patterns and challenges. It makes use of the ESCO classification to standardise information collection and produce comparable results.

The Mechanism of Labour Market Diagnosis plays a vital role in forecasting future labour market trends. Using statistical models and predictive analytics, it can project future employment needs based on current data. It provides forward-looking skills anticipation for policymakers and educational institutions, which can then proactively design interventions and training programmes that align with anticipated changes in the labour market. The Mechanism is still in development, with three sectors fully implemented (information and communication, pharmaceutical industry, financial sector) and others planned. Forecasting outcomes will be linked to other data, notably skills information. Sector by sector, the key skills are identified through those linkages, then reviewed by sector experts in focus group meetings before their release. As the Mechanism provides a very detailed view of available sectors, occupations, and skills, MEKY has started to train experts (PES counsellors) to use the tool and interpret results.

Source: https://mdaae.gr/en/

The Belgium-Flemish PES (BE-VDAB) is supporting skills forecasting in the GAP project, currently developed by the Flemish Centre of Expertise for Labour Market Monitoring[11]. The GAP project is an integrated labour market projection model for Flanders which addresses skills mismatches and seeks to improve labour market outcomes. The GAP project follows the typical modular framework to provide a well-rounded and robust forecasting instrument. It includes modules on expansion and replacement demand based on EU-LFS and social security data. For labour supply, it combines unemployment data with inflows from school leavers. It is intended to provide regular updates on future developments to identify opportunities and challenges in the Flemish labour market. The current model provides insights into trends and future developments by sector and occupation. More refined mismatch indicators and the inclusion of additional skill information are in development.

The Slovenian PES uses a skills forecasting model developed by the Ministry of Labour. With a modular approach, it integrates data from the EU-LFS and various administrative sources to address the demand and supply sides of the labour market. The model is still in development and is part of an integrated labour market platform to facilitate public sector users' sharing labour market information and tools.

The Dutch PES co-funds (along with other ministries) a skill forecast produced by the Research Centre for Education and the Labour Market (ROA) for medium-term forecasts[12]. As one of the models used to develop the Cedefop, it has similar modules, albeit with more levels of detail. It distinguishes 114 occupational groups and 99 types of qualifications. The Dutch model uses EU-LFS data, administrative information on employment and wages, and administrative data from the Ministry of Education to predict graduate outcomes and

[11] https://www.steunpuntwerk.be/onderzoeksthemas/trends-en-toekomstbeeld/geïntegreerde-arbeidsmarktprojecties

[12] Skills forecast, https://roa.nl/projects/project-onderwijs-arbeidsmarkt-poa.

examines the resulting shortages extensively. Forecasting results are regionalised and updated annually and are combined with background information from a labour market information system (AIS). The PES also has a short-term forecasting project (run by SEOR[13] and Bureau Louter) that identifies job growth by region and job growth and vacancies by broad industry.

German PES has access to a medium-term forecast developed in collaboration with the IAB and the Federal Institute of Vocational Education and Training (BIBB) as part of the QUBE (*Qualifikation und Berufe in der Zukunft*) project. This project offers extensive coverage of occupations and qualifications, including detailed information on VET occupations, which are essential to the German labour market. The IAB also undertakes short-term employment projects.

Swedish PES regularly assesses job opportunities and recruitment in various occupations at regional and national level and forecasts how the demand for labour in each occupation is expected to develop in the coming five years. It uses several administrative data sources, job postings, a time series of matched employer-employee data, and data on unemployed people[14]. The 'PES occupational barometer' is based on a survey of recruiting employers and register data.

In Cyprus, the Human Resource Development Authority (HRDA) oversees the skills forecast methodology. While the main roles of the HRDA are to design and implement training programmes for employed and unemployed people and to establish and operate a system of vocational qualifications, they traditionally provide forecasts of labour demand and supply in the Cypriot economy. The HRDA systematically offers long-term and short-term forecasts of employment needs, which are identified annually and validated with social partners and other relevant stakeholders. Stakeholders' inputs and estimates are gathered through a questionnaire on the occupation and skills needs of the Cypriot economy. Anticipated occupation and skills needs are collected annually from enterprises collaborating with the HRDA.

Foresight or foresight-based approaches are an alternative to quantitative skills forecasts. The Estonian Qualification Authority has run the OSKA skills forecasting system since 2014 (see the box below). Developed with several stakeholders (labour market experts, unions, employer associations, education and training providers), it is a sector-based approach that predicts and analyses future developments for the next 5-10 years. The analysis is done separately by sector and validated by sectoral specialists. The Estonian PES uses the sector outcomes for its tasks.

[13] See https://www.seor.nl/.

[14] The Swedish methodology was changed in 2024 to follow this modular approach.

Long-term forecasting in Estonia (OSKA)

For long-term forecasting, PES Estonia uses its OSKA system to project labour force trends over the next 5-10 years and inform education and training adjustments. The Estonian Qualifications Authority undertakes OSKA studies and prepares labour and skill forecasts. OSKA uniquely integrates quantitative and qualitative methods to analyse professional training across all educational levels.

Data are gathered from various sources, including statistical and registry data and interviews with industry experts. Five economic sectors are analysed each year, with comprehensive reviews every 5-10 years. An expert group monitors the implementation of study recommendations and supports future trend evaluations. Thematic studies focus on broader labour and skill topics, while the main analysis unit is the occupational field critical to sector functioning.

OSKA updates its general labour forecast annually and produces a detailed report on labour and skill demands every three years, addressing changes and influencing trends.

Source : https://ec.europa.eu/social/BlobServlet?docId=26475&langId=en

Several countries use short- and medium-term forecasts as part of their LMSI. The most common approach to medium-term forecasting is the modular approach (e.g. Cedefop), tweaked towards national elements. Often, this is a national classification of qualifications and occupations, but it also entails specific data sources available in a particular country. As the medium-term forecast is detailed, it is often undertaken in collaboration with, or outsourced to, specialist organisations, departments, or teams. The PES is usually at least a key stakeholder in the process, just as it is often a user of the outcomes.

There are several longer-running forecasting projects. Newly developed models mimic certain elements of the traditional models while exploring new ways of combining the data. Greece's Mechanism of Labour Market Diagnosis is one example where the forecast is embedded and (somewhat) designated as one of many information sources that allow labour market specialists (whether within or outside the PES) to find detailed and granular data on those sectors that have been covered. Estonia decided several years ago to use foresight to provide the key outcomes of the OSKA process, rather than a quantitative model, a premise that made sense for a small country with limited (initial) data.

A common problem for medium-term skills forecasts based on EU-LFS data is the lack of skills in the forecast. The underlying data have information on occupations and qualifications, but not on skills. Various approaches to skills are taken, in some cases linking skills to forecasts. The Cedefop skills forecasts have been subject to discussions on including more detailed information, especially on skills. The Eurostat-Cedefop project OVATE[15] notes that information from OJA contains textual information that is automatically processed to produce skills that could be linked to occupations through the ISCO classification. However, this has yet to be implemented, as OVATE lacks coverage for some occupations and has other technical issues.

[15] Eurostat-Cedefop (n.d.), OVATE project offers detailed information on the jobs and skills employers demand based on online job advertisements (OJAs) in 32 European countries. It is powered by Cedefop's and Eurostat's joint work. See more here.

Skills forecasts in, or used by, PES - practical lessons

- Medium-term skills forecasts ideally follow a modular approach that includes a closed macroeconomic model, demand (including replacement needs), a supply by qualification, and some modules that link supply and demand to identify future imbalances.
- Data availability is usually the limiting factor in respect of the level of detail that can be made available. A trade-off needs to be made between level of detail at various dimensions (occupation, qualification, regionalisation).
- PES do not necessarily develop their own skills forecasts. In many countries, external organisations - often in collaboration with or including PES – develop and analyse the forecast on behalf of the PES and other interested parties.

3. IDENTIFYING SKILLS

Medium-term forecasts often lack the identification of skills, with occupation and/or qualification serving as a proxy for the skills needed. However, many PES indicated in the TRW that more detailed information on skills in their LMSI is useful. Accordingly, many countries have sought to link information on future occupation needs to real skill needs.

3.1 Bringing skills into skills forecasts

One approach is to use the ESCO classification by linking specific ESCO codes to occupations and qualifications. This uses the occupation element within ESCO, allowing ESCO to be linked to ISCO[16].

Several PES participating in the event have used and validated such linkage (e.g. Greece, Slovenia) to bring skills into medium-term skills forecasts. Greece's Mechanism of Labour Market Diagnosis validates the matches of ESCO skills to occupations at sector level. This allows forecasting outcomes and other labour market information to be linked to skills, adding another dimension to all outcomes (alongside sector, occupation, and qualification). This helps the Mechanism to identify skills mismatches within the labour market by analysing workforce qualifications and competencies against employers' demands. Discrepancies identified between skills and job requirements help to inform training programmes and educational curricula, ensuring that workers are equipped with the necessary skills to meet labour market demands.

Similarly, Slovenia links its skills classification system to the ESCO framework. Initially, the national occupation classification was aligned with ISCO, with the implied ESCO framework then used to assess the relevant competencies for various occupations through a 'competency weighting' method. The method comprises a comprehensive database that integrates administrative data, survey data, and the ESCO framework, enabling detailed analysis of labour market trends and the identification of skills gaps. This process identifies skillsets from the ESCO database that are then linked to occupations, resulting in a range of 7-25 skills per occupation. When matching jobseekers to job opportunities, these findings indicate potential matches beyond the current occupational context.

Many PES (BE-VDAB, CY, EE, LV, LU, NL, PL) report the use of international data[17] to supplement national data, complement areas where national data are lacking, or gain a

[16] International Standard Classification of Occupations.

[17] International data come from Eurostat, European Employment Services (EURES), European Commission sources, Eurofound, ELA, Cedefop, ILO, OECD.

comparative view of their own situation. This helps to broaden national understanding and enriches the analysis. Most PES emphasise that these international sources are usually used solely at central rather than regional PES and counsellor level.

Issues with international data include information sources failing to provide the level of detail needed or not being directly comparable to national data.

3.2 Extracting information on skill (demand) using Big Data

Many countries are working to incorporate Big Data approaches to harvest relevant information from existing data. There are two main sources in the context of skills and PES:

- OJA, which are automatically collected, cleaned and stripped for the relevant information. They are often collected and processed outside the PES, either by private companies or by national statistical offices. These collections can entail the online part of job openings published by PES (if openly available), but do not typically contain job advertisements held in administrative databases, nor are they made public (e.g. through online access). Challenges include de-duplication of the advertisements, the lack of representativeness of such data, incomplete skills demands in adverts, and variable information completeness between countries. Not all job openings are publicised by OJA: for example, job openings with higher qualification levels, especially information technology (IT) occupations, are frequently published online, while lower-level occupations are not;
- Internal information on job requirements, as well as a jobseekers' ability and skills based on the job openings forwarded to the PES (as part of its function to match jobseekers to job offers).

The Eurostat-Cedefop OVATE project uses OJA collected in most Member States to provide a common data source to analyse the demand for occupations. The European Training Foundation conducts a similar exercise to provide labour market intelligence in a number of partner countries. Both projects make use of the ESCO classification to detect skills advertised in OJAs. The outcomes are not representative of the full universe of job openings in an economy, as not all job openings are searched or published on online websites. However, providing and collecting regular updates on current OJAs facilitate analysis of dynamic developments in the labour market, a level of granularity that instruments based on labour force surveys could not provide (the number of observations in surveys is usually too small to provide very detailed occupational breakdowns or specific regionalisation).

Information on required skills is additional data that can be extracted from the OJA. These are usually taken from the job description, job requirements or competences required of applicants. A continuous challenge is to combine explicitly mentioned requirements with the implicit requirements in the naming of the function or occupation in the national context. OVATE has been used to analyse the development of general skill requirements, providing a list of key skills sought within a region, occupation, or sector. Cyprus, for example, uses data extracted from OVATE to gain insights into occupation and skill needs based on online job advertisements across the EU.

The Belgian-Flemish PES (VDAB) uses large language models (LLM) to analyse skills, either through focused studies or more simplified models of skills trends. It uses its 'Skills Framework' (based on LLM) to identify current and future skills trends. This framework is influenced by the language used by citizens, notably the terms used by both employers and jobseekers in job postings, CVs, and other employment-related texts. The framework is used as follows:

- The first step, Skill Cloud, measures and visualises the relationships between different expressions to identify skills. The Skill Cloud links these textual expressions based on semantic and linguistic connections, defining standardised

forms using a scoring mechanism in the graph components of the linked data to identify the dominant expression;

- In the second step, the 'Skill Tagger' simplifies a text by removing HTML tags and special characters (among other things). It then searches for recognised Skill Cloud expressions and annotates them with their standardised forms. For example, in the phrase 'We expect you to be a true team player,' the Skill Tagger will identify the term 'team player' as a known skill expression;
- The Skill Navigator then informs users about skills that are relevant to a given text (e.g. job description or function title), even if these skills or their recognised Skill Cloud forms are not explicitly mentioned. It uses LLMs to map known skills and the text provided.

Skills in three languages - Luxemburg's approach to extracting skills

The PES in Luxembourg has focused on identifying skills required in job vacancies. These are extracted from the (administratively available) requirements of the organisation posting the job opening. This is then used to identify skills uses, via LLMs such as augmented text-matching and integrating AI-based text processing to improve the accuracy of the skills identified.

Similarly, jobseekers provide information on their qualifications and previous career. This information can then be processed to yield similar typologies of skills that a jobseeker might have.

The PES has developed in-house models to extract skills data from job vacancy descriptions (and is starting to do the same with CVs). The hybrid approach combines structured text matching, augmented text matching and paragraph embedding. The Luxembourg PES uses the ESCO framework, including open data, to assist their efforts. They are already using these data to analyse skills trends and develop novel approaches for measuring skills proximities between occupations to help reskilling efforts.

One challenge is the multilingual environment of Luxembourg, which has three to four working languages (German, French, English, Lëtzebuergesch or Luxembourgish). Each language will yield slightly different results, creating challenges for the PES to balance these advanced methods with accuracy and fairness across all language groups. One possibility is to include jobseekers in the process to review and validate their own skills.

Several other PES reported using data from OJA either directly or in processed form. In some countries, national statistical offices are developing tools to harvest, clean and analyse OJA, similar to the OVATE project (EE, NL, SI, SE). These are usually considered complementary to information gathered from administrative job openings within the PES or job vacancy surveys (JVS).

PES have similar ideas for matching CVs to vacancies via ESCO or national classifications, with AI tools expected to facilitate these processes. However, these tools are often complex and can raise ethical questions (e.g. if implicit biases are included), with frontline counsellors requiring training to fully understand the tools.

3.3 Survey-based approaches to skills anticipation

Surveys are a common approach to identifying existing or emerging skill needs in labour markets. Approaches include skills matching surveys or surveys that focus on skills needs. In principle, both elements could be – and often are – included in a single survey. While the outcomes of skills needs surveys should be collected more frequently to identify changes in the labour markets quickly, skills matching elements are more structural in nature and do not need quick updates. Accordingly, skills needs surveys are usually conducted regularly and with a quick turn-around to gather information on current skills, differentiated by sector and region (e.g. Spain, Slovenia). Skills matching surveys, such as

Cedefop's European Skills and Jobs Survey, as well as tracer studies, are more detailed but less frequent, and focus on identifying mismatches and underlying reasons for these mismatches.

Several PES attending the event use surveys of employers (e.g. Spain, Sweden) and regional offices (e.g. Germany, Poland) to identify local and emerging labour market dynamics and specific skill needs.

The Spanish PES uses online, ESCO-based self-assessment surveys of employers to collect regional information on key soft skills needs[18]. It draws on the national training demands report, labour market shortages report, and a new AI tool (LeO). The online survey allows information to be collected and processed rapidly. This approach has helped the Spanish PES to detect shortages and tensions in the labour market and prepare resources for frontline counsellors and policymakers. Additionally, the PES plans to launch an AI tool for translating job vacancies into free text on the internet to enhance their quantitative analysis.

The Slovenian PES carries out an employment forecast survey twice a year, asking employers about expected trends for the coming six months and conducts Occupational Barometer, an annual overview of occupations in deficit or surplus on the labour market in Slovenia and the regional units. Similarly, the Polish PES uses its Occupational Barometer to assess labour demand and skills needs across national, regional, and district levels[19].

While some PES use surveys to gather direct information on employment or skill needs within a specific work area, more general surveys attempt to uncover skills, skill mismatches, and developments. These provide additional information for PES that can be included in a LMSI.

Specific skills surveys of employees, such as the European Skills and Jobs Survey (ESJS), can be used to identify and link skills to qualifications and occupations. Cedefop implements the ESJS in all Member States and has already undertaken two rounds of data collection[20] (2014 and 2021). The ESJS collects data from representative samples of adult workers on variables such as sociodemographic characteristics, job characteristics, job skill requirements, skill mismatches (vertical, horizontal, specific skills, gaps, and transitions), participation in VET, and labour market outcomes (wages, job insecurity, job satisfaction). The 2014 wave included effects of the 2008 global financial crisis and focused on skill mismatches in EU job markets. The 2021 wave addressed the impact of digital technologies and the COVID-19 pandemic on job skill requirements and workers' adaptability through vocational training.

Graduate tracking, via surveys or tracer studies, uncovers skills usage, skills requirements, and skill matches or mismatches. The coverage is usually limited to (a sample of) graduates within a country, as the focus is usually to understand graduates' school-to-work transition. If implemented regularly, it provides a useful tool in understanding graduates' perspectives on the skills needed, as well as the education system's capability to provide those skills. At the TRW, the Dutch PES reported using a combined tracer study, with both administrative sources and a survey element. Some work is done to link and harmonise

[18] Spanish employers' survey, https://www.sepe.es/encuestas/cuestionario-autodiagnostico.html.

[19] Poland, Occupational Barometer, https://barometrzawodow.pl/forecast-card-zip/2024/report_pl/raport_ogolnopolski_2024.pdf.

[20] Cedefop (n.d.), ESJS, https://www.cedefop.europa.eu/en/projects/european-skills-and-jobs-survey-esjs.

national tracer studies and provide common EU core data for Member States conducting tracer studies through surveys, administrative sources, or by linking these approaches[21].

Identifying skills - practical lessons

- Linking skills to occupation and qualification using existing frameworks (e.g. ESCO) can quickly map forecasts to true skills forecasts.
- Validating the list of skills needed in a sector or occupation by complementing the existing framework through a list of additional occupational or sector-specific skills is often done using qualitative approaches.
- The AI-based tools of Big Data analysis provide another toolbox to identify skills and their dynamic changes through analysis of job-postings.
- Combining information on skills from different sources (classifications, skills surveys, graduate tracer studies, etc.) allows to enrich the understanding of how skills and occupations might be linked.

4. SKILLS ANTICIPATION IN ACTION

The labour market information used by various PES consists primarily of statistical data on labour markets from national statistical offices or for instance from EU-LFS. It also includes job vacancy data (gathered from surveys, online job postings or administrative sources), administrative data on employment and unemployment, and information on jobseekers and graduates.

Cedefop's skills anticipation instruments entail a toolbox of instruments that are largely commonly used by PES (see Table 1). Cedefop classifies the instruments along several dimensions. First, their time horizon, from short term (current to one/two years ahead), medium term (3-10 years), and long term (10+ years). Second, the focus of the coverage is either narrow (selected parts of the economy) or broad (entire economy). Third, representativeness evaluates potential biases, as full population is not covered. Fourth, data needs, including demands on the data (high, if long time series or very detailed data with good coverage is needed (e.g. EU-LFS with long time-series), or low, if there are no restrictions on the depth of the information to be included). Fifth, stakeholder influence covers how much inputs and participation from various stakeholders is necessary. Sixth, the technical expertise necessary to implement and run the instrument. Finally, the costs are relatively broadly evaluated to rank the instruments. They are not in themselves conclusive, as they always depend on type of implementation and set-up.

[21] For more information, see the European Network of Graduate Tracking: https://education.ec.europa.eu/education-levels/higher-education/relevant-and-high-quality-higher-education/about-relevant-high-quality-higher-education/european-network-of-graduate-tracking.

Table 1: Skills anticipation instruments

	Forecast	Employee Survey	Employer Surveys	Tracer Studies	Big Data	Foresight
Time horizon	Medium – long	Short – medium	Short – medium	Short	Short	Medium - long
Skills (granularity)	Low (broad occupations/ qualifications)	Medium (education requirements; skills/tasks)	Medium (skill gaps/shortages)	Medium (horizontal/ vertical mismatch)	High (detailed occupation, skills, qualification)	High (occupation; degrees; skills)
Coverage	Broad	Broad	Broad	Broad	Narrow	Specific; narrow
Representativeness	Full	Full	Full/partial	Partial	Partial	Partial
Data needs	Long time series	-	-	-	Training set	Existing
Stakeholder influence	Low	Low	Low	Low	Low	High
Expertise (technical)	High	Medium	Medium	Medium	High	High
Costs (updates)	Large	Medium	Medium – large	Medium	Low – medium	Medium

Source: Adapted from Cedefop's presentation shared during the TRW

Forecasts, primarily medium-term forecasts, are quite technical to implement and require a high level of expertise. They are usually costly to run and require long and detailed time series of employment data, disaggregated by occupation and qualification. Several modules use the time series development of employment (by occupation, qualification, sector, and their cross-cells) to forecast developments. Classification changes and breaks in the series make that work difficult, if not impossible. Usually based on EU-LFS data, the skills are represented by broad occupations and qualification s, with some exceptions where the EU-LFS allows more granularity, or the data are enriched with administrative or other more encompassing data. The advantage of the medium-term skills forecast is its breadth – it can develop a picture of the entire economy.

The Cedefop overview does not explicitly mention short-term employment forecasts. These provide quick updates on employment figures, often by sector, to estimate the current economic situation. Several PES participating in the event have or use such tools. Cedefop recently introduced its own short-term employment forecast, 'Short-term anticipation of skills trends and VET demand' (STAS)[22].

Foresight is another forecasting tool. It takes a more qualitative approach, but usually uses all quantitative information to inform a group of specialists that develop likely future scenarios. It uses existing data and thus does not require specific data collection. However, while the costs are usually lower than for medium-term forecasts, considerable technical expertise is required to develop such foresight and combine the various quantitative and qualitative inputs into a reliable output.

Employer surveys are a less demanding instrument. These often include forward-looking elements, asking about expectations or current job openings, alongside information on

[22] Cedefop, STAS.

types of occupations, qualifications, or skills that are in high demand. Depending on the set-up, the coverage can be broad (even allowing for regional results) or cover only specific parts of the labour market (e.g. sectors). It requires some expertise to set up and run, and costs depend on the procedures to invite participation.

Tracer studies can be valuable instruments in following the school-to-work transition and identifying skill mismatches that could be overcome by better-aligning qualifications and labour market needs. Often, these studies are not run from within the PES, but the data might be valuable in advising on qualification and career choices. The coverage is broad within its target group (young people), and, like employer surveys, they require some level of expertise to develop and carry out.

Big Data is regularly used by PES. It has the advantage that, in most cases, the data are already available in some form. The challenge lies in understanding its precise use, as well as the processing to ensure reliable and informative outputs. While it demands considerable technical expertise, knowledge around Big Data is evolving quickly. Once set up, it can be run at lower cost, and repeated quickly, with very detailed outcomes. The most common elements are OJA and administrative data.

Administrative data from social security or similar institutions covering employment relations were mentioned by several PES (Belgium (Flanders), the Netherlands, Poland, Portugal, Slovenia, Sweden) during the Thematic Review Workshop. These unlock the potential of administrative data collected outside of the PES that can be combined or used together with other statistical data or tools. Examples of such data are employment numbers from social security insurance (often broken down by sector, region, or occupation), tax data with similar information from revenue services, and information on graduates or students in the education system from the Ministry for Education. Using such data requires agreements and collaborations to be put in place and data exchanges organised.

The Estonian PES looks at its own data to analyse the historical number of individuals trained and job vacancies related to training fields. It uses derived statistics, such as the ratio of vacancies to individuals with relevant educational backgrounds, with a ratio indicating a deficit or excess of existing jobseekers with specific skills. Machine-learning algorithms then predict employment probabilities after 12 months of training.

The Luxembourg PES emphasises the central role of information from job vacancies. It bases most of its labour market analysis on the job vacancies reported to PES (a legal obligation for all job openings). Where relevant, the PES includes data on job entries reported to the social security system, which cover all jobs in Luxembourg, albeit with less detail and, ultimately, poorer quality.

The Polish PES is developing a more elaborate tool based on a pilot project by the Rzeszów Regional Employment Office. The new system aggregates data from various public institutions to better monitor the demand for occupations and qualifications. The Polish PES stresses the importance of real-time data generated within the local offices – this timely information on job vacancies, registered unemployment, and the demand for specific skills allows prompt reactions to current labour market situations. This successful pilot is planned to be rolled out nationwide by 2025, as part of Poland’s broader strategy to refine labour market forecasting by 2050.

4.1 Combining tools

LMSI draws its strength from combining data, analysis, and outcomes from various tools. As many tools complement one another, combining and using different tools and analyses is highly recommended to gain a multifaceted view of labour market developments.

Greece’s Mechanism of Labour Market Diagnosis is a good example of combining different tools to achieve deeper insights. While the goal is to provide detailed information to all

types of users, the current dashboard (with many very specific choices) will likely attract specialists or trained PES counsellors. Combining forecasts, background information, and dynamic real-time data yields very granular and current insights into the country's skills landscape and labour market dynamics.

In Greece, MEKY identifies skills through empirical surveys of employees' proficiency, as well as ESCO and the Greek National Strategy for Upskilling 2023. The Greek PES can combine MEKY's tracking of skills with administrative data gathered from registered unemployed people. This capacity to analyse the creation or disappearance of jobs, interlinked with the skills needed per occupation, together with geographical and demographic characteristics, facilitates effective monitoring of labour market trends, as well as potential forecasting.

The platform is accessible to policymakers and the general public. The Mechanism facilitates collaboration between various stakeholders, including government bodies, businesses, and education providers. These entities can work together to create a more responsive and adaptable labour market by sharing insights and data. This collaborative approach ensures that policies and programmes are based on current needs and are forward-thinking, preparing the workforce for future challenges.

One challenge is proper use of the tool and understanding outcomes and results, with PES counsellors being trained on the tool's capabilities and functionality. To date, the Mechanism includes three sectors but will gradually be expanded to encompass all sectors of the economy.

BE-VDAB combines survey data from the EU-LFS and Job and Vacancy Survey (JVS), internal PES data on vacancies and unemployed people, social security data on employment, and statistics from the Belgian data warehouse on the labour market and social security. The Flemish Centre for Expertise of Labour Market Monitoring[23] provides longer time series data.

The Cypriot PES uses internal data on job vacancy and unemployment registration counts from within the PES, labour force surveys from the Statistical Service of Cyprus, and reports from the Employment Observatory. It combines forecasts from the HRDA with additional information from OVATE and data on employment, registered unemployment, new job openings, and job vacancies, reflecting the current labour market and economic conditions. The significant seasonality of certain occupations, particularly in the tourism sector, is also considered. In addition, Cyprus is experimenting with forecasting methods to project labour market prospects for jobseekers in terms of the ease of finding a job and for employers in terms of potential recruitment problems.

4.2 Effective use of skills intelligence

Effective use of skills intelligence requires a streamlined approach to different types of users. Specialist labour market researchers will be able to use more detailed data and understand the limitations of some of the results. More practical users, such as PES counsellors, will require a layer of simplification or translation. Jobseekers and people seeking information on career and qualification choices will require simplification, and, ideally, a different form of presentation to specialist guidance counsellors. In some cases, the LMSI is used to restrict the choice or availability of training (e.g. Estonia) and training provision (see box on page 18).

PES leverage skills intelligence to provide jobseekers and counsellors with detailed insights into labour market trends, emerging skills needs, and training opportunities through evidence-based policies. This information helps jobseekers and counsellors to make

[23] Flemish Centre for Expertise of Labour Market Monitoring.

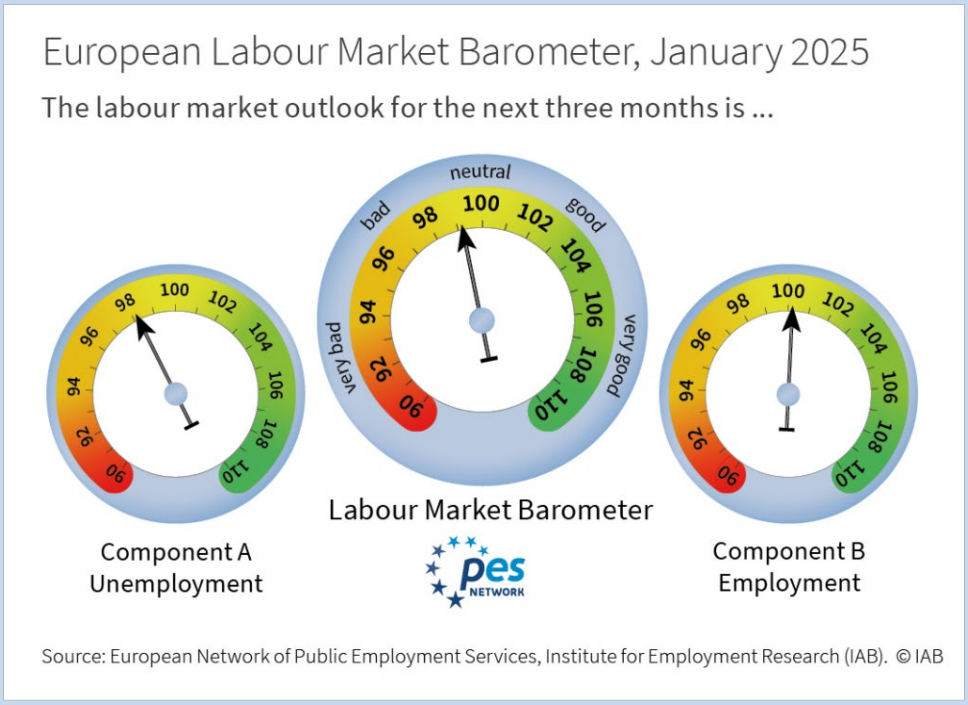
informed decisions about their career paths and training potential. During the Thematic Review Workshop, PES participants agreed on the importance of making skills intelligence accessible to all stakeholders.

A typical transformation is to develop specific indicators that are easy to interpret. A concept of shortage occupations exists in many countries and is sometimes used in immigration and work permit decisions. Similarly, indicators of future imbalance at the level of qualifications or occupations or a tension indicator[24] are calculated and presented to inform professionals (PES counsellors; training institutions) and the public (qualification choice) (for example, in the Netherlands). The Netherlands and Germany use similar approaches in their occupation forecast (the Netherlands) and the employment barometer (Germany).

European Labour Market Barometer

The European Labour Market Barometer is a leading indicator of employment and skills trends in European labour markets, derived from a survey of local and regional employment agencies in 17 PES services. Since June 2018, the survey has been carried out collaboratively by European Network of Public Employment Services and the Institute for Employment Research IAB.

Agencies are asked to evaluate the unemployment and employment outlook for the next three months, leading to two components and one barometer score for each PES. The overall European Barometer is calculated as a weighted average of these national scores. Evaluations by the IAB indicate that the European Labour Market Barometer possesses high predictive power, effectively signalling future changes in employment and unemployment.



The Barometer is also an example of a simple representation of outcomes that is easily understood.

Source: https://iab.de/en/daten/european-labour-market-barometer/

[24] Such indicators attempt to summarise or reflect on specific outcomes. The future imbalances indicator of ROA reflects the labour market prospects (see Bakens et al., 2024); the Dutch PES (UWV) tension indicator relates the number of unemployment benefit recipients in a region to the number of vacancies.

The dissemination of skills intelligence needs to be user-friendly, with easily accessible tools (e.g. websites), and targeted information. PES counsellors should be trained to best use the information to provide jobseekers with up-to-date and relevant information and advice.

Several **key success factors for effective skills forecasting and LMSI** emerged during the Thematic Review Workshop discussions:

- Regular and repeated data collection and analysis allow users to understand and learn about the tools available;
- Using reliable and timely data;
- Combining qualitative and quantitative data;
- Stakeholder involvement;
- Providing user-specific information.

4.3 LMSI for PES counsellors

The different user groups of LMSI have specific outcome presentation needs. Labour market analysts who typically work with and process outcomes independently are likely to need detailed information on the individual components of the LMSI. By contrast, PES counsellors who prefer not to conduct additional analyses would benefit from receiving simplified outcomes that are easy to interpret. The use of LMSI within PES usually involves presenting outcomes in a user-friendly way, e.g. via dashboards or similar tools.

For PES counsellors, real-time labour market information assists them in guiding jobseekers to make informed career decisions and identify relevant training opportunities. Decision-makers can utilise skills intelligence to develop evidence-based policies and allocate resources efficiently.

Greece’s Mechanism of Labour Market Diagnosis is a tool for specialists and for PES counsellors. Its depth of information requires some training for PES counsellors to use and interpret it effectively.

Poland’s Occupational Barometer condenses information on the current labour market situation for PES counsellors. The system uses and processes data collected by multiple public institutions and generates aggregate information on the demand for specific occupations and qualifications.

The Netherlands provides labour market information and outcomes from the short- and medium-term forecasts at national level and for regions to assist PES counsellors. The various indicators are regularly translated into scales that are more easily understood (e.g. three-point traffic light).

Slovenia has initiated the Labour Market Platform project as a comprehensive resource for stakeholders, namely the Ministry of Labour, PES, and the National Statistical Office. The Platform will collect insights into the current and future labour market and the final version is expected to be available in 2026. It will enable users to visualise competencies at individual and job vacancy levels, identify in-demand skills for the next six months, and make predictions for the coming 10-15 years.

The raw outcomes of LMSI are processed somewhat differently across countries, but the general trend is to simplify and condense the information for PES counsellors. Often, it is linked to or part of an information system that also allows access to more detailed uncondensed information.

4.4 Presenting outcomes of LMSI

The ways in which LMSI outcomes should be presented depend on the choices made by the targeted audience. This section discusses approaches to simplifying the presentation of certain outcomes to the general public and PES counsellors.

When seeking work or career opportunities, jobseekers benefit from understanding emerging skills demands, enabling them to pursue suitable career opportunities and relevant upskilling and reskilling initiatives. PES provide information on these trends from their LMSI using online websites or similar information sites. More recently, the use of specialised transformations in some countries makes that information more accessible.

In Belgium, VDAB uses the Skills Framework to identify skills trends. This framework is influenced by the language used by employers in job postings. VDAB has developed several accessible and intuitive applications to help citizens to think about skills, gain insights into the labour market, explore related professions, and support targeted training searches. For example, the tool *Jobbereik* allows citizens to quickly and easily create a skills profile to discover which professions align with their current skills and which require enhanced skills or additional training. Another tool, *Competentiecheck*, allows jobseekers to assess their current profession and determine if they possess the relevant skills. Users can check whether they are still up to date in their jobs by taking a test, after which they receive training suggestions to help them grow and remain relevant in their field.

The Dutch medium-term forecast provides detailed information at occupation and qualification level, describing each occupation's future labour market opportunities and imbalances, along with key labour market statistics (wage, unemployment rate, imbalance indicators). This information is provided in specific formats to school leavers deciding their further qualification choices.

Portugal plans to introduce automated, AI-based recommendation systems for jobseekers. These systems could use virtual agents to send information on job offers and candidate profiles to candidates and employers. A final phase will develop virtual assistants and optimise the skills management process to improve the interaction and efficiency of registering and applying for job offers.

Finally, since June 2023, the European Commission has offered the Job and skill trends tool on the Europass platform, based on the European Skills Agenda and the Europass Decision[25]. Using big data from millions of online job vacancies, the tool offers valuable insights on the demand for specific occupations and skills across EU countries. Users can look for the occupations that are highest in demand in selected countries, the countries where selected occupations are highest in demand, the skills that are most essential for those occupations and the most recent relevant demand trends. The tool allows individuals and guidance professionals to have a clearer picture of occupation and skill needs in Europe and therefore to make informed decisions about career and skills development.

[25] European Commission (2018), Decision (EU) 2018/646 of the European Parliament and of the Council of 18 April 2018 on a common framework for the provision of better services for skills and qualifications (Europass) and repealing Decision No 2241/2004/EC.

Estonia's application of LMSI in training recommendations

Estonia uses LMSI (more specifically, information extracted and combined in OSKA) to develop a methodological framework to provide training to jobseekers. Limited funding means that the PES can only fund relevant training and eligible jobseekers.

The methodology was developed in response to the discovery that the training offered through the PES did not necessarily provide the skills required/anticipated on the labour market.

Statistical data on the historic experience of training and vacancies in related fields were used to determine ratios of excess or deficits of skills and calculate employment probabilities. Using OSKA's current and future labour market needs, the estimated potential success of training in providing future employment to job seekers was evaluated and only those training programmes likely to lead to higher success probabilities were funded.

The current implementation will be evaluated against participants' actual employment outcomes, hiring and skills requirements, and the development of labour market shortages.

Development of the methodology was crucial, as is collaboration between the PES, Ministry of Education and training providers. The changing context of the economy also needs to be considered, e.g. the energy crisis, Russia's war of aggression against Ukraine, or the COVID-19 pandemic. Each will lead to slightly different shocks to the economy and training outcomes.

Skills anticipation in action - practical lessons

- LMSI should rely on several data sources and tools, as these usually complement each other;
- The outputs of LMSI should be transformed to cater for different users: labour market specialists usually rely on detailed outcomes, while PES counsellors and jobseekers benefit from simplification, enabling them to digest the information more easily;
- Key success factors include regular and repeated data collection and analysis, providing timely access to outcomes, and involving key stakeholders.

5. Conclusions

The Thematic Review Workshop emphasised the need for PES to use LMSI. PES should know the underlying concepts of the various tools if they are to understand their use and requirements, implement them properly, and combine them effectively with other elements.

LMSI or related tools are now being implemented in some form in all PES. However, not all countries will achieve structural use by the PES. Despite the toolbox of instruments available, having forward-looking skills and anticipation tools remains challenging. In developing and using tools within labour market intelligence**, it is crucial to consider the entire range of methods**, with medium-term skills forecasting being just one component alongside survey-based forecasting. PES should avoid delegating this responsibility entirely to AI to avoid implicit bias.

A skills-focused approach is somewhat hindered by using occupations and qualifications as proxies for skills. Medium-term forecasts are usually primarily focused on occupations and qualifications, creating a longstanding challenge in linking them to skills. Several approaches help to add other dimensions, for example including (validated) information

from existing classifications, or incorporating external information on emerging skill needs through Big Data applications. To date, however, these have only provided outcomes at the level of occupations and qualifications.

Emerging instruments used by some PES apply modern AI-based text tools to identify skills from OJA or to identify information from the matching process of an employer's job descriptions to a jobseeker's CV. **AI-based tools can also help to extract relevant information from OJA or similar sources**, such as desired occupation, sector and skills employers require. These tools can assist in processing and contextualising information, results can be updated frequently, and information can be provided with a high level of granularity. However, not all information might have been processed and interpreted correctly, nor do OJA typically cover the entire labour market.

Challenges in generating LMSI include bringing nationally available data together. Partnerships should be established between the organisations responsible for collecting data and those that have or want to develop the expertise to use the data to contribute to the LMSI. Such data exchanges will have to be formally established.

A related challenge is **to improve taxonomies and classifications that facilitate the integration of data from various sources**. By implementing processes to enhance classifications (e.g. from ESCO), sector-specific skills can be verified and (if necessary) incorporated into the classification. This will help to highlight skills more prominently in LMSI.

Linking skills to medium-term (occupational) forecasts is limited by the poor availability of information on skills, as well as the level of detail at which the information can be linked. For example, linking skills to three levels of qualification in the Cedefop forecast would not make sense, while linking skills to occupations in the same forecast would provide a more fruitful approach.

It is important to use LMSI to inform PES, PES counsellors, and jobseekers to make good career decisions. Ideally, information from several tools should be combined. **Skills intelligence is crucial to helping counsellors to deliver more relevant career guidance services.** By anticipating the needs of the labour market, counsellors can better identify training and guide jobseekers accordingly.

However, targeted and processed information is needed for the various groups LMSI is to inform. More detailed and specialised information can be provided at the analytical level, while PES counsellors would benefit from the information being processed so as to inform jobseekers on the labour market situation. Matching tools can assist in providing suggestions and context. These new approaches, together with the potential overflow of information, suggests a need to train PES counsellors to make effective use of the tools at their disposal.

Jobseekers should be informed using simplified outputs. While several PES work with specialised outputs that inform jobseekers, other PES are considering AI-supported tools to provide information and context at jobseeker level.

Thematic Review Workshop participants discussed the application of advanced technologies, stressing the need for PES counsellors to be trained to use them effectively and identify their limitations (including potential ethical concerns). Complementary tools should support forecasting outcomes, with information shared and displayed simply and understandably for jobseekers and for PES counsellors.

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