Identification and anticipation of skill requirements

Instruments used by international institutions and developed countries

Gerla van Breugel

PROJECT
DOCUMENTS

UNITED NATIONS

ECLAC

NORWEGIAN MINISTRY
OF FOREIGN AFFAIRS

Identification and anticipation of skill requirements

Instruments used by international institutions and developed countries

Gerla van Breugel

UNITED NATIONS

ECLAC

NORWEGIAN MINISTRY
OF FOREIGN AFFAIRS

Economic Commission for Latin America and the Caribbean (ECLAC)

Contents

Tables

Figures

Diagrams

Abstract

Responding to the current skills situation or anticipating on the future skills situation is only feasible when reliable and accurate skills information is available when needed. Various quantitative and qualitative methods are available, and each of these is capable of serving certain research objectives, such as the type of skills and how many individuals with these skills are needed, now or in the future. These methods also require certain stakeholder involvement of for example ministries, social partners, education providers, local governments, public employment offices, and sector skills councils. Lastly, these methods require a determined combination of resources such as data, human resources and financial resources. Various methods generate data that are used as input in other methods, some examples of the methods and sources discussed are input-output models, computable general equilibrium models, manpower requirement approach, informed opinion and specialist knowledge, employer surveys, labour force surveys and scenario development. Selecting and developing a suitable approach to skills identification and anticipation exercises involves a trade-off process in which the various aspects have to be weighed against each other. However, based on past experience, a mixed method approach, i.e. using a combination of various quantitative and qualitative approaches, generates the most reliable results. In most cases the need for skills is not projected directly, however via occupational demand. When these results are combined with detailed descriptions of occupations including skills information and educational attainment information (education type, level, field of study), the need for skills can be determined and can also be linked to what Vocational Education and Training program is required. Information on skills needs can be used as input for a wide variety of policy fields such as employment, education and training, migration, social and other development issues.

Executive summary

The effectiveness and efficiency of a national vocational education and training (VET) system depends, amongst others, on whether it provides its learners with the required skills now and in the future. These requirements have changed over the last decades and they are expected to change again in the future. National VET systems need to adapt to these changes in time to avoid costly skill mismatches as not having the right skills means lower wages and lower job satisfaction for workers, lower productivity and more hiring costs for employers, and lower economic output for the economy as a whole. Skill mismatches are omnipresent in developed countries: on average 45% of workers in 27 EU countries reported being under- or over-skilled in 2010. Skill mismatches can be reduced by certain policies, however these depend heavily on information about current and future demand for and supply of skills and corresponding mismatches. Therefore, this report gives an overview of the current mechanisms used by international institutions and developed countries to identify and anticipate the skills requirements of firms, and furthermore it shows how this information is then used for policy development and communication. Special attention is given to the identification and anticipation of skills of individuals with a Vocational Education and Training (VET) background, either at secondary or tertiary level.

I. Skills identification and anticipation exercises: an overview of approaches and characteristics

In this report skills are broadly defined as individual characteristics that drive at least one dimension of individual well-being and social-economic progress, that can be measured meaningfully, and that are malleable through environmental changes and investments. Skills can be classified as generic versus job specific skills, or as cognitive versus social and emotional skills. Furthermore, skills identification refers to the assessment of current skill levels and needs, while skills anticipation refers to any exercise that tries to predict future skill levels and needs. Instead of measuring skills directly, like in the UK, Canada and Austria, most countries use proxies due to disagreement about skills definitions between the educational sector and the labour market, the huge number of possible skills to be measured, and the time and costs involved. Frequently used proxies for skills are occupations, fields of study, qualification levels and qualification types. Skills exercises mainly focus on answering three categories of research questions: 1) how many jobs will exist now and in the future, 2) what

skills are needed now and in the future?, and what do they consist of?, and 3) what training and education are required to equip individuals with the skills required, now and in the future?

As the research questions show, skills exercises either have a more quantitative focus, a more qualitative one or combine both foci. Therefore, the approaches and sources used by international institutions and developed countries are presented among similar lines. Approaches and sources used that are mostly of a qualitative nature are for example literature studies, informed opinion and specialist knowledge, enterprise or employer surveys, labour force surveys, graduate surveys and scenarios. Informed opinion and specialist knowledge is retrieved from for example employee or employer representatives, education and training providers, qualification agencies, enterprise and trade development agencies, academics, and consultants by means of interviews, focus groups, workshops and surveys. An enterprise or employer survey collects information on employment and skills demand by asking firms about their current employment levels, human resource requirements, and anticipated needs, both in the short and the longer run. A good example is the Employer Skills Survey held in the UK. Labour force surveys on the other hand collect information on the supply of employment by industry, occupation, and skill level. Important skills data that these surveys generate are the formal educational attainments of individuals working in a certain job, and sometimes overall experience and other measurements of skills are also available. One of the most extensive and frequently held labour force surveys is the European Union Labour Force Survey which is held every three months in 33 countries. Graduate surveys are another useful source of information concerning the supply of skills, including not only the employed, but also individuals in further education or training, unemployed or inactive. In most countries these studies are initiated and executed per educational institution; however the Dutch School-leaver and graduate surveys are commissioned at national level and cover the complete breath of the Dutch educational system at secondary and tertiary levels. Lastly, scenarios use imaginative exploration to create descriptions of contrasting but plausible futures and are used to anticipate skills needs for the longer term, i.e. generally over ten years or more.

Approaches and methods having a more quantitative focus that are being discussed are the input-output models, social accounting matrices, computable general equilibrium models and the manpower requirement approach. Input-output models first estimates how the final demand for goods and services by households, government and (domestic and foreign) companies will change in the future based on historical data. Then, by using past data reflecting the supply and demand relationships between various sectors in an economy, the model estimates the effects of this final demand change for each sector as it works itself through the interconnected value chains of the economy. Social accounting matrices (or SAMs) are basically extended versions of the input-output model as they include additional accounts for the public sector, taxes and transfers, and household accounts. By including these accounts, SAM models are capable of capturing distributive dynamics as they can disaggregate the household sector by household income for example. Furthermore, SAMs can be used to look at the impact on taxes and government spending. Input-output models and social accounting matrices share the same basic assumptions: 1) changes in relative prices and possible substitution effects are not considered, 2) productive relationships are fixed and linear, i.e. they do not change over time and production will increase proportionally with demand, and 3) the supply-side is not constrained, i.e. whatever demand, it can be delivered. Although not being simplistic, both models have operations and assumptions are relatively transparent and easy to understand, which makes it easier to assess whether these models are the right ones to use in a certain situations, to validate the plausibility of their predictions and to explain them to policy makers. The latter also can increase policy makers' confidence in the models outcomes. On the downside, the basic assumptions of both input-output models and social accounting matrices limits their applicability to certain situations such as those in which productive relationships can be considered rather stable and no disruptive technological changes are to be expected. Furthermore, these models can only handle activities that belong to a classified sector, meaning they are not fit to study skills in the green or digital economy.

Computable General Equilibrium or CGE models consist of a series of equations, each describing certain economic behaviour. These models are used in the UK and the European Union, amongst others. At the heart of the model sits an input-output model showing various relationships between industrial sectors and final demand plus a variety of elasticities describing how demand reacts to prices changes. Households and firms are supposed to respond to price signals and pursue some form of optimizing decision-making. Equilibrium condition(s) such as market clearing or full employment are critical to CGE model in order to arrive at one unique solution to the system of equations. Macroeconomic equilibrium conditions are also a prerequisite for these models to work, such as that savings equal investment, ex post. CGE models differ from input-output models and social accounting matrices models regarding the role of prices in influencing behaviour and determining economic outcomes which is larger in CGE models, the need for equilibrium conditions to "solve" the equations, and the CGE models' capacity to study the impact of policies in the long-run, instead of only short and medium-term, output and employment growth. CGE models´ strengths compared to the previous two models are that with CGEs a wider range of topics can be studied, they can be used to study of long-run impact of policies on output and employment growth. And lastly, when performing sectoral analysis CGE models have the advantage that this analysis is embedded in the larger economy and that inter-sectoral linkages can be explored. The weaknesses of CGE models are mainly caused by their complexity. Because of this complexity development costs are high and as a result these models are mostly developed by private entities. This limits access to the model, as well as its transparency and the independent verification of the models assumptions. The complexity of CGE models also makes them harder to understand and explain to outsiders like policy makers.

The Manpower Requirement Approach or MRA estimates occupational imbalances as a proxy for skills imbalances, i.e. skills shortage or surplus. In order to do this, firstly occupational demand is projected. This is done by forecasting total expenditures, then future output by industry which is then combined with labour productivity per industry to calculate employment by industry. Then expansion demand by industry is calculated combining employment by industry with occupation coefficients (shares of an occupation in a certain industry). Furthermore replacement demand (i.e. number of workers needed to replace individuals who have left) and separations are calculated separately. Expansion and replacement demand are then combined in order to project occupational demand. Secondly, occupational supply is projected starting with an estimation of the number of graduates and dropouts which is combined with education to occupation matrices, labour participation rates to calculate a ´base´ labour supply by occupation. This ´base´ labour supply is then corrected for interregional migration, future immigration and future re-entrants to arrive at projected occupational supply. Comparing these projections of future occupational demand and supply gives an indication of where any future shortages or surpluses might arise. In practice, several versions of this model are used, for example using fixed or dynamic coefficients, or allowing or not allowing for interactions between supply and demand. Criticism on the MRA model focuses mainly on the validity of its assumptions, the trade-off between accuracy of results and usefulness of the results, and the vast amounts of data required. Despite this critique, the MRA model is regarded helpful in assessing future changes in specific occupations, how labour policies change future levels and structure of employment and as input for individual investment decisions regarding what skills, training and education to go for.

The various skills identification and anticipation exercises used vary considerably with regards to the time horizon and frequency on the one hand, and with regards to scope and level on the other. Skills identification exercises generally assess the current situation and therefore have the shortest time horizons, whether skills anticipation exercises can have a time horizon varying from short term (6 months to 2 years) up to long term (5 years or more) in which a ten year horizon is rather common. Skills identification and anticipation exercises are repeated more frequently when their time horizon is shorter. With regards to scope and coverage, skills identification and anticipation exercises often use occupational levels or educational levels as proxies to estimate required skills in the future. Skills exercises differ from each other with respect to the amount of occupational or educational levels

used. The more levels are used, the more detailed information can be generated, like demand for individuals with a certain VET background, however, limited data availability often hinders this. A frequently used categorization for occupational levels is the International Standard Occupational Classification (ISCO) of the International Labour Organization while for educational levels one often resorts to the International Standard Classification of Education (ISCED) developed by the United Nations Educational, Scientific and Cultural Organization. As regional and sectoral differences might be considerable within a country, many skills identification and anticipation exercises therefore include studies at national level accompanied by studies per region and per sector, again if data availability permits such analyses.

II. Stakeholders involved in the identification and anticipation of skills requirements

Various stakeholders are and should be involved in 1) the development of the skills exercises, 2) the discussion of the exercises´ results, and 3) the development of adequate policy responses based on these results. Stakeholder involvement in these activities generally enhances the possibility that the output produced meets the needs of its users, that stakeholders reach consensus about what skills are needed and finally, that the policy responses developed will be coherent and complementary.

Although many stakeholders participate in the development of skills identification and anticipation exercises, this activity seems to be mainly dominated by Ministries of Labour or Education, statistical offices and employer organizations, followed by the involvement of universities, trade unions and public employment services. The governance models used to organize the involvement of different stakeholders in skills exercise development are situated on a continuum that ranges from policy driven exercises on one end to independent exercises on the other, with hybrid models in between. Policy driven exercises are led by the end users of skills information, like VET agencies, employers and public employment services, and are intended to serve certain policies or programmes, while independent exercises are led by agencies that are independent of the end users of the skills information, such as statistical offices, universities and research institutes and are developed for a broad audience without a certain policy or programme in mind. The choice between one governance model or the other boils down to a trade off between scope and fit: policy driven exercises tend to be more focused to a certain policy field and better fitted to the requirements of the end users in that field, hence a smaller scope and a better fit. In contrast, independent model exercises can be used by end users of various policy fields, i.e. these exercises tend to have a wider scope but at the expense of a good fit each particular policy field.

When it comes to the discussion of the results of skills identification and anticipation exercises and drafting an adequate policy response, Ministries of Labour and Education are the most involved, with contributions from other Ministries as well such as Ministries of Economy, Industry, Agriculture or Treasury. Non-ministerial stakeholders, such as VET providers, tend to more frequently involved in discussing the results of skills exercises than in developing an adequate policy response to these results.

Stakeholders might run into conflicts in all three activities discussed above mainly due to the number and variety of the stakeholders involved, each of them having different interests and objectives with regards to skills identification and anticipation exercises. In the development phase of the skills exercise, stakeholder conflicts can be cause by limited time availability, changing priorities and resources, lack of mutual benefits and the desire to avoid duplication. When stakeholders are discussing the results of skills exercises, they do not always agree on the skills needed because at times various skills exercises executed simultaneously produce conflicting results, the results are opposite to some stakeholders perceptions, or the same results are sometimes interpreted differently by various stakeholders. Lastly, when stakeholders are discussing an adequate policy response, conflicts may arise due to the pursuit of different interests by stakeholders, the distribution of

responsibilities concerning skills policy among stakeholders might get in the way or sometimes the social dialogue process itself makes it sometimes harder to reach agreement on what the most effective policy response is.

In order to enhance coordination and/or reach consensus between the stakeholders involved, countries are using various solutions ranging from informal/ad-hoc ones to more structural/formal ones. One solution is ensuring that the agencies developing and executing the skills exercises are independent and well respected by all stakeholders. Another is to invite stakeholders to workshops where skills exercises and their results are explained and discussed. Furthermore, in some countries studied stakeholders are given a formal position in the agencies that develop and execute skills exercises or in their advisory boards. To facilitate coordination between skills exercises at various levels some countries use a network or a central agency, a legal framework or a national skills strategy. Such a strategy improves coordination and consensus as it generally provides direction via the objectives formulated and in general it will provide a framework for all stakeholders involved. A final approach to facilitate coordination and/or consensus that has worked in a few countries is to first set clear objectives and realistic time tables and centre the following discussions on achieving them. Choosing the "right" solution to enhance coordination and/or reach consensus will depend on factors like the country's social dialogue characteristics, the skills exercise government model it uses and the number and type of stakeholders involved.

III. Case studies

Several cases have been selected to demonstrate the wide variety of skills identification and anticipation exercises used by national governments and international organizations. These are Cedefop's pan-European model, the national approaches of Canada, the USA, the United Kingdom and France. And the approaches used by the World Bank, the International Labour Organization (ILO), and the Organization for Economic Cooperation and Development (OECD).

The European Centre for the Development of Vocational Training (Cedefop) coordinates a pan-European 10-year skills forecast which occurs every two years and is executed by a consortium of research institutes. These forecasts are important building blocks of the EU Skills Panorama under the flagship initiative 'Agenda for New Skills and Jobs' of the 'Europe 2020 strategy'. The Cedefop's forecasts are intended to add value to existing national initiatives and not replacing them. The forecast results include labour demand, labour supply and job opportunities, all disaggregated by EU member country, and then by qualification level, occupation and industry. This European model is based on the previously discussed Manpower Requirement Approach (MRA) and starts with macro-economic forecasts of labour demand by country and 42 sectors, and of labour supply by age groups and gender. This labour demand is refined into number of job openings by three levels of qualification (ISCED based) and by 26 occupation categories based on assessments of expansion demand, and replacement demand. Labour supply follows a stock model approach and consists of a forecast of the stock of people by their highest formal qualification achieved, employment status, age and gender. The forecasts of labour demand and supply are then contrasted to assess future imbalances between skills demand and supply by three levels of qualification. The main strengths of this approach are the use of a similar methodology and harmonized data that produce results than can be compared between countries and added up to create pan-European information. Furthermore, other countries and variables or components can be easily added which enables continuous improvement and development. Results have been quite robust as they are similar to national forecasts despite differ approaches. Finally, input data and key assumptions can be changed to develop alternative policy scenarios. In contrast, the main weaknesses of this pan-European model mostly reside in the fact that limited data is availability for certain variables or countries, that skills are not estimated directly and that certain important changes (technological changes, green economy) are hard to incorporate in the model. Furthermore, other weaknesses are module specific: the replacement demand module for example does not account for interoccupational mobility and the forecast of labour supply would be

greatly enhanced if a stock flow instead of a stock model could be used, but data limitations, especially of smaller EU member countries prevent this.

The Canadian Occupational Projection System or COPS has been used by Employment and Social Development Canada (ESDC) for over thirty years to produce 10-year occupational forecasts covering labour demand, supply and any imbalances and are updated every two years. COPS is also based on the MRA and uses data from a Census, Labour Force Surveys, the Longitudinal Administrative Databank, National Graduate Surveys and other national and international sources. Any imbalances between occupational supply and demand in COPS are treated in two ways: firstly in a quantitative way by calculating the difference between occupational supply and demand and then in a qualitative way by calculating the 'normalized future labour market situation indicator'. This indicator helps to interpret the imbalances found. The results of both ways are communicated to the public using the rating 'shortage', 'balanced' or 'surplus´. Based on the education requirements for an occupation, the projections per occupation are transformed into projections by skill level using the skills categories Management Occupations (M), Skill level A (requiring university education), Skill level B (requiring college education or apprenticeship training), Skill level C (requiring secondary school and/or occupation-specific training), and Skill level D (none, as on-the-job training is provided). The projection results are communicated by synthesis documents describing job openings by occupation, skill level and source, job seekers by occupation, skill level and source, and projected labour market conditions by occupation.

The Bureau of Labor Statistics (BLS), a government body of the United States, produces a 10-year forecast exclusively showing occupational demand in the USA and is updated every two years. The forecasts are based on the manpower requirements approach and use economic projections, an input-output matrix and an industry-occupation matrix. The data are disaggregated for 334 occupational profiles, representing 84% of available jobs in the US economy and including self-employed and unpaid family workers as well as wage and salary workers and two sets of industry sector categorizations. Future skill needs are not only assessed indirectly by projecting occupational demand, but also indirectly via an analysis of the education and training requirements of each occupation and the current level of educational attainment of workers. These education and training requirements per occupation are displayed using three different groupings: ´typical education needed for entry´ (eight categories ranging from less than high school to doctoral or professional degree), 'typical work experience in a related occupation' (three categories ranging from no training to five years or more), and 'typical on-the-job training' category (six levels ranging from none to Internship/residency). These groupings give indirect information on the demand of skills of individuals with a VET background and various levels. The data used in occupational demand forecasts are, amongst others, Census data (Census Bureau), Labour Force Survey data (Current Population Survey) and Foreign Sector data (Oxford Economics). Furthermore, education and training requirement analyses are based on data from the American Community Survey (Census Bureau), Occupational Information Network (O*NET) and the National Centre for Education Statistics. The forecasting results are distributed via the publication Occupational Outlook Handbook and corresponding websites. The BLS projections assess long term trends based on the presumption that future is best predicted by the past. Its main limitation therefore is that these predictions explicitly do not take shocks to the system into account such as armed conflicts, natural disasters, changes in relevant laws and policies.

In the United Kingdom, various skills exercises are lead, coordinated and funded by the UK Commission for Employment and Skills (UKCES), a publicly funded, industry-led organisation that includes commissioners representing employers, trade unions, the third sector, and further and higher education across all four UK nations. These exercises include a skills identification exercise, the Employer Skills Survey (ESS), a skills anticipation exercise using forecasting techniques called Working Futures and a skills anticipation exercise using foresight techniques named the Future of Work study. Results are produced at the aggregate UK wide level but also at rather detailed levels such as for a certain local area or sector. The exercises put more emphasis on the demand side of skills than the supply side, and most studies are performed at regular intervals of two to three years. The

time horizon varies from the current situation or past year to ten years for the forecast exercise and fifteen years for the foresight exercise. Various stakeholders are involved in the different exercises representing all four national governments, various policy areas with an emphasis on employment and education and training, local area representatives such as Local Enterprise Partnerships (LEPS) and Sector Skills Councils and Bodies.

The Employer Skills Survey covers recruitment and skill-shortage vacancies, internal skills challenges, under-use of skills and qualifications, working practices, product market strategies, and investments made in the training of employees during the previous year. The labour projections of the Working Futures are rather similar to the European Cedefop approach and the Canadian COPS. The foresight study the Future of Work uses an entirely qualitative approach involving six sequential steps: 1) a systematic literature analysis and expert interviews to get an overview of the relevant societal, technological, economic, ecological and political factors impacting future UK-specific jobs and skills; 2) identification of major trends and disruptions that are likely to affect the jobs and skill fifteen years in the future; 3) identification of key drivers of relevant trends and disruptions and their likelihood, direct and indirect impact, level of activity, and projections on how these factors will develop; 4) developing raw scenarios based on consistent combinations of projections using software; 5) enriching the raw scenarios by making more detailed assumptions about the causalities or underlying logics of a scenario and explaining possible paths leading to the scenario's future and 6) inventory of the implications of the scenarios for various labour market stakeholders during a conference in which these stakeholders participate.

The French system of skills identification and anticipation exercises consists of regular analyses at macro-, meso- and micro-levels plus some ad hoc studies. Most studies involve skills anticipation exercises with time horizons varying between five to ten years, although employers generally identify skills as well and look at skills changes in the nearer future. Furthermore, the exercises are repeated every three to six years. Overall, both skills demand and supply are considered in France; however, this depends on the actual level of analysis (macro, meso or micro). Quantitative methods such as econometric modelling are used and qualitative methods like consultations and discussions with stakeholders as well, especially in the observatories at regional and sectoral level. A broad array of stakeholders is involved depending on the type and level of the skills exercise such as numerous ministries, sectoral organizations, social partners, regional partners and (large) employers. Their involvement includes extensive consultation, information dissemination, but also funding and execution as in the case of skills analysis by mid-sized and larger companies. The results can be disaggregated by sector or domain, occupation, dominant occupational level, and region, amongst others. Most results are disseminated by online available reports and in discussions with stakeholders and are mainly used for VET and labour policies.

The macro level occupations and skills forecast differs from previously discussed cases as they are developed based on three scenarios (baseline, crisis, target) and therefore result in three employment forecasts, all based on a multisectoral macroeconomic model. These results are then disaggregated by occupational level using the French "Familles Professionnelles" (FAP) classification, by seven skills levels, and by sector. These forecasts have struggled with major changes in important data sources, trend breaks, lack of studies on occupations and skills in France, political constraints, and a lack of economic knowledge in labour market debates. At meso level many regional observatories, involving a range of stakeholders, develop forecasts on branch-specific employment, occupations, specific professions, recruitment, and demand for qualifications, amongst others. At micro level, a law obliges French companies with over 300 employees to establish and discuss an employment anticipation report with employee representatives every three years. The underlying idea is to anticipate and act on possible economic, technological and legal changes the company might face so as to create a smooth transition.

Besides the pan-European Cedefop model run by the European Union, other international skills programs exist. The World Bank, for example, has developed the 'Skills Toward Employment and Productivity' or STEP framework, a conceptual model to guide relevant actors when designing a

system of skills development that includes skills diagnostics and policy design. STEP is aimed at low and middle-income countries to help them building a skilled workforce as a means to end poverty and promote shared prosperity. The programme includes finance, knowledge and technical assistance to individual countries. This framework includes two surveys: a household survey to collect data on cognitive, socio-emotional, and job relevant skills allowing for the identification of skills supply, and secondly an employer survey generating data about workforce characteristics, skills used by its workforce, hiring practices, training and compensation and background characteristics in order to identify skills demand. The results of both surveys are disaggregated by industry, occupation, skill level and educational attainment level, amongst others. So far, the household survey has been applied in twelve countries and the newer employer survey in four countries. The World Bank intends to survey more countries in the future.

Skills for Green Jobs is a joint global research project of the International Labour Organization and the European Union. It is aimed at the identification of skill needs for greener economies in 21 developed and developing countries. This global research project is of a qualitative nature and is based on an ad-hoc analysis of existing cases in order to select best practices and to give recommendations or directions for improvements. The initiative seems to be mainly directed at influencing labour and education and training policies and at the institutional sector. Its results have been disseminated by means of reports. This project shows that identification and anticipation of green jobs and related skills is is not an easy task as these do not fit nicely into the existing sector, industry and occupational categories, and furthermore are rather dynamic due to technological changes and innovation.

The OECD has developed a Skills Strategy framework to help national governments to identify the strengths and weaknesses of their existing national skills pool and skills systems, benchmark them internationally, and develop policies for improvement". The framework consists of several instruments to analyse skills supply and demand of cognitive skills, social and emotional skills, creativity and critical thinking. The instruments give more attention to skill supply and the focus is on the analysis of the current situation and of past trends. Qualitative methods are mainly used and levels of disaggregation of output vary among instruments, however, results are always provided at country level. The research results are mostly used as input for education and training policies, labour policies and social policies. These results are disseminated through workshops, reports (Skills Outlook, Education at a glance, Employment Outlook) and databases made available on the OECD website.

Two instruments to analyse the current skill supply have been developed under this framework. The first one is the Programme for International Student Assessment (PISA) containing an international survey of 15-year old students in 70 economies who are questioned about their reading, mathematics and science abilities every three years. The second one is the Programme for the International Assessment of Adult Competences (PIAAC) which assesses the literacy, numeracy and information-processing skills of 16 to 65-year olds. Roughly 5000 adults have been interviewed in each of the 40 participating countries (OECD and partner countries). The data generated by this programme is disaggregated by three educational attainment levels: lower than upper secondary level, upper secondary level and tertiary level.

IV. Use and dissemination of skills information

The skills information generated via the previously discussed skills identification and anticipation exercises is used in a variety of policy fields such as employment, education and training, migration, social policies and development. Regarding employment policies, skills information is mainly used to keep occupational standards up to date and to revise, design and allocate re-training programs. In Austria, Belgium and Estonia for example, unemployed individuals are actively stimulated by public employment services to retrain themselves for occupations which are high in demand. Other important applications within this field are the revision, design and allocation of on-the-job training programmes, the up- or re-skilling of trainers and the development of apprenticeship programs. In a

few cases tax incentives for workers and employers are developed based on skills information, or it is used as input during collective bargaining processes.

Somewhat similar can be seen in how information from skills identification and anticipation exercises is used in the education policy field: its main application there is to update, design and revise qualifications and curricula. However, other frequent applications are informing students and their families about labour prospects of certain careers, and deciding what courses should get funding. This latter application occurs more frequently regarding upper secondary level courses than tertiary level and adult training courses. An example of this can be found in New Zealand where a looming shortage in the Science Technology, Engineering and Mathematics (STEM) fields lead to increased university vacancies and reduced tuition fees for [STEM] related programs. Other uses of skills information in the education policy field are to update career guidance or train advisors, develop apprenticeship programmes and up- or re-skill teachers. In some cases funding for research initiatives is allocated based on skills information.

Another area in which skills information has been put to practical use is migration. Some countries produce lists with occupations that are or will be in high demand. Examples of these lists are the Skilled Occupations List (SOL) in Australia, the Skill Shortage List (SSL) in New Zealand and the Labour Shortage List in Sweden. Immigrants who can fulfil these highly demanded occupations generally have to fulfil fewer requirements when applying for visas and/or can apply to long-term permits or even citizenship earlier than others.

Various countries are going through transformation processes either to a greener economy and/or a digital economy. Skills information can play a role in such transition processes as these tend to make certain skills obsolete while others will be more in demand. Predicting the related skills trends accurately can help to reduce job displacement and ensure that the skills needed in these transitions are available in the labour market and thus make these transitions as smooth as possible. Such predictions are far from easy, however, as for example the generation of skills information related to a greener economy struggles with defining what green jobs, occupations and skills are, how to adapt skills instruments to include environmentally driven (changes in) competencies, qualifications, courses and curricula, and the fact that green activities do not fit neatly into the traditional sectors of an economy. For the latter reason, while investigating renewable energy sector in the previously discussed study Skills for Green Jobs, the researchers looked beyond the five traditional sectors that make up the renewable energy sector and also included sectors like manufacturing and distribution of equipment, project development, and construction and installation.

With regards to the transition to the digital economy several countries have conducted specific studies into the changes in skill supply and demand due to digitization. Based on such studies, Ireland for example has revised its ICT Skills Action Plan and included specific actions to achieve a much needed increase of ICT graduates in order to reach the overall objective of making Ireland a global leader in ICT talent.

Skills demand and supply information can also be used for a wide array of social policies as it shows where skills shortages and mismatches currently are or might arise in the future. One can think of social policies regarding demography, youth, social inclusion, care policies, social assistance and pensions for example.

As can be concluded from the previous discussion, skills information has a large number and variety of (potential) end users. This makes it rather challenging to provide the skills information in such a way that it satisfies end users´ needs and that the information reaches them. Most skills exercises' results are disseminated by means of reports, sometimes accompanied by searchable databases or original data output files, all published on public websites. Some countries use skills information as input for their occupational profiles database. Public media are used to attract attention to the skills publications via press releases, Twitter messages and media appearances on TV and radio, for example. Lastly, skills information is spread in a face to face manner via workshops, seminars and conferences aimed at experts and/or policy makers representing various stakeholders.

V. Choosing and developing a suitable approach
to skill identification and anticipation exercises:
some aspects to consider

The first aspects to consider are related to the research objectives of skills exercises and include whether qualitative or quantitative information regarding skills is preferred, or both, who will be the end users and what will they use the information for? Other choices to make are the scope of the exercise, its time horizon and if and how frequent it will be repeated. In order to satisfy as many end users in a wide variety of policy fields, the most suitable approach would include supply and demand of skills, the current and future situation, and repeated regularly. Furthermore, such exercises would deliver aggregate nationwide data, but also detailed data per sector and region, and finally, skills information at occupation level and at educational level. However, this ´ideal´ is difficult to execute due to the high costs related to such an approach in combination with lack of resources, such as data, time, and/or human resources that often occur in practice. A second aspect is the characteristics of the methods and sources employed in various skills identification and anticipation exercises. Most methods and related sources that have been discussed are either more suitable to find out what skills are needed or supplied, i.e. for a qualitative approach, or for a quantitative approach meaning assessing how many individuals with a certain skill are needed or supplied. The more powerful the quantitative approach used, like the manpower requirement approach, the more data are needed. When the ´what skills´ question and the ´how many individuals´ question are both relevant, a mixed approach including both qualitative and quantitative methods would be more suitable and provide more comprehensive results. Thirdly, one should consider the number of stakeholders involved as well as their level of involvement during development, while discussing the results and finally when formulating an adequate policy response. Stakeholder involvement is important in all three stages in order to make sure that the skills exercise perfectly fits the stakeholders' needs, that they understand the process and know how to interpret and use the results and therefore it is more likely that a suitable policy response is formulated. However, increased stakeholder involvement can give rise to conflicts and should therefore be coordinated well. Finally, the quality of skills exercises depends heavily on resource availability which includes the availability of sufficient and reliable data, of human resources who are capable of developing and executing skills exercises and adequate financial resources to fund all of the above.

Resumen ejecutivo*

La efectividad y eficiencia de un sistema nacional de formación y capacitación profesional (VET, por sus siglas en inglés) depende, entre otras cosas, de que este provea de las cualificaciones requeridas por el mercado tanto en el presente como para el futuro. Estos requisitos de formación han cambiado a lo largo de las últimas décadas y se estima que seguirán cambiando en el futuro. Los sistemas nacionales de formación y capacitación profesional necesitan adaptarse a estos cambios a tiempo para evitar desajustes de habilidades costosos. En efecto, no poseer de las cualificaciones apropiadas puede implicar salarios más bajos, menor satisfacción laboral para los trabajadores, menor productividad y mayores costes para empleadores, además de menor producción y rendimientos macroeconómicos en general. Los desajustes de habilidades están omnipresentes en los países desarrollados: en promedio un 45% de los trabajadores en 27 países de la Unión Europea se consideraron sub- o sobre calificados en 2010. Estos desajustes pueden reducirse a través de ciertas políticas públicas, sin embargo estas dependen fuertemente de la información disponible sobre la demanda actual y futura de competencias y oferta disponibles de las mismas y de los correspondientes desajustes. Este informe ofrece un resumen de los mecanismos usados por organismos internacionales y países desarrollados para identificar y anticipar los requisitos de formación, competencias o habilidades[1] de las empresas. Además muestra cómo esta información es usada para el desarrollo de políticas y cómo se comunica a los usuarios. El informe dedica especial atención a la identificación y anticipación de las habilidades de personas con formación técnica y profesional, sea a nivel secundario o terciario.

I. Modelos de identificación y anticipación de habilidades: un resumen de estrategias y características

En este informe las competencias o habilidades están definidas, en términos generales, como características individuales que promueven al menos una dimensión del bienestar individual y del progreso socioeconómico que puedan ser medidas, y modificadas a través de cambios en el contexto o de ciertas inversiones. Así, las competencias o habilidades pueden ser clasificadas como genéricas o específicas a un trabajo, o como cognitivas frente a las sociales y emocionales. Por su parte, la "identificación de habilidades" se refiere al proceso de evaluación de los niveles de las misas que se

---

[1] La palabra "skills" puede traducirse al español de diversas formas, en este documento se la considera como competencias, habilidades o cualificaciones.

necesitan o demandan en el presente mientras que "la anticipación de habilidades" se refiere a cualquier ejercicio que procure anticipar los requerimientos futuros de las mismas. En lugar de medir las competencias directamente, como en el Reino Unido, Canadá y Austria, la mayoría de los países usan otros indicadores similares (*proxies*) debido principalmente a las discrepancias entre el sector educativo y el mercado laboral respecto a la definición de las mismas, la gran cantidad de posibles competencias a medir, y el tiempo y costes involucrados. Los *proxies* más frecuentes suelen ser ocupaciones, áreas de estudio y niveles y tipos de cualificación. Los ejercicios de identificación y anticipación de competencias se concentran principalmente en tres categorías de preguntas de investigación: 1) ¿Cuantos trabajos existen actualmente y cuantos existirán en el futuro? 2) ¿Qué habilidades se necesitan actualmente y cuales en el futuro? ¿Y en qué consisten? 3) ¿Qué tipo de formación y capacitación se necesita para proveer a los individuos con las habilidades demandadas, tanto en la actualidad como en el futuro?

Como demuestran las preguntas de investigación, los ejercicios de identificación y anticipación de habilidades tienen ya sea un enfoque más cuantitativo, uno más cualitativo o una combinación de los dos. Por lo tanto, las estrategias y fuentes de datos usadas por instituciones internacionales y países desarrollados tienen ciertas similitudes. Las estrategias y fuentes de carácter más cualitativo suelen incluir, por ejemplo, estudios bibliográficos, opiniones informadas y conocimientos de especialistas, encuestas de empresas o empleadores, encuestas de los trabajadores y estudiantes y el análisis de situaciones hipotéticas. Las opiniones informadas y los conocimientos de especialistas son extraídas, por ejemplo, de representantes de empleadores o trabajadores, instructores de formación, agencias de certificación, agencias de desarrollo empresarial y comercial, académicos, y consultores a través de entrevistas, grupos focales, encuestas y talleres. Una encuesta a empresas o empleadores recoge información sobre la demanda de empleo y habilidades preguntando sobre los niveles actuales de empleo, requisitos de recursos humanos, y necesidades anticipadas, tanto a corto plazo como a largo plazo. Un buen ejemplo es la encuesta sobre competencias a empleadores (*Employer Skills Survey*) en el Reino Unido. Por otro lado, las encuestas de empleo (*Labor Force Surveys*) recogen información sobre la oferta de trabajo por industria, ocupación y nivel educativo. Algunos datos importantes sobre las cualificaciones que son generados por estas encuestas incluyen los niveles de educación formal de individuos en un trabajo específico, y a veces también los años experiencia en general y otras medidas sobre el nivel de capacitación. Una de las encuestas sobre la mano de obra más difundida y frecuentemente utilizada es la encuesta de empleo de la Unión Europea (*European Union Labour Force Survey*) que se hace cada tres meses en 33 países. Las encuestas a graduados representan otra fuente útil de información útil para describir las cualificaciones de la oferta laboral, incluyendo no solo a que ya están empleados, sino también a individuos que continúan estudiando o que están desempleados o inactivos. En la mayoría de los países, estas encuestas son diseñadas y ejecutadas por cada institución educativa. Una excepción es la encuesta a graduados y ex-alumnos en los Países Bajos que son encargadas a nivel nacional y cubren el espectro completo del sistema educativo del país a nivel secundario y terciario. Por último, los ejercicios de anticipación de habilidades suelen analizar diversas situaciones hipotéticas plausibles para llegar a resultados de largo plazo, e.g. normalmente para diez años o más.

Las estrategias y los métodos de carácter más cuantitativo en uso consisten en modelos de entrada y salida (Input-output models), matrices de contabilidad social, modelos de equilibrio general computado, y el enfoque de necesidades de recursos humanos (MRA por su nombre en inglés "manpower requirement aproach"). Los modelos de entrada y salida estiman primero como cambiará en el futuro la demanda final de los hogares, gobiernos y empresas domésticas y extranjeras para bienes y servicios basándose en datos históricos. Entonces, usando datos históricos sobre las relaciones de oferta y demanda entre varios sectores de una economía, el modelo estima los efectos de este cambio de demanda final para cada sector a través de las cadenas de valor interconectadas de la economía. Las matrices de contabilidad social (SAM, por sus siglas en inglés: *social accounting matrices*) básicamente son versiones extendidas del modelo de entrada y salida al incluir cuentas adicionales del sector público, impuestos y transferencias, y cuentas domésticas. Al incluir estas cuentas, los modelos SAM son capaces de capturar dinámicas distributivas ya que pueden desagregar

el sector doméstico por ingresos por ejemplo. Además, las matrices de contabilidad social pueden ser usadas para estudiar el impacto sobre impuestos y gastos gubernamentales. Los modelos de entrada y salida y las matrices de contabilidad social comparten las mismas supuestos básicos: 1) no se consideran los cambios en los precios relativos y posibles efectos de sustitución, 2) las relaciones productivas son fijas y lineares, es decir que no cambian con el tiempo y la producción se incrementa proporcionalmente a la demanda, y 3) no hay restricciones por el lado de la oferta, lo que implica que cualquiera sea la demanda esta se podrá cubrir sin problemas. Aunque no sean simples, ambos modelos tienen operaciones y supuestos relativamente transparentes y fáciles de entender, lo cual facilita valorar si estos modelos son apropiados en ciertas situaciones, validar la verosimilitud de sus proyecciones y explicarlos a los hacedores de política (lo que puede aumentar su confianza en los resultados del modelo). La desventaja es que los supuestos básicos de ambos modelos limitan su aplicación a ciertas situaciones tales como aquellas en las cuales las relaciones productivas son estables y no se espera ningún cambio tecnológico disruptivo. Además, estos modelos solo pueden utilizarse para analizar actividades que pertenecen a sectores ya clasificados, es decir que no son aptos para analizar las competencias de la economía verde o digital.

Los modelos de equilibrio general computado EGC (CGE por su nombre en inglés "*computable general equilibrium*") consisten en una serie de ecuaciones, cada una describiendo ciertos comportamientos económicos. Estos modelos son usados en el Reino Unido y la Unión Europea, entre otros. Como núcleo de esta metodología se encuentra un modelo de entrada y salida mostrando varias relaciones entre sectores industriales y demanda final más una variedad de elasticidades describiendo como la demanda reacciona a cambios de precio. Se supone que los hogares y las empresas responden a las señales de los precios y buscan una forma de optimizar la toma de decisiones. Las condiciones de equilibrio como el equilibrio de mercado o el pleno empleo son críticos para el modelo EGC para poder llegar a una única solución al sistema de ecuaciones. Las condiciones macroeconómicas de equilibrio además son prerrequisitos para que estos modelos funcionen, como que los ahorros igualen a las inversiones*, ex post*. Los modelos EGC se diferencian de los de entrada y salida y de las matrices de contabilidad social respecto al papel de los precios que influyen en el comportamiento y determinan los resultados económicos, la necesidad de condiciones de equilibrio para "resolver" las ecuaciones, y la capacidad de dichos modelos para estudiar el impacto de políticas a largo plazo, en vez de solamente a corto o medio plazo, el crecimiento de la producción y el empleo. Las ventajas del modelo EGC en comparación con los dos modelos previos incluyen la mayor variedad de temas que se puede estudiar, el enfoque a largo plazo del impacto de políticas en el crecimiento de producción y empleo, y finalmente, para los análisis sectoriales, la integración de modelos EGC en un marco macroeconómico que ayuda a explorar los vínculos intersectoriales. Las debilidades de los modelos EGC son principalmente causados por su complejidad. Debido a esto los costos de su desarrollo son altos y por lo tanto estos modelos son elaborados principalmente por entidades privadas. Esto limita tanto el acceso al modelo, como su transparencia y la verificación independiente de sus supuestos. Además, la complejidad de los modelos EGC hace que estos sean más difíciles de entender y explicar a personas no técnicas como los hacedores de política.

El modelo de la necesidad de recursos humanos (MHR) calcula desequilibrios por ocupación como proxy para desajustes de habilidades (déficit o excedentes). En primer lugar, el modelo proyecta la demanda de empleo por profesión. Esto se consigue pronosticando gastos totales, y la producción futura para cada industria que se combina con la productividad laboral por industria para calcular el empleo por industria. A continuación se calcula la demanda de expansión por industria combinando empleo por industria con coeficientes ocupacionales (participación de una profesión en una industria específica). Por otro lado, la demanda de sustitución (es decir el número de trabajadores que se precisa para sustituir individuos que se fueron) y la movilidad se calculan separadamente. La demanda de expansión y la de sustitución se combinan para proyectar la demanda total por profesión. En segundo lugar, la oferta laboral es proyectada comenzando con una estimación del número de graduados y abandonos escolares que se combina con matrices de educación por profesión, y tasas de participación laboral para calcular una oferta laboral "base" por profesión. Esta oferta de ´base´ es

posteriormente adaptada considerando la migración y los re-ingresantes al mercado laboral para llegar a la oferta proyectada por profesión. Comparando estas proyecciones de demanda y oferta futuras se obtiene una idea de las ocupaciones en las cuales podrían surgir futuras escaseces o excedentes. En la práctica, se utilizan varias versionas de dicho modelo, por ejemplo aplicando coeficientes fijos o dinámicos, o permitiendo o no interacciones entre oferta y demanda. Las críticas al modelo MRH se concentran principalmente en la validez de sus supuestos, el "trade-off" o necesidad de elegir entre la precisión de los resultados y la utilidad de los mismos, y la gran cantidad de datos requerida. A pesar de estas críticas, el modelo MRH es considerado útil para considerar cambios en ocupaciones específicas, cómo determinadas políticas laborales producen cambios en los niveles y estructura del empleo o como herramienta para decisiones de inversión en educación y capacitación de individuos.

Los modelos para la identificación y anticipación de habilidades varían considerablemente tanto respecto al horizonte temporal y frecuencia como respecto al alcance y nivel de desagregación. Los modelos de identificación generalmente valoran la situación actual y por lo tanto tienen un horizonte temporal más corto, mientras que los modelos de anticipación pueden tener un horizonte tanto a corto plazo (6 meses a 2 años) como a largo plazo (5 años o más) donde un horizonte de diez años es lo más común. Los modelos de identificación y anticipación de habilidades se repiten con mayor frecuencia cuando el horizonte temporal es más corto. Respecto al alcance y nivel de desagregación, los métodos considerados suelen utilizar las ocupaciones o niveles educativos como indicadores para estimar las habilidades necesarias pero varían en lo que respecta a la cantidad de ocupaciones o niveles educativos considerados. Cuantos más niveles se usan, más detallada puede resultar la información, como la demanda por individuos con determinada educación o experiencia técnica, sin embargo la escasez de datos disponibles a menudo lo impide. Una categorización frecuentemente usada para ocupaciones es la Clasificación Internacional Uniforme de Ocupaciones (CIUO) de la Organización Internacional del Trabajo mientras que para los niveles educativos a menudo se recurre a la Clasificación Internacional Normalizada de la Educación (ISCED en inglés, CINE en español) desarrollada por la Organización de las Naciones Unidas para la Educación, la Ciencia y la Cultura (UNESCO, por sus siglas en inglés). Al poder presentarse diferencias considerables entre regiones y sectores dentro de un país, muchos modelos de identificación y anticipación de habilidades incluyen estudios a nivel nacional acompañados por estudios por región y sector, si la disponibilidad de datos permite dichos análisis.

II. Actores involucrados en la identificación y anticipación de las demandas de habilidades

Una amplia variedad de grupos de interés están y deberían estar involucrados en 1) el desarrollo de modelos de identificación y anticipación de habilidades, 2) la discusión de los resultados de estos modelos, y 3) el desarrollo de respuestas políticas adecuadas basadas en dichos resultados. La implicación de diversos grupos de interés en estas actividades por lo general aumenta la posibilidad de que el resultado producido alcance las necesidades de sus usuarios, que los grupos lleguen a un consenso sobre las habilidades requeridas y finalmente, que las respuestas políticas desarrolladas sean coherentes y complementarias.

Aunque muchos grupos de interés participen en el desarrollo de los modelos de identificación y anticipación de habilidades, esta actividad parece estar principalmente dominada por ministerios de trabajo o educación, oficinas de estadísticas y organizaciones de empleadores, aunque en varios casos también hay participación de universidades, sindicatos de comercio y servicios públicos de empleo. En cuanto al modelo de gobernanza de diferentes grupos de interés en el desarrollo de estos modelos, este oscila entre modelos enfocados en solamente en aspectos de política y modelos independientes con modelos híbridos en medio. Aquellos enfocados en aspectos de política son generalmente gestionados por los consumidores finales de la información sobre habilidades, como instituciones de formación y capacitación técnica y profesional, empleadores y servicios públicos de empleo, con la intención de validar ciertas políticas y programas. Por su parte, los modelos independientes se realizan

sin considerar los consumidores finales de dicha información, por agencias como oficinas de estadísticas, universidades e institutos de investigación, y son desarrollados para un público más amplio sin políticas o programas específicos en mente. La elección entre un modelo de gobernanza u otro se reduce a un "trade-off" o elección entre alcance y enfoque: los modelos enfocados en políticas tienden a ser más orientados a un campo de políticas específico y más adaptados a los requisitos de los consumidores finales en el área, ofreciendo por tanto un menor alcance, pero un mayor enfoque. En cambio, los modelos de modelos independientes pueden ser utilizados por consumidores finales de diversas áreas de políticas, por ejemplo estos modelos tienden a tener un mayor alcance a costa de un menor enfoque para un área política en particular.

A la hora de discutir los resultados de los modelos de identificación y anticipación de habilidades y diseñar una respuesta política apropiada, los ministerios de trabajo y educación son los más involucrados, aunque también contribuyen los ministerios de economía, industria, agricultura y finanzas. Grupos no ministeriales, como organizaciones de formación técnica y profesional tienden a estar más involucrados en la discusión de los resultados de los modelos que en el desarrollo de respuestas de políticas adecuadas en base a estos resultados. Los diversos grupos de interés posiblemente tengan conflictos en las tres actividades mencionadas sobre todo por el número y la variedad de grupos involucrados, cada uno representando diferentes intereses y objetivos respecto a estos modelos. En la fase de desarrollo, el conflicto entre grupos puede ser causado por escasez de tiempo disponible, el cambio de prioridades y recursos, la falta de beneficios mutuos y el deseo de evitar duplicación. Además, cuando los grupos de interés discuten los resultados de los modelos no siempre concuerdan en las competencias requeridas porque puede ser que modelos ejecutados simultáneamente produzcan resultados contradictorios, que los resultados sean opuestos a la percepción de algunos grupos o que estos sean interpretados de forma diferente. Por último, cuando los grupos de interés discuten una respuesta de política adecuada, puede haber conflictos debido a diferencias en los intereses de cada grupo y la distribución de responsabilidades entre ellos. A veces el mismo proceso del diálogo social puede dificultar el consenso sobre la respuesta política más efectiva. Para mejorar la coordinación y/o alcanzar un consenso entre los grupos de interés involucrados, los países están usando varias soluciones, oscilando desde opciones informales/ad-hoc a alternativas más estructurales/formales. Una solución es asegurar que las agencias responsables de desarrollar y ejecutar los modelos de identificación y anticipación de habilidades sean independientes y respetadas por todos los grupos. Otra solución es invitar a los grupos a talleres donde los modelos y sus resultados sean explicados y discutidos. Más aun, en algunos países estudiados, a algunos grupos de interés clave se les otorga un rol formal en las agencias que desarrollan y ejecutan los modelos o en su junta de asesores. Para facilitar la coordinación entre los modelos a varios niveles algunos países usan una red o agencia central, un marco legal o una estrategia nacional de habilidades (National Skill Strategy). Esta estrategia mejora la coordinación y el consenso dato que generalmente provee directivas claras a través de la formulación de objetivos y de un marco para la acción de los diversos actores involucrados. Por último, una estrategia que ha funcionado en algunos países es fijar primero objetivos claros y un calendario realista y centrar las discusiones subsiguientes en su implementación. Escoger la solución "correcta" dependerá de factores como las características de diálogo social del país, el modelo de gobernanza de los modelos de identificación y anticipación y de la cantidad y tipo de actores involucrados.

III. Estudios de casos

Con el fin de demostrar la gran variedad de modelos de identificación y anticipación de habilidades usados por gobiernos nacionales y organizaciones internacionales, se ha seleccionado varios casos. Estos incluyen el modelo paneuropeo Cedefop, las estrategias nacionales de Canadá, EEUU, Reino Unido, y Francia. Además, se comentan los métodos usados por el Banco Mundial, la Organización Internacional del Trabajo (OIT), y la Organización para la Cooperación y Desarrollo Económico (OCDE).

El Centro Europeo para el Desarrollo de la Formación Técnica y Profesional (Cedefop, por sus siglas en francés) coordina un modelo de anticipación de habilidades Pan-europeo con un marco de 10 años. El mismo se realiza cada dos años y es ejecutado por un consorcio de institutos de investigación. Bajo la iniciativa emblemática de 'una agenda para nuevas cualificaciones y empleos' de la estrategia Europa 2020, estas proyecciones son las bases fundamentales del panorama de habilidades de la UE y pretenden complementar iniciativas nacionales ya existentes y no sustituirlas. Las proyecciones incluyen la oferta y demanda laboral y las oportunidades de trabajo, todo desglosado por país miembro de la UE, por nivel de cualificación, profesión e industria. Este modelo europeo está basado en el previamente mencionado enfoque de las necesidades de recursos humanos (MRA) y comienza con el pronóstico macroeconómico de la demanda laboral por país y para 42 sectores, y de la oferta laboral por grupos de edad y sexo. Esta demanda laboral es ajustada según el número de vacantes de empleo para tres niveles de cualificación (basado en la Clasificación Internacional Normalizada de la Educación) y para 26 categorías ocupacionales basadas en la evaluaciones realizadas según la demanda de expansión, y la demanda de sustitución. Por su parte, las estimaciones de la oferta laboral utilizan un modelo de stock y consiste en la proyección del stock de personas según el mayor nivel de cualificación formal alcanzado, situación laboral, edad y sexo. A continuación, las proyecciones de la demanda y oferta laboral futuras se contrastan para evaluar posibles desequilibrios según tres niveles de cualificación. Los principales puntos fuertes de este enfoque son el uso de una metodología parecida y datos armonizados que producen resultados que pueden ser comparados entre países y computados para crear información paneuropea. Además, se puede agregar fácilmente otros países y variables o componentes, lo cual permite hacer mejoras y desarrollos continuos. Los resultados han sido bastante sólidos ya que se asemejan generalmente a pronósticos nacionales a pesar de los diferentes enfoques utilizados. Además, los datos utilizados y los supuestos pueden cambiarse para desarrollar escenarios de políticas alternativos. Por otro lado, los principales puntos débiles de este modelo paneuropeo se relacionan con la falta de datos para ciertas variables o países, la estimación indirecta de las habilidades y la dificultad de incorporar cambios importantes (cambios tecnológicos, economía verde) en el modelo. Además, también hay otras debilidades específicas a ciertos módulos: por ejemplo el módulo de la demanda de sustitución no incorpora la movilidad inter-ocupacional, mientras que las proyecciones de oferta laboral mejorarían sustancialmente si se aplicara un modelo del flujo y no solo de stock, sin embargo las limitaciones de datos, especialmente de países miembros más pequeños de la UE, lo impide.

El sistema de proyección ocupacional canadiense (COPS, por sus siglas en inglés: *Canadian Occupational Projection System*) ha sido usado por el ministerio de empleo y desarrollo social canadiense (*Employment and Social Development Canada*) durante más de treinta años para producir pronósticos por profesión con un horizonte temporal de 10 años. El mismo estima tanto la oferta como la demanda laboral y sus desequilibrios y es actualizado cada dos años. COPS también se basa en el modelo MRA y utiliza varias fuentes de datos como el censo, encuestas de empleo, datos administrativos longitudinales, encuestas nacionales de graduados y otras fuentes nacionales e internacionales. Todos los desequilibrios entre la oferta y la demanda por profesión son tratadas de dos maneras: primero de forma cuantitativa calculando la diferencia entre la oferta y la demanda por profesión y luego de forma cualitativa calculando el 'indicador normalizado de la situación futura del mercado laboral'. Ese indicador ayuda a interpretar los desequilibrios identificados. Los resultados de los dos cálculos se comunican al público usando la clasificación 'escasez', 'equilibrado' o 'excedente'. Considerando los requisitos educativos para cada profesión, se transforman las proyecciones por profesión a proyecciones por nivel de competencias según 5 categorías: 1) profesiones de gestión (M), 2) profesiones con nivel educativo A (requiere educación universitaria), 3) nivel educativo B (requiere educación profesional), 4) nivel educativo C (requiere educación secundaria y/o formación ocupacional específica), y 5) nivel de formación D (no requiere nivel educativo, formación en el trabajo). Los resultados de la proyección se comunican a través de documentos que resumen las vacantes disponibles por profesión, nivel y fuente de capacitación (*jobs openings*), buscadores de empleo por profesión, nivel y fuente de capacitación (*job seekers*), y las condiciones proyectadas del mercado laboral por profesión.

En Estados Unidos la oficina de estadísticas laborales (BLS, por sus siglas en inglés*: Bureau of Labor Statistics*) produce cada dos años proyecciones de la demanda por profesión con un horizonte de 10 años. Estas proyecciones se basan en el enfoque de la necesidad de recursos humanos y usa proyecciones económicas, una matriz de entrada y salida y una matriz de industrias y ocupaciones. La información es desglosada en 334 perfiles ocupacionales, representando el 84% de los puestos de trabajo disponibles en la economía estadounidense e incluyendo autónomos y trabajadores familiares no remunerados así como trabajadores asalariados y dos conjuntos de categorizaciones del sector industrial. Las necesidades futuras de competencias no solo se evalúan indirectamente proyectando la demanda ocupacional, sino además a través de un análisis de los requisitos educativos y de formación de cada profesión y del actual nivel de logro educativo de los trabajadores. Estos requisitos educativos y de formación por profesión se presentan usando tres agrupaciones diferentes: 'educación típicamente requerida para la entrada' (ocho categorías oscilando entre por debajo de educación secundaria y el grado doctoral o profesional), 'típica experiencia laboral en una profesión relacionada' (tres categorías oscilando entre ninguna formación y cinco años o más), y la categoría de 'típica formación en el trabajo' (seis niveles oscilando entre ninguna formación y pasantía/residencia). Estas agrupaciones ofrecen información indirecta sobre la demanda de habilidades de individuos con diversos niveles de formación incluyendo la técnica y profesional. Los datos usados en las proyecciones de demanda profesional provienen, entre otros, del censo (*Census Bureau*), la encuesta de empleo (actual encuesta de población) y datos externos (*Oxford Economics*). Además, los análisis de requisitos educativos y de formación se basan en datos extraídos de la encuesta de la comunidad americana (*American Community Survey del Census Bureau*), la red de información ocupacional (*O*NET*) y del centro nacional de estadísticas de educación. Los resultados de las proyecciones son distribuidos a través del "Manual de perspectivas profesionales" y de las páginas de internet correspondientes. Los pronósticos de la BLS evalúan tendencias a largo plazo sobre la base de la presunción que el futuro se predice mejor mirando al pasado. Su principal limitación por lo tanto es que estas predicciones explícitamente no consideran posibles shocks como conflictos armados, desastres naturales, cambios en leyes relevantes y políticas.

En el Reino Unido, la comisión del empleo y capacitación (*UKCES por sus siglas en inglés Commission for Employment and Skills*) lleva a cabo y coordina varios modelos sobre identificación y anticipación de competencias. Esta organización está financiada con fondos públicos y está orientada al sector industrial, la misma incluye miembros representantes de los empleadores, los sindicatos, el tercer sector, y de instituciones de educación superior de las cuatro naciones del Reino Unido. Estos modelos incluyen un modelo de identificación de habilidades, la encuesta de habilidades de empleadores (*Employer Skills Survey*) y un ejercicio de anticipación usando técnicas de pronóstico llamado Estudio sobre el futuro del trabajo (*Future of Work Study*). Los resultados se producen a nivel agregado para el Reino Unido pero también a niveles más bien detalladas como a un área o sector específicos. Los modelos utilizados enfatizan más el lado de la demanda de las habilidades que el de la oferta, y la mayoría de los estudios se realizan en intervalos regulares de dos o tres años. El horizonte temporal varía de la situación actual o el año anterior y va desde los diez años para el modelo de proyección a quince años para el modelo de previsión. Varios grupos de interés se involucran en los diferentes modelos e incluyen representantes de los cuatro gobiernos nacionales, de varias áreas políticas con énfasis en empleo, educación y formación, representantes locales como las asociaciones de empresas locales (*Local Enterprise Partnerships)* y consejos de competencias sectoriales (Sector Skills Councils). La encuesta de competencias a empleadores (ESS) cubre información sobre vacantes por escasez de habilidades, desafíos para cubrir vacantes, sub- utilización de competencias, prácticas de trabajo, estrategias de mercado, e inversiones en la capacitación en los empleados durante el año anterior. Por su parte el modelo de proyecciones laborales utiliza un enfoque similar al de la Cedefop europeo y a de COPS canadiense y el modelo de previsión aplica un enfoque completamente cualitativo siguiendo seis pasos: 1) análisis sistemático de la literatura y entrevistas a expertos para sacar una perspectiva de los factores relevantes a nivel social, tecnológico, económico, ecológico y político que impactarán los trabajos en el futuro y la competencias específicas al RU; 2) identificación de las principales tendencias y alteraciones que probablemente afecten los trabajos y competencias en quince años; 3) identificación de las principales causas de estas tendencias y cambios

y su probabilidad de ocurrencia, sus impactos directos e indirectos, el nivel de actividades, y proyecciones de cómo estos factores se desarrollarán; 4) establecer panoramas de base utilizando combinaciones consistentes de proyecciones a través de software; 5) enriquecer los panoramas de base haciendo suposiciones más detalladas sobre las causalidades o lógicas subyacentes y explicar posibles vías que lleven al futuro del panorama y 6) realizar un inventario de las implicaciones de los panoramas para varios grupos de interés del mercado laboral que se discuten en una conferencia en la cual estos participan.

El sistema francés utilizado en modelos de identificación y anticipación de habilidades consiste en análisis regulares a niveles macro, meso y micro, además de algunos estudios ad hoc. La mayoría de los estudios involucran modelos de anticipación de habilidades con un horizonte de cinco a diez años, sin embargo, los empleadores generalmente también anticipan habilidades y observan más los cambios a corto plazo. Además, estos modelos se repiten cada tres a seis años. En general, en Francia se toma en cuenta tanto la oferta como la demanda de habilidades; sin embargo, esto dependerá de los niveles de análisis (macro, meso, micro). En general se utilizan tanto métodos cuantitativos como el modelo econométrico como también métodos cualitativos como consultas o discusiones con grupos de interés, sobre todo en las observaciones a nivel regional o sectorial. Un gran espectro de grupos de interés participa de estas consultas dependiendo del tipo y nivel de los modelos, tales como numerosos ministerios, organizaciones sectoriales, diversos actores sociales, socios regionales y empleadores (a gran escala). Su participación incluye consultas extensivas, la diseminación de información, pero también el financiamiento y la ejecución como en el caso de análisis de habilidades en empresas medianas y grandes. Los resultados se pueden desagregar por sector o ámbito, profesión, nivel profesional dominante, y región, entre otras. La mayoría de los resultados se distribuyen a través de informes disponibles en linea y en discusiones con los grupos de interés, siendo principalmente usados para políticas de formación profesional y laboral. El modelo de previsión de habilidades a nivel macro se diferencia de los casos previamente mencionados en que se desarrollan basándose en tres escenarios (base o de referencia, crisis, objetivo) y por lo tanto resultan en tres previsiones laborales, todos basados en un modelo macroeconómico multisectorial. Estos resultados entonces se desglosan por nivel profesional usando el sistema francés de clasificación llamado "*Familles Professionnelles*" (FAP), para siete niveles de habilidades, y por sector. Estos modelos han debido enfrentar cambios significativos en las principales fuentes de datos, rupturas de tendencias, falta de estudios sobre profesiones y competencias en Francia, restricciones políticas, y la falta de conocimientos económicos en debates sobre mercados laborales. A nivel meso o intermedio muchos observatorios regionales, incluyendo una variedad de grupos de interés, desarrollan pronósticos sobre empleo específicos a sectores, ocupaciones, profesiones específicas, reclutamiento, y demanda de cualificaciones, entre otros. Al nivel micro, una ley obliga a empresas francesas con más de 300 empleados a establecer y discutir un informe sobre la anticipación de empleo cada tres años junto con los representantes de los empleados. La idea subyacente es anticipar y actuar sobre posibles cambios económicos, tecnológicos y legales a los que la compañía puede enfrentarse y así crear una transición más suave.

Además del modelo paneuropeo Cedefop de la Unión Europea, existen otros programas internacionales interesados en identificación de necesidades de competencias. El Banco Mundial, por ejemplo, ha desarrollado el marco de 'habilidades para el empleo y la productividad' (STEP, por sus siglas en inglés: *Skills Toward Employment and Productivity*). El mismo es un modelo conceptual para guiar los actores pertinentes al diseñar un sistema de desarrollo de habilidades que incluya el diagnóstico y el diseño de políticas. STEP está dirigido a países de ingresos bajos y medios para ayudarlos a construir una población activa capacitada como vía para erradicar la pobreza y promover la prosperidad. El programa incluye la asistencia financiera, de conocimientos y asistencia técnica a países. Este marco incluye dos encuestas: una encuesta de hogares para recoger datos sobre habilidades cognitivas, socio-emocionales y específicas al trabajo que permite la identificación de la oferta de habilidades, y además una encuesta a empleadores generando datos sobre las características del personal, habilidades usadas por el personal, prácticas de contratación, formación y compensación y características generales para identificar la demanda de competencias. Los resultados de ambas

encuestas se desagregan por industria, profesión, y nivel de habilidades y de educación, entre otros. Hasta ahora, la encuesta de hogares ha sido aplicada en doce países y la encuesta a empleadores, más reciente, en cuatro países. El Banco Mundial planea encuestar a más países en el futuro.

Por otro lado, las "Habilidades para Trabajos Verdes" (*Skills for Green Jobs*) es un proyecto de investigación conjunto a nivel global de la Organización Internacional del Trabajo y la Unión Europea. Su objetivo es la identificación de las necesidades de competencias para economías más verdes en 21 países desarrollados y en desarrollo. Este proyecto global de investigación es de carácter cualitativo y se basa en el análisis ad-hoc de casos existentes para seleccionar las mejores prácticas y dar recomendaciones o direcciones para mejoras. La iniciativa parece estar principalmente dirigida a políticas laborales, educativas y formativas y al sector institucional y sus resultados han sido difundidos a través de informes. El proyecto demuestra que la identificación y anticipación de empleos verdes y las habilidades relacionadas no es una tarea fácil ya que no encajan bien en las categorías existentes de sector, industria y profesión, siendo más bien dinámicos a causa de los cambios tecnológicos y la innovación.

La OCDE ha desarrollado un marco de análisis de denominado "Estrategias de competencias, destrezas y habilidades"(*Skill Strategy*) para ayudar gobiernos nacionales a identificar los puntos fuertes y débiles de su reserva nacional de habilidades existentes y de su sistema de capacitación, compararlos internacionalmente, y desarrollar políticas para sus mejoras. El marco consiste en varios instrumentos para analizar la oferta y demanda de habilidades cognitivas, sociales y emocionales, y el pensamiento creativo y crítico. Los instrumentos utilizados dan una mayor atención a la oferta de habilidades y el enfoque se centra en el análisis de la situación actual y de tendencias del pasado. Se usa principalmente métodos cualitativos y el alcance del desglose de la producción varía según instrumento, aunque los resultados siempre se presentan a nivel del país. Los resultados de investigación sirven principalmente como aportación a políticas educativas y formativas, políticas laborales y políticas sociales. Estos resultados son difundidos a través de talleres, informes (Panorama de habilidades, Educación a simple vista, Perspectivas de Empleo) y bases de datos puestos a disposición en la página web de la OCDE. Bajo este marco se han desarrollado dos instrumentos para analizar la oferta actual de habilidades. El primero es el Programa Internacional para la Evaluación de Estudiantes (PISA por sus siglas en inglés: *Programme for International Student Assessment*) que contiene una encuesta internacional de estudiantes de 15 años en 70 economías que examina cada tres años sus habilidades de lectura, matemáticas y ciencia. El segundo es el Programa Internacional para la Evaluación de las Competencias de Adultos (PIAAC por sus siglas en inglés: *Programme for the International Assessment of Adult Competences*) que evalúa la alfabetización, aprendizaje numérico y las habilidades para el procesamiento de información de personas de 16 a 65 años. Alrededor de 5.000 adultos fueron entrevistados en cada uno de los 40 países partícipes (países OCDE y socios). La información generada por este programa es desglosada para tres niveles educativos: por debajo de secundaria, secundaria superior y nivel terciario.

IV. El uso y la difusión de información sobre las necesidades competencias

La información sobre las necesidades de competencias o habilidades generadas a través de los modelos de identificación y anticipación previamente discutidos, se utiliza en una variedad de áreas políticas como de empleo, educación y formación profesional, migración, políticas sociales y desarrollo. Respecto a las políticas de empleo, la información sobre habilidades sirve principalmente para mantener los estándares profesionales actualizados y para revisar, diseñar y asignar programas de recapacitación. En Austria, Bélgica y Estonia, por ejemplo, individuos desempleados reciben

estímulos con servicios públicos de empleo para volver a capacitarse para profesiones en alta demanda. Otras aplicaciones importantes en esta área son la revisión, el diseño y la asignación de programas de formación en el lugar de trabajo, la actualización y recapacitación de entrenadores y el desarrollo de programas de pasantías. En algunos casos se desarrollan incentivos fiscales para trabajadores y empleadores basados en la información sobre necesidades de competencias, o se usan como aportación en los procesos de negociación colectiva.

Se puede observar ciertos paralelos en cómo se aplica la información provista por estos modelos en el área de políticas educativas: el enfoque principal es actualizar, diseñar y revisar las cualificaciones y los currículos. Sin embargo, también se aplica otras prácticas frecuentes como informar a los estudiantes y sus familias sobre las perspectivas laborales de ciertas carreras, y decidir qué cursos deberían recibir fondos. Esta última práctica ocurre más frecuentemente en cursos de secundaria superior que en cursos de educación terciaria o de formación adulta. Un ejemplo de esto se encuentra en Nueva Zelanda donde una inminente escasez en los campos de tecnologías científicas, ingenierías y matemáticas lleva a un incremento de vacantes universitarias y una reducción de las tasas de matriculación para programas pertinentes. Otros usos de esta información en el área de políticas educativas incluyen la actualización de guías o asesores profesionales, el desarrollo de programas de pasantías y la recapacitación de profesores. En algunos casos se asigna los fondos dedicados a iniciativas de investigación acorde a la información sobre las necesidades de competencias.

Otra área en el que la información sobre las necesidades de habilidades encontró fines prácticos ha sido la inmigración. Algunos países producen listas con profesiones que están o estarán en alta demanda, por ejemplo la lista de trabajos profesionales (SOL, por sus siglas en inglés: *Skilled Occupations List*) en Australia, la lista de escasez profesional (SSL, por sus siglas en inglés: *Skill Shortage List*) en Nueva Zelanda y la lista de escasez laboral en Suecia. Los inmigrantes que se ajustan a los perfiles profesionales en demanda reciben mayores facilidades a la hora de solicitar visados y/o permisos de estancias a largo plazo o incluso la nacionalidad antes que otros.

Varios países están pasando por un proceso de transformación a una economía más verde y/o a una economía digital. La información de sobre las necesidades de competencias puede jugar un papel importante en dicho proceso de transición ya que tiende a reducir la demanda para algunas habilidades y crearla para otras. La precisión a la hora de predecir las tendencias pertinentes de habilidades puede ayudar a reducir los desplazamientos de empleo y asegurar que las habilidades requeridas en estas transiciones estén disponibles en el mercado laboral, haciendo más fluidas las transiciones. No obstante, las predicciones conllevan varias dificultades, por ejemplo en la producción de información sobre competencias necesarias en una economía más verde surgen problemas en la definición de trabajos, profesiones y habilidades verdes, cómo adaptar los instrumentos de capacitación para incluir cambios impulsados por un enfoque medioambiental en competencias, cualificaciones, cursos y currículos, y el hecho que actividades verdes no encajan nítidamente en los sectores tradicionales de una economía. Por la última razón, al analizar el sector de energía renovable en el previamente discutido estudio sobre "Habilidades para trabajos verdes" los investigadores fueron más allá de los cinco sectores tradiciones que componen el sector de energía renovable y también incluyeron sectores como la fabricación y distribución de material, el desarrollo de proyectos, y la construcción e instalación.

Respecto a la transición a la economía digital, varios países han realizado estudios específicos sobre los cambios en la oferta y demanda de habilidades a causa de la digitalización. Con base en estos estudios, Irlanda, por ejemplo, ha revisado su plan de acción para las habilidades ICT e incluido acciones específicas para alcanzar el necesario incremento de graduados en ICT y cumplir el objetivo final de convertir a Irlanda en un líder global en talentos ICT.

La información sobre la oferta y demanda de habilidades también puede ser usada para una amplia gama de políticas sociales ya que indica donde las escaseces y desajustes de habilidades se encuentran actualmente o pueden surgir en el futuro. Se podría pensar en políticas sociales

relacionadas con la demografía, juventud, inclusión social, políticas de cuidados, asistencia social y pensiones, por ejemplo.

Tal y como se puede concluir de la discusión previa, la información sobre necesidad de competencias tiene un gran número y variedad de posibles usuarios finales. Esto dificulta la presentación de la información de tal manera que satisfaga las necesidades de todos usuarios y que esta sea suficiente. La mayoría de los resultados de los modelos de identificación y anticipación de competencias son difundidos a través de informes, frecuentemente acompañados por las bases de publicados en páginas web de oficinas públicas. Algunos países usan la información de habilidades como entrada para su base de datos de perfiles profesionales. Gracias a los medios públicos, las publicaciones sobre las habilidades reciben una amplia atención a través de comunicados de prensa, mensajes de Twitter y apariencias mediáticas en televisión y radio por ejemplo. Por último, la información de habilidades también se difunde cara a cara en talleres, seminarios y conferencias dirigidos a expertos y/o hacedores de política representando varios grupos de interés.

V. Elegir y desarrollar un enfoque apropiado para los modelos de identificación y anticipación de competencias: algunos aspectos que considerar

Los primeros aspectos que considerar están relacionados a los objetivos de la investigación de los modelos de identificación y anticipación de competencias y determinar si se prefiere información cuantitativa o cualitativa, o ambas, quienes serán los usuarios finales y para qué fines usará la información. Otras decisiones que tomar incluyen determinar el alcance de los modelos, sus horizontes temporales y si se repiten y con cuanta frecuencia se hará. Para satisfacer a un público más bien amplio en una variedad de áreas políticas, la estrategia más adecuada incluiría la oferta y demanda de competencias, la situación actual y futura, siendo repetida regularmente. Además, tales modelos ofrecerían datos agregados a nivel nacional, pero también detallados por sector y región, y finalmente, la información por profesión y nivel educativo. Sin embargo, esta estrategia 'ideal' es difícil de ejecutar por sus altos costes y la falta de recursos que se observa frecuentemente en la práctica (datos, tiempo y/o recursos humanos). Un segundo aspecto a considerar se refiere a las características de los métodos y fuentes aplicados en los modelos de identificación y anticipación de competencias. La mayoría de los métodos y fuentes que han sido discutidos o son más aptos para descubrir qué competencias se requiere u ofrece, por ejemplo para un enfoque cualitativo, o más bien para un enfoque cuantitativo evaluando cuantos individuos con cierta habilidad son requeridos o disponibles. Cuanto mayor peso tenga el enfoque cuantitativo usado, como el enfoque de necesidades de recursos humanos, más datos se necesitan. Si se procura responder tanto a la pregunta de 'qué competencias' como a la de 'cuántos individuos', un enfoque mixto puede ser más pertinente incluyendo métodos tanto cualitativos como cuantitativos para unos resultados más completos. En tercer lugar, es recomendable plantearse el número de grupos de interés involucrados y su nivel de participación durante las fases de desarrollo, discusión de los resultados y finalmente la formulación de respuestas políticas adecuadas. La participación de estos grupos de interés es importante en las tres fases para asegurar que los modelos de identificación y anticipación de competencias se ajusten perfectamente a sus necesidades, que comprendan el proceso y sepan cómo interpretar y usar los resultados para que sea más probable que formulen respuestas políticas apropiadas. Sin embargo, una mayor participación de grupos de interés puede resultar en más conflictos y por lo tanto debe ser bien coordinada. Finalmente, la calidad de los modelos de identificación y anticipación de competencias depende en gran parte de los recursos disponibles que incluye la disposición de suficientes datos fiables, de recursos humanos capaces de desarrollar y ejecutar los modelos y de recursos adecuados para financiarlos.

Introduction

The effectiveness and efficiency of a national vocational education and training (VET) system depends, amongst others, on whether it provides its learners with the skills required by the employers they will be working for, now and in the future. Due to globalization, technological change, demographic trends and migration, just to name a few, the skills in demand have changed over the last decades and they are expected to change again in the future. If national VET systems do not manage to adapt to these changes in time, costly skill mismatches are inevitable. After all, not having the right skills means lower wages and lower job satisfaction for workers, it also implies lower productivity and more hiring costs for employers and lower economic output for the economy as a whole (OECD, 2016). Skill mismatches are omnipresent in developed countries: 45% of the workers in the 27 EU member countries reported a skill mismatch in 2010,[2] however, the extent varies considerably between these countries, from 32% in Portugal to 60% in Romania (OECD, 2016). More recently, 38% of the companies from 42 developed and developing countries reported skill shortages[3] in 2015. Again, the percentages vary widely: only 11% of Irish companies reported skill shortages against every four out of five Japanese companies (ManpowerGroup, 2015).

Although it is unlikely to prevent skill mismatches and shortages entirely, it is very well possible to reduce their incidence by certain policies like improving co-ordination between the labour market and the education system, improving career guidance services, promoting labour mobility, and increasing the offer for adult learning and work-based training or the training to unemployed workers (Quintini, 2011). However, these policies do not work well unless they are based on accurate information about the current and future demand for and supply of skills and corresponding mismatches and shortages (Shah & Burke, 2005). Therefore, this report has two objectives: firstly, to analyse the mechanisms used by international institutions and developed countries to identify and anticipate the skills requirements of firms and secondly, how the information on skills requirements is then used for policy development and communication. Furthermore, where applicable, the identification and anticipation of skills of individuals with a Vocational Education and Training or VET background (secondary or tertiary level) will be highlighted.

---

[2] These results are based on the European Working Conditions Survey. Skill mismatches have two components: workers being over-skilled, i.e. having the skills to perform more complex tasks (32%) and workers being under-skilled, i.e. requiring more training to perform their tasks (13%).

[3] Skill shortages are present when companies report having difficulties filling jobs due to lack of available talent (OECD, 2016, p. 22).

The first chapter sets out an overview of the most important characteristics of the systems of skills identification and anticipation used by international organizations and developed countries. The report continues in the second chapter with how stakeholders are involved in these skills exercises. In the third chapter several systems are discussed in more detail as holistic cases. The fourth chapter delves into ways in which the skills information generated is used for policy development and how it is communicated to stakeholders. The fifth chapter will conclude with the aspects to consider while choosing a suitable approach to create a skills information system.

I. Skills identification and anticipation exercises: an overview of approaches and characteristics

This chapter starts by discussing how skills are defined and the difference between skills identification and anticipation. It then continues showing how skills exercises differ with respect to how skills are measured and what research questions they aim to answer. The main part of this chapter then delves into the various qualitative and quantitative methods and sources that are commonly used in skills exercises. Characteristic discussed thereafter are the time horizon and frequency of skills exercises, and their scope and coverage which include the occupational level, educational level, national or regional and the sectoral level.

A. Definition of skills[4]

In this report skills are broadly defined as "individual characteristics that drive at least one dimension of individual well-being and social-economic progress (productivity), that can be measured meaningfully (measurability), and that are malleable through environmental changes and investments (malleability) (OECD, 2015b, p. 34). There a different ways to classify skills, one of them is that of generic versus job specific skills. Generic skills are useful in any job, occupation or sector, and are transferrable between them. Job-specific skills, in contrast, are generally only of use in a specific job, occupation or sector. Examples of these are "firm-specific knowledge about the functioning and culture of the organization, technical knowledge, or practical competences that are specific to a particular sector" (OECD, 2016, p. 36). Another useful categorization is that of cognitive versus social and emotional skills. Cognitive skills involve the "understanding, interpretation, analysis and communication of complex information and the ability to apply this information in situations of everyday life" (OECD, 2015a, p. 22) and include numeracy, literacy, and information processing skills for example. Social and emotional skills,[5] on the other hand, are "individual capacities that (i) are manifested in consistent patterns of thoughts, feelings and behaviours, (ii) can be developed

---

[4]   This section is based on the following sources: (OECD, 2015b, 2016).
[5]   Social and emotional skills are also referred to as non-cognitive skills, soft skills or character skills.

through formal and informal learning experiences, and (iii) influence important socioeconomic outcomes throughout the individual's life" (OECD, 2015b, p. 34). Examples of social and emotional skills are perseverance, sociability and optimism. Some even argue that a third category of skills can be distinguished which arise from the interaction of the former two, i.e. skills that incorporate cognitive and socio-emotional dimensions such as creativity and critical thinking, which are referred to as 21st century skills.

B. Definition of skills identification exercises vs. skills anticipation exercises

Skills exercises are "tools to generate information about the current and future skills needs of the labour market (skill demand) and the available skill supply" (OECD, 2016, p. 34). This report, however, has two protagonists: skills identification exercises on the one hand and skills anticipation exercises on the other. The main difference between the two exercises, boils down to the different time horizons covered by them. In this report, skills identification refers to the assessment of current skill levels and needs, while skills anticipation refers to any exercise that tries to predict future skill levels and needs. With regards to skills anticipation, various further distinctions are made, like distinguishing between skill forecast and skill foresight exercises. Skill forecast exercises "use available information or gather new information with the specific aim of anticipating future skills needs, mismatches and/or shortages. Forecast results are meant to provide general indications about future trends in skill supply and/or demand in the labour market" (OECD, 2016, p. 39). Skill foresight exercises on the other hand, "provide a framework for stakeholders to jointly think about future scenarios and actively shape policies to reach these scenarios" (OECD, 2016, p. 39). A second further disaggregation of skills anticipation exercises is the distinction between projections on the one hand and forecasts on the other. "Projections are focused on the underlying long-term trends" and its users "are typically more interested in analysing the plausible scenarios so as to better understand the ramifications of the long-term trends" (Thomas, 2015, p. 46) while forecasts "focus primarily on calculating actual, predicted outcomes" and the users of forecasts "are typically concerned with the resultant forecast values, due to their prophetic powers" (Thomas, 2015, p. 46).[6] A recent study[7] by the OECD and other international partners amongst 28[8] OECD countries reveals that all countries but one use skill identification exercises and furthermore, most of them (90%) are also engaged in skills anticipation by means of skills forecasts. The other form of skills anticipation, skills foresight exercises, is a lot less common: 55% of the countries surveyed use them. One of these countries is the UK and its foresight study called The Future of Work.[9] These results also show that various exercises co-exist, in other words, skill identification and anticipation exercises are not mutually exclusive as they have different purposes and serve different audiences.

---

[6] Exercises based on the manpower requirement approach or MRA (Cedefop, COPS, BLS) are all projections for example, although they are frequently referred to as forecasts. MRA will be discussed in detail in section 0 of this chapter and the models of Cedefop, COPS and BLS will be discussed in detail in chapter III.

[7] The OECD has collaborated with the European Centre for the Development of Vocational Training (Cedefop), the European Training Foundation (ETF) and the International Labour Organization (ILO) on a survey amongst the 34 OECD member countries about anticipating and responding to changing skill needs. 29 of these countries have participated in this study: Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, the Netherlands, Norway, Poland, Portugal, Spain, Slovak Republic, Slovenia, Sweden, Switzerland, Turkey, the United Kingdom and the United States. (OECD, 2016).

[8] Not all 29 participating countries have responded to all the survey's questions. With regards to this topic, only 28 countries have responded to the corresponding question (See footnote 7 for an explanation about the survey).

[9] This foresight study will be discussed in detail in chapter III, section 0.

C. Measurement of skills[10]

A crucial element in skills exercises is how to measure skills. Countries rarely measure skills directly in these exercises due to disagreement about skills definitions between the educational sector and the labour market, the huge number of possible skills to be measured, and the time and costs involved. Some of the countries that do this are the UK, Canada and Austria. The UK-wide Employer Skills Survey (ESS) measures the need for 24 specific skills directly, including technical and practical skills as well as people and personal skills.[11] Canada's Office of Literacy and Essential Skills (OLES) has identified a set of Essential Skills and it has developed a series of assessment tools, including the Test of Workplace Essential Skills (TOWES). The latter has been used in the Canadian province of Manitoba "to identify generic skill shortages and inform curriculum development in adult training programs" (OECD, 2016, p. 37). The AMS Skills Barometer contains 23 skills areas divided into roughly 230 skills which are then divided into approximately 8.000 detailed skills (Cedefop, 2012).

Instead of measuring skills directly, most countries use proxies. Frequently used proxies for skills are occupations, fields of study, qualification levels and qualification types. Occupations are used as a proxy as they fit very well with labour market projections: the need for current and future skills is linked to labour market needs; if the need for a certain occupation changes, so will the skills needed for this occupation. Countries like the USA, Australia, New Zealand and the Nordic countries use occupations as a proxy for skills in their skills exercises. Furthermore, where detailed occupational standards or descriptions of needed skills per occupation exist, occupations can be linked to more specific skills. Such occupational standards or descriptions are used for skills exercises in Canada (National Occupational Classification), USA (O*NET), Italy (Occupations, Employment and Needs survey), and France (Famille Professionnelle). Fields of study, qualification levels and qualification types, on the other hand, are used as proxies for skills by Canada, Australia, Italy and Norway, amongst others. Using these concepts as proxies for skills has the benefit of being easily understood by various stakeholders and well covered by existing data sets. However, users of these proxies should be aware that these "educational credentials do not necessarily map skills required on the job and that there is a substantial variability amongst individuals with the same credentials in terms of their skills and readiness to perform a job" (OECD, 2016, p. 37).

D. Research questions[12]

As stated before, the objective of skills exercises is to generate information about current and future skills demand and supply. Before one can elaborate on how this information is (or should be) generated, i.e. the methods and resources used, it is important to look at the specific questions one wants to answer through a skills exercise as these questions determine the method(s) to be used.

The specific questions answered by the skills exercises currently used in developed countries can be clustered into three broad categories. The first category is concerned with the "how many" question: how many jobs will exist now and in the future, as this determines the current and future quantitative need for certain skills. Examples of skills identification exercises focussing on how many jobs and thus skills are needed can be found in Australia, New Zealand and Austria for example. Australia and New Zealand for example, use the answers to this question to construct skills lists that are used by their public employment services and immigration offices to direct the guidance and training efforts for the unemployed and select immigrants. With regards to skills anticipation, all

---

[10]   This section is mainly based on the following source: (OECD, 2016).
[11]   This UK-wide survey is discussed in detail in chapter III.
[12]   This section is mainly based on the following source: (ILO, 2011).

forecast exercises and projection exercises try to answer the same "how many" question, but for the longer run, such as Cedefop's Future skills supply and demand in Europe forecasts and the projections made by the Canadian Occupation Projection System.[13] The number of jobs, i.e. employment in skills anticipation exercises is ideally determined by adding up three types of employment: direct employment (employment generated in the sector under study), indirect employment (employment generated in other sectors through the supply chains of business in the sector under study) and induced employment (employment generated in the wider economy by the consumption of those employed in the sector(s) under study).

The second category is more concerned with the "what" question: what skills are needed now and in the future? what do they consist of? In other words, this question is more of qualitative nature and therefore, qualitative methods will be used to answer them. However, frequently, this category contains sub questions with both qualitative and quantitative aspects. If one takes the need for occupations as a proxy for the skills needed, one comes across the following questions in skill exercises. "How do occupations change and what does this mean for the skills needed?" is a question with both qualitative and quantitative aspects, whereas "How does the need for existing occupations change" is merely quantitative. Other sub questions like "What new occupations will emerge in the future and what skills will be needed for them?" has both qualitative and quantitative aspects. And finally one could ask "What new skills will be demanded across occupations?" which is a question of an entirely qualitative nature. Examples of skills exercises that include one or more of the previous questions are: the Future of Work foresight exercise in the UK, the micro-level company studies in France, the exercises stimulated by the OECD's STEP programme and the joint ILO and EU programme Skills for Green Jobs.[14] Including all four sub questions in one single research effort is rather challenging in terms of costs and time, so it is not uncommon for exercises to only focus on one or two questions at the time and/or to perform skills exercises using a rotation scheme, like the more qualitative Employer Skills Survey is alternated with the more quantitative Working Futures in the UK. Summarizing one can say that qualitative and quantitative approaches should be used in tandem to cover the full range of relevant questions to be asked regarding skill needs and supply. There is yet another reason to add qualitative research to macro-level quantitative research: the latter tend to be based on sectors in the private sector and hence miss out on the skills required in the government and public administration sector. This omission can be compensated for by a macro-level qualitative study.

The third category of research questions regarding skills is focussed on the determining what training and education are required to equip individuals with the skills required, now and in the future. Again, this question category contains both qualitative and quantitative aspects calling for a mixed methods approach. Furthermore, the information needed from skills research to answer these questions depend heavily on the institutional arrangements for course design and development in a country. Broad guidance on future changes, which emerging skill requirements and how many of them are required is sufficient if well-developed arrangements for ongoing development of courses are in place. In the opposite case, detailed guidance on these topics is needed, calling for skills exercises that provide a considerable amount of information rich in details. As part of their employment projections, the Bureau of Labor Statistics (BLS) in the US estimates for each occupation its education and training requirements, amongst others, the 'typical education needed for entry' using eight categories of educational attainment. These are No formal educational credential, High school diploma or equivalent, some college, no degree, Postsecondary nondegree award, Associate's degree, Bachelor's degree, Master's degree, and Doctoral or professional degree.[15] VET requirements are covered in some of these categories.

---

[13]   Both skills anticipation exercises will be discussed in detail in chapter III.
[14]   All these examples are discussed in detail in chapter III.
[15]   For detailed descriptions of these educational categories, see http://www.bls.gov/emp/ep_nem_definitions.htm# education accessed July 26th, 2016.

E. Methods and data sources

From the previous section it shows that various approaches can and according to several experts should be used to identify and anticipate skills demand and supply. The European Centre for the Development of Vocational Training (Cedefop) and the European Training Foundation (ETF) are just two advocates of the so called holistic approach for skills exercises. Holistic in this context means that all exercises "should be a combination of various methods seeking to achieve robust and reliable results" (OECD, 2016, p. 42). On the list of methods are included "macro-level forecasts, sectoral studies, questionnaires to employers and regional surveys of employment" (OECD, 2016, p. 42), amongst others. A combination of methods is recommended because all methods have their particular advantages and disadvantages which do not overlap, i.e. one methods disadvantage can be compensated for by another methods advantage. For example, a sectoral study that uses both quantitative and qualitative evidence has the disadvantage that it might be hard to compare its results with those of other sectors. This can be counteracted by simultaneously executing forecast-based projections and quantitative models at national level to ensure consistent data across sectors. In this section various methods and data sources will be discussed. First the qualitative approaches followed by the quantitative ones, as frequently the results of qualitative approaches are used as input for the quantitative ones.[16]

1. Qualitative approaches & sources[17]

(a)   Secondary research: literature study & statistics

A review of the current literature on skills for example serves to make sure that common definitions and concepts are used in skills research. In scenario developing, discussed later, a literature review serves to learn about current and future trends that need to be taken into account, as happens in the initial stage of developing scenarios in the Future of Work foresight study in the UK.[18] Statistics on a wide variety of topics are used as input for quantitative models or are "useful in setting the context and anchoring qualitative analysis" (ILO, 2011, p. 104). Examples of statistics used are data on employment, occupations, output, exports, graduates, workforce and many, many more.

(b)   Informed opinion and specialist knowledge

Very useful skills information resides in people such as those working in the industry as employee or employer representatives, education and training providers, qualification agencies, enterprise and trade development agencies, academics and consultants. Various methods are used to extract these individuals' opinions and knowledge such as interviews, either face to face or by telephone, often for the initial round of research. Focus groups of different sizes are used to generate initial ideas and information or to verify and contextualize other studies results such as forecast results from quantitative econometric models. Cedefop for example, verifies its skills forecast results with a group of experts before making them final and France Stratégique and DARES discuss initial results with sector experts before publishing the French occupational and skills forecast results. The opportunities for interaction between the focus group members are an added feature that the previously described interviews lack. Another information extracting format involving a group of experts, are the workshops. These workshops include for example plenary presentations followed by break-out parallel sessions to discuss key issues in smaller groups. The final stage of the UK Future of

---

[16]   It has to be said that the distinction between qualitative and quantitative approaches or methods is sometimes blurry; the same applies to the distinction between methods and approaches versus sources.

[17]   This section is mainly based on the following sources: (ILO, 2011; OECD, 2016).

[18]   This example will be discussed in detail in chapter III.

Work foresight study includes even a conference to test and enrich the implications of the four scenarios developed. Qualitative questionnaire surveys are another method to be used in case one needs to collect very specific information from a significant number of people in a structured way.[19]

(c)   Enterprise/employer surveys

An enterprise survey is a direct way of collecting information on employment and skills demand by asking firms about their current employment levels, human resource requirements, and anticipated needs, both in the short and the longer run. Enterprise surveys come in various shapes and sizes with less to more attention skill needs and their proxies such as the Enterprise Survey of the World Bank Group, the Manpower Talent Shortage survey and the European Employer Survey on skill needs that has been piloted by Cedefop.[20] National examples of enterprise surveys focusing on skill needs are the Employer Skills Survey (ESS) in the UK, the employer survey as part of the Austrian AMS Skills Barometer and the Australian Survey of Employers who have Recently Advertised (SERA) which is part of the Skill Shortage studies.[21] From the examples mentioned, only the Australian SERA includes questions about the required qualifications for the vacancies the enterprises surveyed have (or had, in case the vacancy was fulfilled in the meantime).

Enterprise or employer surveys are highly customizable, are easy to target at one or more specific sectors and can be used to gather both quantitative and qualitative skills information. Its weaknesses relate to the fact that these surveys only focus on direct employment, i.e. excluding indirect and induced employment and thus underestimate actual employment and skills demand; furthermore, it might be challenging to determine its scope, population and sample. And lastly, enterprise surveys might suffer from bias due to selective and/or low response rates or because the shortages witnessed by employers are actually due to a possible unwillingness to offer competitive wages, working conditions or training opportunities on the employers' part (Shah & Burke, 2005).

(d)   Labour force surveys (LFSs)

Labour force surveys, abbreviated as LFSs, are "nationally representative household surveys which collect information on employment by industry, occupation, and skill level. Often, they are also representatives at sub-national levels, such as at the region/province/state and metropolitan area levels" (ILO, 2011, p. 19). The LFS represents a crucial data source in the quantitative approaches to skills and labour markets as sector-occupation matrices are derived from them, as will be discussed later. The data concern the supply-side of the labour market and as such, the LFS is the opposite of the previously discussed enterprise survey. The most important skills data that labour force surveys tend to generate are the formal educational attainments of individuals working in a certain job, and sometimes overall experience and other measurements of skills are also available. These surveys tend to be held at frequently (yearly) and regularly intervals and run for quite some time, providing time series data. The limitations of LFSs are that they cannot provide much "information on insufficient supply of skills, i.e. jobs left vacant because of lack of qualified applicants, or anticipated future demand for certain skills" (ILO, 2011, p. 21). And, although information on the enterprise is collected, i.e. skills demand information could possibly be generated, this information is likely to be more

---

[19]   All the examples mentioned in this section will be discussed in detail in chapter 0. The different stakeholders involved also will be developed in more detail.

[20]   More information on these surveys can be found here: http://www.enterprisesurveys.org/ accessed July 25th, 2016 and (Cedefop, 2013; ManpowerGroup, 2015).

[21]   The ESS will be discussed in detail in chapter 0, information on the other two surveys can be found here: (Cedefop, 2012, chapter 6) and https://docs.employment.gov.au/system/files/doc/other/ss_methodology.pdf accessed July 25th, 2016.

limited than that generated by an enterprise survey due to less in-depth knowledge of individual workers of relevant aspects of the company compared to the company's managers and owners. A final concern regarding labour force surveys is that they are sample surveys, i.e. sufficient sample size is needed to generate reliable results. This is especially important when one wants to analyse skills data across a great number of different occupations and/or sub sectors.

One of the most extensive and frequently held labour force surveys is the European Union Labour Force Survey (EU LFS) which is held every three months amongst 1,8 million individuals aged 15 years and over distributed amongst 33 countries (28 EU member countries and 5 others) and managed by Eurostat.[22] It is an important data source for Cedefop's skills projections.[23] To determine an individual´s educational background, individuals surveyed for the EU LFS are asked about their highest level of education or training successfully completed.[24] These levels are then classified using the nine education categories and various subcategories of the UNESCO´s International Standard Classification of Education (ISCED 2011 revised version). When determining the highest level, both general and vocational education/training are taken into consideration: categories 2 (lower secondary education) until 5 (short-cycle tertiary education) each have the subcategories ´general´ and ´vocational´, while the highest categories 6 (Bachelor´s) until 8 (Doctoral) include the subcategories ´academic´ and ´professional´.[25]

(e)   Graduate surveys

Another useful source of information concerning the supply of skills is the surveys held amongst recent graduates. These surveys include not only individuals that are employed, but also the ones that are in further education or training, unemployed or inactive. For the employed, generally information is collected about in which sector and in which occupation the recent graduates are employed. In most countries, the education and training providers themselves survey their recent graduates as they want to know how effective the education provided has been. However, in some countries this survey comprises of the data of a group of institutions such as the Italian Almalaura Graduates' employment condition survey covering 570.000 graduates from 71 universities. The Dutch School-leaver and graduate surveys go even further, as they include graduates from both general and vocational education at secondary and tertiary levels, therefore covering the complete breadth of the Dutch educational system. Three separates studies (or Monitors) are directed at VET levels: the ´BE Monitor´ covers school-leavers with a lower secondary VET background, the ´MBO Monitor´ studies school-leavers at upper secondary VET levels and finally the ´HBO Monitor´ is directed at graduates from tertiary level VET institutions. These surveys and the ones directed at general education are all executed by the Research Centre for Education and the Labour Market (ROA) since the early nineties using highly standardized survey instruments.[26] Graduate surveys are useful in identifying what happens in the graduate labour market, which is useful in validating and improving predictions from models, on the condition that the response is sufficient and that these surveys are executed regularly.

---

[22] Source: http://ec.europa.eu/eurostat/web/lfs/overview accessed July 25th, 2016.

[23] The Cedefop skills projections will be discussed in detail in chapter III.

[24] An educational level is considered ´successfully completed' if one has obtained a certificate or a diploma, when there is a certification. In cases where there is no certification, successful completion must be associated with full attendance.

[25] More information on the ISCED classification as used in the EU LFS can be found in the following manual: Joint Eurostat-OECD guidelines on the measurement of educational attainment in household surveys Version of September 2014, pp. 13-14 downloaded from http://ec.europa.eu/eurostat/documents/1978984/6037342/Guidelines -on-EA-final.pdf accessed July 26th, 2016.

[26] Sources: https://www.almalaurea.it/en/universita/occupazione and http://roa.sbe.maastrichtuniversity.nl/roanew/wp-content/uploads/2014/07/roaflyer_A4_schoolleavers.pdf both accessed July 25th, 2016.

(f)   Scenarios

When skills need to be anticipated for the longer term, quantitative projections, to be discussed later, are less useful, instead constructing scenarios would be a more useful option. Scenarios are supposed to be highly descriptive, including an "imaginative exploration of contrasting but plausible futures" (ILO, 2011, p. 110), in other words, scenarios should be used as instruments for a qualitative approach towards skills anticipation. The UK foresight study The Future of Work, completed in 2014 and including four scenarios for the UK in 2030, is an example of scenarios developed using a qualitative approach.[27] However, as discussed earlier, many skills related research questions are (at least partly) quantitative and therefore several studies combine quantitative projections with descriptions of several scenarios that fit these projections well. The French macro-level quantitative occupational projections are done for three scenarios, a baseline, a crisis and a target scenario (France Stratégie & DARES, 2015) and therefore can be considered an example of the use of scenarios as an instrument for a mixed approach. According to scenario advocates, however, it only makes sense to project skills using quantitative models for the first few years of the scenarios as the uncertainty would be too high to deem these models results credible.

2. Quantitative approaches & sources

As discussed in the previous section on Research questions (see 0), only some questions regarding skills can be answered by using qualitative approaches, most of them need a quantitative approach. Therefore, this section will focus on several interrelated quantitative approaches: input-output models, social accounting matrices, computable general equilibrium models and lastly, the manpower requirement approach.

(a)   Input-output models, social accounting matrices and computable general equilibrium models[28]

In this section two broad categories of quantitative approaches for macro-level skills anticipation exercises will be discussed: on the one hand the input-output models and social accounting matrices (SAM) and on the other hand the extended versions of the input-output models, which include additional economic relationships and constraints, such as computable general equilibrium (CGE) models.

(b)   Input-output models

Input-output models start with estimates of how the final demand for goods and services, made up of household consumption, government expenditures, capital formation, inventories and exports, will change in the future based on historical data. Then, by using past data reflecting the supply and demand relationships between various sectors in an economy, the model estimates the effects of this final demand change as it works itself through the interconnected value chains of the economy. The input-output models vary in level of disaggregation, i.e. some use a higher number of sectors than others. Models with higher levels of disaggregation allow for more detailed analysis. When the level of disaggregation is not sufficient for the desired analysis, frequently another method, case studies or expert consultation for example, is used to overcome this deficit. These input-output models are for example used in the USA and Hungary.[29]

---

[27] The four scenarios developed carry the following titles: Forced Flexibility, The Great Divide, Skills Activism and Innovation Adaption (Stormer et al., 2014). The Future of Work study is discussed in more detail in chapter III.

[28] This section is mainly based on the following source: (ILO, 2011).

[29] See for detailed descriptions Pollin, Wicks-Lim, Garrett-Peltier (2009) The Economic Benefits of Investing in Clean Energy. How the economic stimulus program and new legislation can boost U.S. economic growth and employment. Political Economy Research Institute, Amherst, MA. and European Climate Foundation (2010) Employment Impacts of a Large-Scale Deep Building Energy Retrofit Programme in Hungary. The Hague: European Climate.

(c)   Social Accounting Matrices (SAM)

SAMs are basically extended versions of the input-output model as they include "additional accounts for the public sector, taxes and transfers, and household accounts"(ILO, 2011, p. 44). By including these accounts, SAM models are capable of capturing distributive dynamics as they can disaggregate the household sector by household income for example. Furthermore, SAMs can be used to look at the impact on taxes and government spending. In sum, the main difference between input-output models and SAMs is that the latter includes more types of data than the former. The main output of both Input-output models and SAMs are estimates of the changes in output, i.e. GDP and employment, sector-by-sector, produced by a particular sector or a combination of sectors.

(i)   Strength and weaknesses of input-output models and social accounting matrices

Input-output models and SAMs are very similar with regards to how they operate and the assumptions used. Both models are empirically grounded, i.e. they are based on historical data on the structure of the economy. Their main assumptions are that (i) changes in relative prices and possible substitution effects are not considered, (ii) productive relationships are fixed and linear, i.e. they do not change over time and production will increase proportionally with demand, and (iii) the supply-side is not constrained, i.e. whatever demand, it can be delivered. These assumptions are both strengths and weaknesses of these types of models. They can be considered as strengths because, although these models are not simplistic, their operations and assumptions are relatively transparent and easy to understand, which makes it easier to assess whether these models are the right ones to use in a certain situations, to validate the plausibility of their predictions and to explain them to policy makers. The latter also can increase policy makers' confidence in the models outcomes.

At the same time, these before mentioned assumptions can be considered a weaknesses as it limits the applicability of these models to certain situations such as those in which productive relationships can be considered rather stable and no disruptive technological changes are to be expected. Input-output models and SAMs are for example useful approaches for the following situations:

(i)   To study the effect of public policies and private expenditures in the short and medium run, given productive relationships can be considered stable in such time period;
(ii) To study employment outcomes when supply side constraints are unlikely to occur, i.e. sufficient capacity is available or capacity can be expanded;
(iii) To study output quantity effects instead of price effects.

It is important to emphasize that the assumptions described previously can be changed, in other words it is possible to make input-output models and SAMs more dynamic, include price effects and impose supply-side constraints. This will be discussed further in the next section on computable general equilibrium (CGE) models.

Another possible weakness of input-output models and SAMs is that both are limited by the fact that they can only handle activities that belong to a classified sector. This poses a challenge for countries that want to estimate the employment effects of for example the green economy or the digital economy (see chapter III, section 0 0) both comprising several (parts of) sectors. There are two ways to get around this limitation: "i) use the existing sectors in the input-output model to construct a 'synthetic sector' which reflects the composition of activities associated with the activity in question or ii) conduct an enterprise survey or wider sectoral study in order to modify an existing input-output model to introduce an entirely new sector" (ILO, 2011, p. 44). Examples of these solutions can be found in the USA and in Germany respectively.

(d)   Computable General Equilibrium (CGE) models

Computable General Equilibrium or CGE models consist of a series of equations, each describing certain economic behaviour. At the heart of the model sits an input-output model showing various relationships between industrial sectors and final demand plus a variety of elasticities describing how demand reacts to prices changes. With regards to the latter a neoclassical perspective is mostly followed meaning that households and firms are supposed to respond to price signals and pursue some form of optimizing decision-making. Equilibrium condition(s) such as market clearing or full employment are critical to CGE model in order to arrive at one unique solution to the system of equations. These conditions can be market clearing[30] (prices adjust in order for supply to equal demand) or full-employment. Macroeconomic equilibrium conditions are also a perquisite for these models to work, such as that savings equal investment, ex post.

CGE models have several features in common with the input-output models and/or social accounting matrices (SAMs) described earlier. CGE models are also empirically based models that estimate how an economy may react to specific policies, new technologies, and external shocks or changes. Like SAMs, CGE models may include institutional details that allow studying the distributional effects of policies. And finally, CGE models also have a sectoral structure: detailed linkages between sectors are included and sectors are also needed to produce skills analysis results. However, CGE models differ from input-output models and social accounting matrices models regarding the role of prices in influencing behaviour and determining economic outcomes which is larger in CGE models, the need for equilibrium conditions to "solve" the equations, and the CGE models' capacity to study the impact of policies on long-run, instead of only short and medium-term, output and employment growth.

An example of a CGE model is the E3ME model used in the Future Skills Supply and Demand in Europe forecasts by Cedefop. The E3ME model consists of basic input-output tables and also includes accounts associated with social accounting matrices such as institutional income and expenditures. It includes over twenty equations, estimated using time series, which product demand, factor substitution, labour force participation, investment behaviour, amongst others, while energy supplies and population dynamics are exogenously determined. The function of the E3ME model is to model and forecast broad macro-economic outcomes which are the starting point of the following analyses to arrive at the future levels of skills supply and demand.[31] Other examples of CGE models are the MONASH model of the Australian economy and the VATTAGE model used in Finland. Both are dynamic CGE models and the Finnish model is actually based on the Australian model.[32]

(i)   *Strength and weaknesses of computable general equilibrium models*

Computable general equilibrium models have several strengths, especially compared to the less complex input-output and SAM models. First, with CGE models a wider range of topics can be studied, such as an exploration of price effects, a detailed analysis of substitution with regard to consumption or productive inputs and significant changes in productive relationships over time. Secondly, by not assuming productive relationships to be static, CGE models are more dynamic and therefore can be used to study of *long-run* impact of policies on output and employment growth. And lastly, when performing sectoral analysis CGE models have the advantage that this analysis is embedded in the larger economy and that inter-sectoral linkages can be explored.

---

[30] Market clearing refers to the situation in which prices adjust in order for supply to equal demand.

[31] This skills anticipation exercise will be discussed in detail in chapter III.

[32] For more information on the MONASH model, look at http://www.copsmodels.com/monmod.htm accessed July 27th, 2016 and for the VATTAGE model (Honkatukia, 2013).

One of CGE models' major weaknesses is the fact that these models are complex and therefore costly to develop. As a result CGE models are often proprietary like the E3ME model developed and owned by Cambridge Econometrics and used by the UK and Cedefop for their respective skills anticipation exercises.[33] The fact that the models are private property can limit access, transparency and independent verification of the models assumptions. This is because detailed descriptions of the models, including the equations, are not publicly available. It is also more difficult to derive the assumptions from the general descriptions of the model that are available. Another weakness is related to the assumptions and conditions CGE models are based on. In case of the full-employment equilibrium condition, first, one can question the assumption itself and second, this limits these models' capacity to test the employment generation capabilities of policies. However, this weakness might not be as critical as newer CGE models can deal with equilibrium unemployment, mark-up pricing, and market externalities. Finally, complexity of CGE models mentioned earlier makes these models harder to understand and explain to outsiders, such as policy makers.

(e)   Manpower Requirement Approach (MRA)[34]

When it comes to forecasting future skill needs, one way to proceed is by occupational forecasting, i.e. forecasting the need for occupations as a proxy for the skills needed. There are several approaches to occupational forecasting which fall into one of the following three broad categories, ordered by increased complexity and accuracy: (i) extrapolating based on historical trends, (ii) using simple regression techniques and (iii) sophisticated econometric techniques allowing interactions between variables. The most complex and accurate approaches are also the most demanding in terms of funds and professional time required. The best methods in the third and last category are based on the manpower requirements approach or MRA, an approach that has been around since the sixties, however, it has been developed substantially since then into its current form, which is represented by Diagram 1 Skill anticipation exercises based on the MRA approach can be found Australia, Germany, the Netherlands, New Zealand and UK, and Canada one can find various examples on sub national and industry level.[35]

The MRA approach starts with projecting occupational demand by subsequently following several steps which produce output that is used as input in the following step(s). The starting point for projecting occupational demand is an assessment of future economic conditions which are represented by the expenditure categories consumption, investment, government purchases and net exports and referred to as the macroeconomic reference scenario (Step 1). Based on these expenditures, future output by industry is calculated (Step 2) which then feeds into the subsequent step: projecting future employment by industry based on labour productivity rates per industry (Step 3). By applying occupation coefficients, i.e. shares of an occupation in a particular industry, to the results of the previous step,[36] projections can be made about the first component of future occupational employment: expansion demand by occupation or, put differently, the future net change in occupational employment as a result of a growing economy. The second component of future occupational employment is the replacement demand which refers to the number of workers needed to replace the individuals who have left an occupation.[37] As employers might decide to maintain, decrease or increase current employment levels, replacement demand might equal, be less or greater

---

[33]   Both of these skills anticipation exercises will be discussed in detail in chapter III.

[34]   This section is mainly based on (Thomas, 2015).

[35]   Skills exercises using the MRA approach have been executed in the Canadian provinces British Columbia and Alberta and by the Mining Industry Human Resources Council (MiHR), Build Force Canada and Construction Owners Association of Alberta for their specific industries.

[36]   The results for identical occupations that can be found in two or more industries can be summed across industries in this phase in order to obtain total demand for this occupation.

[37]   Reasons for leaving one's occupation are retirement, death, migration, illness, disability, occupational mobility, maternity leave, amongst others.

than the number of people that have left their occupations. The sixth and final step of projecting occupational demand seems quite straight forward and consists of the projected expansion and replacement demands from Step 4 and 5. As data requirements for calculating replacement demand are high and very advanced statistical techniques need to be employed, in practice, replacement demand is not projected in all MRA approaches. In those cases future occupational employment only consists of expansion demand as projected in Step 4.

Diagram 1
Overview of the Manpower Requirements Approach (MRA)

Projecting occupational demand

- Step 1: Forecasting future macroeconomic reference scenario
- Step 2: Projecting future demand by industry
- Step 3: Projecting employment by industry
- Step 4: Projecting future employment or expansion demand by occupation
- Step 5: Projecting replacement demand and separations
- Step 6: Calculating occupational demand

Projecting occupational supply

- Step 1: Projecting the number of graduates and drop outs
- Step 2: Estimating labour force participation rates
- Step 3: Projecting interprovincial and interregional migration
- Step 4: Projecting future immigration
- Step 5: Projecting future re-entrants
- Step 6: Calculating labour supply by occupation

Interpreting potential labour market imbalances

- The projection of future labour market imbalances is done by comparing measures of occupational supply and demand, and determining where any potential shortages or surpluses may arise.

Source: (Thomas, 2015, p. 16).

The second main part of the MRA approach represented by the middle column of Diagram 1, is projecting the occupational supply. It consists of several important steps, like the previously discussed projection of occupational demand; however, the main differences between both projections are that the steps presented below are independent and that the projections require even more data and methodologically rigour than the ones needed to project occupational demand. A 'base' labour supply is created in the first step by means of projecting the number of graduates and dropouts using historical data on graduation rates by gender and age. These data are then combined with education to occupation matrices, based on field of study or level of education, to project the number of school leavers per occupation. As not all school leaves will actually enter the labour market, step 2 is about estimating labour force participation rates, either by extrapolating on historical trends or by using econometric equations involving several explanatory variables. The generated labour force participation rates by education are combined with the number of school-leavers by demographic group in order to project the number of labour participants by educational category. The following three steps can be considered as needed to adjust the 'base' labour supply projections of step 1 and 2 to additional changes. Step 3, correcting for interregional or interprovincial migration is only needed when occupational projections are made at sub national levels such as for separate regions, provinces,

cantons, *Lander*, etc. However, in case of substantial sub national differences within a country, making occupational supply forecasts for these levels would be required, hence making it necessary to include step 3 in the forecasting process. A fourth step considers future immigration as this would increase the occupational labour supply over time. Not only the number of immigrants has to be projected in this step, but more importantly, the likelihood that they will enter into the labour force and in what occupation by using immigration participation rates, immigrants' educational attainment and education to occupation matrices. Step 5 takes into account the fact that individuals might leave the labour force temporarily and re-enter at a later stage. The results of the previous steps taken together will ultimately result in the future labour supply by occupation.

Using the data generated in the previous two stages indicators can be developed to measure any imbalances in the labour market by occupation. One of the most common indicators is the cumulative shortages indicator which 'simply' is the difference between projected occupational demand and supply. It is important to note, however, that these quantitative indicators are accompanied by qualitative assessments, like an indication on whether future prospects for a certain occupation are bad, mediocre or good for example. This is especially true when a country's economy has a sizeable informal labour market. The data used in the projections so far cannot capture the impact of the informal labour market, hence, qualitative assessments can, at least partially, close this gap.

The MRA described above leaves room for ample variation in its execution because steps can be omitted or added, the assumptions used can range from basic to advanced and lastly, the amount of information that goes into pre-existing steps can vary widely as well. Furthermore, each step of the MRA can be performed using a less or more complex approach. En several steps, for example, coefficients are used. These coefficients can be either fixed based on historical data, changeable over time based on extrapolation of historical data or estimated taking into account various factors that might affect the coefficient over time. And lastly, in practice MRA models differ from each other because some permit interactions between demand and supply, while most do not and additionally work is in progress to allow for a feedback loop between the results of the exercise (occupation demand, supply and/or imbalances) and the first step, the macroeconomic reference scenario.

(i)   Assumptions and critique regarding the Manpower Requirement Approach (MRA)

A model's quality is defined, amongst other things, by whether the models assumptions will hold. Under the MRA it is often assumed that future participation rates will be equal to current ones and this assumption does not always hold (for example more women start working due to improved child care arrangements). Another assumption concerns occupational mobility that frequently, for simplicity's sake, is assumed to be non-existent, however, in practice, workers do change occupations. Therefore, models that include this inter-occupational mobility are currently being developed. Cedefop, for example, is testing ways to incorporate inter-occupational mobility in its current model, but has to deal with limited data availability in EU member countries, while Canada has included both horizontal (changing occupations at the same skill level) and vertical occupational mobility (changing occupations requiring a lower or higher skill level) in its projections of occupational supply (see chapter III).

Besides the validity of the assumptions of the MRA model, the manpower requirements approach has been criticized for various other reasons as well. One concern is the lack of accuracy of the results due to measurement errors. This accuracy could be improved using a higher level of aggregation[38] or by shortening the time horizon of the forecast; however, both interventions might lead to more accurate but less useful results. A second critique is the separate assessment of supply and demand, as these are known to interact with each other. Thirdly, a tremendous amount of data is

---

[38]   Analyses at more disaggregated levels suffer from a higher volatility to changes in assumptions, making the results less accurate.

necessary for executing occupational forecasts, and these might not always be available or are too costly to obtain. Another critique relates to the lack of differentiation of worker ability levels within occupations. Unfortunately, addressing this critique requires even more data, more assumptions and more econometrics. Finally, another angle of criticism is concerned with certain relationships in the model, like the effect of educational policy on the number of people available for a certain occupation, as firstly, policy can only expand places available for students, but not guarantee that these will be used and secondly, not all occupations have (clear) links to a certain field or level of education.

When interpreting occupational projections' results, two other features of the MRA should be considered: firstly, the approach does not take into account any responses from workers, companies nor governments to the results, i.e. the occupational projections show the future of occupations if relevant actors would do nothing. Secondly, by predicting how labour supply and demand will change during a certain period, it is not clear what the total demand and supply at the end of the period will be, as this depends on supply and demand at the beginning of the period.

Despite the challenges that remain, occupational forecasts based on the MRA are a valuable addition to the labour market information spectrum for at least three reasons: firstly, "they can identify the implications of existing occupational trends and provide information on the current state of labour markets and expected changes to specific occupations" (Thomas, 2015, p. 26), secondly, they can help policy makers estimate the effects of different policy options on the future level and structure of employment, and finally they serve as input for individuals' decisions on what skills, training and education to invest in. In short, occupational forecasts based on the MRA have a lot of potential, however, due to the complex methodology, errors can be made easily and reliable results depend heavily on the data available and the assumptions used.

(f)   **Data sources for quantitative approaches**[39]

Quantitative approaches to skills exercises rely heavily on data from a variety of sources, several of which have already been discussed in detail in the section about qualitative approaches and sources and/or have been briefly mentioned in the discussion of quantitative approaches above. Quantitave approaches use a variety of labour market information (LMI) that includes data on flows in and out of employment by occupation and sector, trends in wages by occupation and trends in hours worked by occupation, for example. Furthermore, the previously discussed employer/enterprise surveys, vacancy surveys, and surveys of recent graduates, provide not only qualitative information, but also quantitative data for quantitative skills identification and anticipation exercises. Administrative data, for example on enrolments in and graduation from various levels of education, are also heavily used in order to forecast skills supply. Ideally, these administrative data can be obtained from published statistics as is the case in several countries. In less ideal cases options are to use course level data from surveys carried out by funding bodies, education ministries or qualifications agencies and as a last resort one can survey the providers of education and training directly in order to obtain these enrolment and graduation data. Bottom line is that all quantitative models require large amounts of data from a variety of sources like demographic data, data from National Accounts, labour force survey data, immigration data, administrative data on age of retirement, mobility, etc.

Other valuable sources of information are meetings with experts and/or stakeholders with in-depth knowledge of the industry/sector at hand, to check and contextualize the results for example. Experts can also assist in developing scenarios about what is likely to happen in the future to contrast these qualitative skills scenarios with the quantitative skills results. Another useful source of information are sector skills studies, such as the Sector Skills Insights studies commissioned by

---

[39]   This section is mainly based on the following sources: (ILO, 2011; OECD, 2016).

UKCES and covering the Energy, Health and Social Care and Tourism sector, amongst others.[40] Finally, skills audits as performed in Italy generate useful information about skills available and needed in the current workforce. The audit has been performed annually since 2012 surveying 35.000 companies, as part of Italy's Occupations, Employment and Needs skills exercise (Castiglioni & Tijdens, 2014).

F. Time horizon and frequency[41]

At the beginning of this chapter, a distinction has been made between skills identification and skills anticipation exercises which also is related to the time horizon of skills exercises: skills identification exercises cover studies which explore the current state of affairs when it comes to skills demand and supply, i.e. they have very short time horizons. Examples of these can be found in initiatives of international organizations like the World Bank's STEP programme, the ILO-EU Skills for Green Jobs initiative, and the OECD's Skills Strategy Framework. At national level, the Employer Skills Survey in the UK and the identification of current skills amongst their workforce by French companies (as part of the GPEC),[42] are examples of skills identification exercises as well.[43]

Skills anticipation exercises on the other hand, have time horizons that generally fall into one of the following three categories: short-term exercises cover 6 months to 2 years, medium-term exercises cover 2 to 5 years and long-term exercises cover 5 years or more. The first category of exercises has the lowest costs and provides the most accurate scenarios; however, these scenarios can only be used for short-term skills policies like migration and active labour market policies. Furthermore, the added value of short term skills anticipation exercises compared to skills identification exercises is probably considered low. Examples of these exercises can be found in Poland, Norway and Italy.

In contrast, the last category, the long-term exercises covering 5 years or more, are useful for policies requiring a longer time frame like education and vocational education and training policies, however, they are the most expensive due to their "sophisticated statistical infrastructure [requirements including] longer data time series and micro-data sources[44] [and because of the] iterative validation process [needed]" (OECD, 2016, p. 41). Another downside of longer-term anticipation exercises compared to the shorter-term ones and skill identification exercises is the fact that the former are "sensitive to random shocks [like] unpredictable technological and economic change, which reduces [their] reliability" (OECD, 2016, p. 41). Anticipation exercises covering a period of 10 years can be found in the EU, Canada, France, the UK and the USA.[45] Some Nordic countries go even one step further with studies covering 20 years (general occupational forecasts in Norway) and 35 years (Norwegian teaching sector) and the Danish DREAM model provides policy makers with scenarios of 100 years into the future.

Examples of the middle category, the medium-term skills anticipation exercises can be found in Austria and France for example. The Austria public employment services run an exhaustive skills instrument for the medium term which is called the AMS Qualifications Barometer. In France, two of its skills exercises qualify as medium-term skills anticipation exercises: firstly, the assessment of

---

[40] For a complete list of sectors reviewed, see https://www.gov.uk/government/collections/sector-skills-assessments accessed July 28th, 2016.
[41] This section is mainly based on the following source: (OECD, 2016).
[42] GPEC is the abbreviation for Ge*stion Prévisionnelle des Emplois et des Compétences* or Management of Jobs and Skills.
[43] The examples mentioned in this paragraph will be discussed in detail in chapter III.
[44] The model used by Cedefop for example uses employment trends by economic sectors, national accounts, and economic and demographic projections. See chapter I.A for a detailed description of this model and the data sources used.
[45] The examples mentioned in this sentence will be discussed in detail in chapter III.
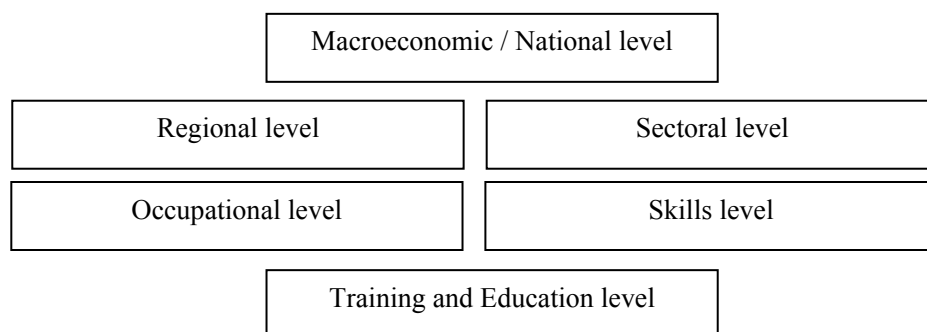
available regional employment developments and prospects data by the regional employment and training observatories (OREFs) and secondly, the anticipation part of the earlier mentioned GPEC[46] by French companies.

In most countries, skills identification exercises and the shorter- and medium-term skills anticipation exercises are repeated every year. The long-term exercises are updated less frequently, but updates every two years are by no means an exception as is the case for the 10-year anticipation exercises of Cedefop (EU), COPS (Canada) and BLS (USA). These regular updates make sure that new developments are taken into account as soon as possible, and that projections and forecasts are based on the most recent trends.

G. Scope and coverage

With regards to skills research and hence skills exercises, different levels of analysis can be distinguished as shown in Diagram 2. The majority of the exercises discussed in this report are at macroeconomic level, i.e. for the country as a whole, or in the case of the European Forecast of Skills demand and supply, for the European Union as a whole.

Diagram 2
Levels of analysis in skills research

Macroeconomic / National level

Regional level	Sectoral level
Occupational level	Skills level

Training and Education level

Source: Adapted from (ILO, 2011).

However, the macro-level results might not be as meaningful from a practical perspective, especially when differences between sectors or occupations for example are considerable. Therefore, a lot of macro-level skills exercises also include analyses at other levels and one level is connected to the next. For example, macroeconomic level analyses are connected to sector level analyses and sector level analyses are connected to occupational level analyses. However, generally, not all levels displayed in Diagram will be included in one single study, or at least not all levels will be explored with the same level of detail simultaneously. The reasons behind this 'incompleteness' can be related to the research question(s) to be answered by the exercise, and the availability of data and resources for example. In the following sections the levels displayed in Diagram 2 will be discussed in more detail.

---

[46]   See footnote 42.

1. Occupational level[47]

As discussed previously in the section about measuring skills, direct skill measurement can prove difficult and for this reason, various countries identify and/or anticipate occupation demand, supply and/or imbalances and use these result as a proxy for the demand, supply and imbalances of skills like in the USA, Canada and the EU amongst others. One approach is to use a standard occupational classification, such as the International Standard Classification of Occupations (ISCO) developed by the International Labour Organization (ILO). The latest ISCO-08 classification contains four levels including ten major groups, 43 sub-major groups, 130 minor groups and finally 436 unit groups. Cedefop's EU wide skill forecasts uses 26 occupational categories based on ISCO 2-digit. Data (un)availability is a main reason for performing analyses at lower or higher levels of disaggregation with regards to occupation. The ISCO classification includes four skills levels which are linked to the major groups as shown in Table 1.

Table 1
Mapping of ISCO-08 major groups to skill levels

ISCO-08 major groups	Skill level
Managers	3 + 4
Professionals	4
Technicians and Associate Professionals	3
Clerical Support Workers	2
Services and Sales Workers	
Skilled Agricultural, Forestry and Fishery Workers	
Craft and Related Trades Workers	
Plant and Machine Operators, and Assemblers	
Elementary Occupations	1

Source: (International Labour Office, 2012).

The other skills exercises discussed in chapter 4 use their own national occupational classifications, and the number of occupational categories used per exercise differs greatly. In the UK for example they use the Standard Occupational Classification (SOC 2010): nine 1-digit categories for the Employer Skills Survey and 25 2-digit categories for the Working Futures projections. France uses 87 Familles Professionnelles (FAP), Canada uses 292 occupational groupings of the National Occupational Classification (NOC) 2011[48] in COPS and in the USA, data are disaggregated for 334 occupation profiles derived from the 2010 Standard Occupational Classification (SOC). In case a source is also available that has information on the occupations held by the labour force and its qualification levels (from a labour force survey for example), then the employment by occupation can be converted into employment by qualification.

---

[47] This section is based on the following sources: (Cedefop, 2012; France Stratégie & DARES, 2015; ILO, 2011; International Labour Office, 2012; R. Wilson, May-Gillings, Pirie, & Beaven, 2016), http://www.bls.gov/soc/, http://www5.hrsdc.gc.ca/NOC/English/NOC/2011/Welcome.aspx accessed July 28th, 2016.

[48] The NOC 2011 actually has 500 unit groups. However, many of these occupations are small in terms of employment. To overcome this problem, small occupations were combined into broader groupings according to the specific tasks of each occupation. By grouping small occupations with similar tasks together, 292 occupational groupings of sufficient size in terms of employment were obtained. (Source: http://occupations.esdc.gc.ca/sppc-cops/l.3bd.2t.1ils@-eng.jsp accessed July 29th, 2016.)

Another approach with regards to using occupations as a proxy for skills is to determine the key types of jobs in the domain of interest and then focusing on their occupational structures as they appear from qualitative research. A third approach is using a combination of the previous two: standard occupational classifications where feasible and categories based on qualitative research where the standard classifications do not fit well. This method is effective for (i) identifying skills that are specific for the domain investigated, but absent in others, (ii) identifying emerging occupations, and (iii) identifying changes in the content of existing occupations.

2. Educational level[49]

Another proxy for skills used frequently in identification and anticipation exercises education. As briefly mentioned in the section about skills measurement, proxies for skills related to education are qualification levels (secondary or tertiary), qualification types (general or vocational) and fields of study (law, agriculture, economics, etc.). Again, one approach is to use a standard classification like the International Standard Classification of Education, ISCED developed by the United Nations Educational, Scientific and Cultural Organization (UNESCO). Its latest version, ISCED 2011, includes nine main categories (1-digit) each of them expressing a different qualification level, starting with Early childhood education (0) and Primary education (1), moving into Lower (2), Upper (3) and Post-secondary education (4), and continuing into tertiary education, distinguishing between Short-cycle tertiary education (5) Bachelor's (6), Master's (7) and ending with Doctoral or equivalent level (8). In the categories 2-5, a further subdivision is made to discriminate between the qualification types general versus vocational education (2-digits) and a third digit is added to administer different levels of completion. A similar methodology is followed for the categories 6 through 8: the second digit shows the difference between the qualification types academic or professional while the third digit expresses the level of completion of the qualification at hand.

Cedefop's most recent EU wide skill forecasts use three categories based on the previous ISCED 1997:[50] Low ((Pre) primary and lower secondary education, ISCED 0-2), Medium, (Upper and post-secondary education, ISCED 3-4) and High (Tertiary education, ISCED 5-6). Furthermore, these forecasts discriminate between fifteen fields of study, ranging from Agriculture and veterinary (01) to Science, mathematics and computing (15). Thus, although ISCED includes qualification types general/academic versus vocational/professional as well, these are not used by Cedefop due to data limitations.

The other skills exercises discussed in chapter 4 use various education classifications. In the USA, the Bureau of Labour Statistics while performing its analysis of education and training requirements per occupation, uses eight levels of 'typical education needed for entry', ranging from Less than high school (1) to Doctoral or professional degree (8).[51] Other formation related information offered per occupation is three categories of "work experience in a related occupation" and six types of "on-the-job training".[52] In the Canadian COPS projections, an occupation's skill level is expressed by the education required for this occupation as follows: Management Occupations (M), Skill level A (university education), Skill level B (college education or apprenticeship training), Skill level C

---

[49] This section is based on the following sources: (Bureau of Labor Statistics, U.S. Department of Labor, n.d.; Cedefop, 2012; ESDC, n.d.; France Stratégie & DARES, 2015; ILO, 2011; Rob Wilson et al., 2016).

[50] ISCED 1997 has been used in the EU Labour Force Survey until 2013 and as discussed in detail in chapter 0, this is an important data source for skills demand and supply in the EU skills forecasts performed by Cedefop.

[51] The eight categories are: Less than high school (1), High school diploma or equivalent (2), Some college, no degree (3), Postsecondary non-degree award (4), Associate's degree (5), Bachelor's degree (6), Master's degree (7) and Doctoral or professional degree (8).

[52] Work experience in a related occupation refers to "Work experience that is commonly considered necessary by employers, or is a commonly accepted substitute for more formal types of training or education" while on-the-job training refers to "Additional training needed (postemployment) to attain competency in the skills needed in this occupation" (Bureau of Labor Statistics, U.S. Department of Labor, n.d.).

(secondary school and/or occupation-specific training), and Skill level D (none, as on-the-job training is provided).[53] In other words, skill is approximated by qualification level only. In the UK, the recently launched Regulated Qualifications framework (RQF) is used. Its eight qualification levels plus the "no qualifications or entry level (0)" are summarized into six categories for the Working Futures projections: from RQF 0 including Foundation Learning and Functional Skills at entry level until RQF 7-8 including Master's Degrees, Postgraduates and Doctorates.[54] And finally, the French use a qualification framework that combines three qualification levels (low skilled, medium skilled and high skilled) with two qualification types (workers and professionals versus employees and managers) into seven categories: independents, low-skilled workers, low-skilled employees, medium-skilled workers, medium-skilled employees, associate professionals and managers.[55]

Assessing skills by qualification level is the most common approach used in the examples described above, with a minimum of three levels: low, medium and high. Qualification type is only used as a discriminator variable in the French case. The ISCED classification does distinguish between general and vocational levels for its qualification levels at secondary and tertiary level, however, due to limited data, this distinction has not been used in the EU skills forecasts by Cedefop so far. This same skills exercise, on the other hand, does include fifteen fields of study, a quality not included in the other skills exercises mentioned in this section. In sum, one can argue that, from what has been described above, current skills identification and especially skills anticipation exercises offer some possibilities to assess the skills need and supply for individuals with a VET background. However, these possibilities could be enhanced when available data differentiating between VET and general education per education level would be added.

3. National or regional level[56]

Skills identification and anticipation exercises across countries also differ from each other with regards to their level of geographical analysis. Most countries perform these exercises at least at national level; however, frequently these nation-wide analyses are accompanied, or in some cases completely substituted, by analyses at state, province or regional level (see Table 2). Executing skills exercises at different levels obviously comes at a cost, especially as some duplication is hard to avoid, but it clearly has its benefits. Fact is that skill exercises at national level benefit "broad training policy and labour market monitoring" (OECD, 2016, p. 45), however, due to their high level of aggregation, they might miss out on considerable differences at sub national level. Put differently, a country's skills demand and supply might be perfectly balanced at national level, however, considerable regional shortages or surpluses might exist underneath due to labour market mobility within certain regions for example (Shah & Burke, 2005).

To avoid duplication, in most countries the regional analyses are integrated in the national analyses (see Table 2). Some countries in contrast, execute regional skills anticipation exercises separately from similar analyses at national level, like in the USA, where each state has its own

---

[53] To see how each of the 292 occupational groupings is rated on one of those 5 skill levels, see http://occupations. esdc.gc.ca/sppc-cops/l.3bd.2t.1ilshtml@-eng.jsp?lid=59&fid=1&lang=en accessed July 29th, 2016.

[54] The RQF has been launched in 2015 as the successor of the Qualifications and Credit Framework (QCF) and it maps to the European Qualifications Framework (EQF). Working Futures uses the following six categories: RQF 0 Foundation Learning, Functional Skills at entry level; RQF 1 BTEC Awards level 1, Functional Skills level 1; RQF 2 BTEC Awards level 2, Functional Skills level 2; RQF 3 BTEC Awards level 3, BTEC and OCR Nationals; RQF 4-6 All sorts of Higher Education, including certificates and diplomas up to Bachelor's degree, and RQF 7-8 Master's Degrees, Postgraduates and Doctorates. For an overview of all qualifications per RQF category, see (Rob Wilson et al., 2016).

[55] The categories' original French labels are "Indépendants", "Ouvriers peu qualifiés", "Employés peu qualifies", "Ouvriers qualifies", "Employés qualifies", "Professions intermediaries" and "Cadres". The English translations are the sole responsibility of the author.

[56] This section is mainly based on the following source: (OECD, 2016).

analyses. Independent regional exercises are also performed in Australia, Canada, Finland, France, Norway, Spain and Sweden. Belgium is a special case, as it is the only country reviewed that exclusively anticipates skills at regional level and not at national level.

Table 2
National and regional levels covered in skills identification and anticipation exercises

	National	Regional as part of the national	Independent regional
Australia	X	X	X
Austria	X	X	
Belgium (Flanders)			X
Belgium (Wallonia)			X
Canada	X		X
Czech Republic	X	X	
Denmark	X	X	
Estonia	X		
Finland	X	X	X
France	X	X	X
Germany	X	X	
Greece	X		
Hungary	X	X	
Ireland	X	X	
Italy	X	X	
Japan	X	X	
Korea	X	X	
Netherlands	X	X	
Norway	X	X	X
Poland	X	X	
Portugal	X	X	
Slovak Republic	X	X	
Slovenia	X	X	
Spain	X	X	X
Sweden	X	X	X
Switzerland	X		
Turkey	X	X	
United States	X	X	X

Source: Adapted from (OECD, 2016, p. 47).

The UK also has made great efforts to tailor the output of its skills exercises to sub-regional/local needs. The Employer Skills Survey results are disaggregated for each of the four nations England, Northern Ireland, Scotland and Wales. The Working Futures projections are also disaggregated for 67 local areas consisting of 39 Local Enterprise Partnerships or LEPS in England,[57] 4 Economic Areas in Wales, 13 Regional Skills Assessment Areas and 5 City Deal Areas in Scotland, and 6 Workforce Development Forum Areas in Northern Ireland.

---

[57] More information on Local Enterprise Partnerships or LEPS can be found on https://www.lepnetwork.net/ accessed July 11th, 2016.

4. Sectoral level[58]

Besides regions, sectors can also substantially differ from each other when it comes to future skill needs and supplies due to differences in technological changes or demographic composition, for example. Therefore, most countries reviewed accompany their national skills exercises with analyses at sector level, as can be seen in Table 3.

Table 3
National and sectoral levels covered in skills identification and anticipation exercises

	National	Sector as part of the national	Independent sector
Australia	X	X	X
Austria	X	X	
Belgium (Flanders)			X
Belgium (Wallonia)			X
Canada	X		X
Czech Republic	X	X	
Denmark	X	X	X
Estonia	X	X	
Finland	X	X	X
France	X	X	X
Germany	X	X	X
Greece	X		X
Hungary	X		X
Ireland	X	X	X
Italy	X	X	
Japan	X		
Korea	X	X	
Netherlands	X	X	
Norway	X	X	X
Poland	X		
Portugal	X	X	
Slovak Republic	X	X	
Slovenia	X		
Spain	X	X	
Sweden	X	X	X
Switzerland	X		X
Turkey	X	X	
United States	X	X	X

Source: Adapted from (OECD, 2016, p. 47).

Similar to the regional level analyses, in most countries the analyses at sector level are performed as an integral part of the nationwide analyses to ensure comparability of the results and to reduce costs. Another cost reducing strategy, employed by Finland, is to perform sector analyses according to a roster, i.e. every year Finland accompanies its national level analyses with results for two to three different sectors. However, in quite a number of countries sector analyses of skills are executed independently of the national

---

[58] This section is based on the following sources: (Bureau of Labor Statistics, U.S. Department of Labor, n.d.; Cedefop, 2012; ESDC, n.d.; OECD, 2016; R. Wilson et al., 2016; Winterbotham et al., 2016).

level analyses even more so than in the case of regional analyses (see Table 2 and Table 3). Sectoral analyses have a more ad hoc nature and are stimulated by professional organizations like in case of the sectors health care and education in Norway and ICT and mechanical engineering in Switzerland. The main advantage of independent sector level analyses is that they can be specifically geared to the needs of that particular sector. Its downside lays in the fact that its results frequently are less comparable to similar exercises in other sectors, regions or at national level.

Considering the five skills exercises discussed in detail in chapter 4, one sees different classifications and different levels of disaggregation when it comes to sectors. Cedefop uses the Statistical Classification of Economic Activities in the European Community, Rev. 1.1 or NACE (its French acronym) Rev. 1.1. of 2002 for its EU wide skills forecast. Two series of categories are used based on NACE: a more detailed one including 41 2-digit sectors and these are then aggregated into a set of only 6 broad sectors.[59] Canada and the USA both ground the industry classification systems used for their skills exercises in the North American Industry Classification System (NAICS). NAICS uses a six-digit hierarchical coding system to classify all economic activity into twenty industry sectors.[60] Five sectors are mainly goods-producing sectors and fifteen are entirely services-providing sectors. Canada uses 33 industry groupings (2-digits) while the USA publishes occupational employment data using a small set of only 18 Major Industry Sectors and a highly disaggregated set using 4-digit industries categories.[61] Unlike its North-American counterparts, the UK sticks to sector classifications based on the Standard Industrial Classifications (SIC) of 2007, an elaborate 5-digit classification scheme. For the Employer Skills Survey, 15 sectors are used while the Working futures projections display the overall output for 75 sectors based on SIC 2007 2-digit, and for 22 sectors when it concerns results per local area. The French PMQ skills exercise does not explicitly use a sector or industry classification, but 19 Domaines Professionnelles or Professional Domains. The discussion above shows that although some sector/industry classifications allow for greater levels of disaggregation, i.e. more sectors, these are not always used. Generally, data limitations hinder a more detailed analysis at sector or industry level.

---

[59] These six broad sectors are Primary sector and utilities, Manufacturing, Construction, Distribution and Transport, Business and other services, and finally Non-marketed services (which are mainly delivered by the public sector) (Cedefop, 2012). NACE is comparable to the United Nations International standard industrial classification of all economic activities (ISIC). Source: http://ec.europa.eu/eurostat/statistics-explained/index.php/NACE_background accessed July 29th, 2016.

[60] NAICS has replaced the Standard Industrial Classifications (SIC), amongst others, as its six digit categorization allows for greater flexibility than its predecessors with less digit classifications.

[61] Complete lists of the industrial categories used can be found here: http://occupations.esdc.gc.ca/sppc-cops/.3nd.5str.3.1ls.5mm.1r.3.2ss.2.1rch@-eng.jsp (Canada); http://www.bls.gov/emp/ep_table_201.htm and http://www.bls.gov/emp/ep_table_207.htm (USA) all accessed July 29th, 2016.

II. Stakeholders involved in the identification and anticipation of skills requirements[62]

A variety of stakeholders such as ministries, employer organizations, trade unions, universities, education providers, statistical offices, public employment offices, just to name a few, are involved in the three main activities related to skills identification and anticipation exercises. Not only are they involved in the (i) development of the skills exercises themselves, but even more so in (ii) discussing the results of these exercises and in (iii) developing adequate policy responses based on these results. Stakeholder involvement is expected to benefit these activities in three ways. Firstly, it enhances the possibility that the output produced meets the needs of its users, secondly, that stakeholders reach consensus about what skills are needed and finally, that the policy responses developed will be coherent and complementary. However, ensuring involvement of all relevant stakeholders, balancing their many interests and coordinating all stakeholder efforts is no easy task. Therefore, this chapter will analyse the principal stakeholders per activity and what ways are used to coordinate stakeholder involvement and to keep conflicts to a minimum.

A. Stakeholder involvement in development of skills exercises

1. The importance of different stakeholders

Figure 1 shows that a large variety of stakeholders are involved in the first activity, the development of skills exercises. However, the figure also makes clear that stakeholder involvement in developing skills exercises is dominated by a limited number of them: in all 28 countries surveyed, either the Ministry of Labour or Education was involved, followed by the statistical offices and employer organizations who are involved in over two thirds of these countries. To a lesser extent, but still in over half of these countries, universities, trade unions and the public employment service are important partners in skills exercises. Interestingly, when comparing data from Figure 1 with the information in chapter III, section 0 about Migration policies, it appears that the Ministry of Migration

---

[62] This chapter is mainly based on chapter 4 of (OECD, 2016).

is involved in exercise development in only about half of the countries that have stated to ground their migration policies in skills exercise results.

Figure 1
Stakeholder involvement in the development of skills exercises
(As a percentage of all countries)
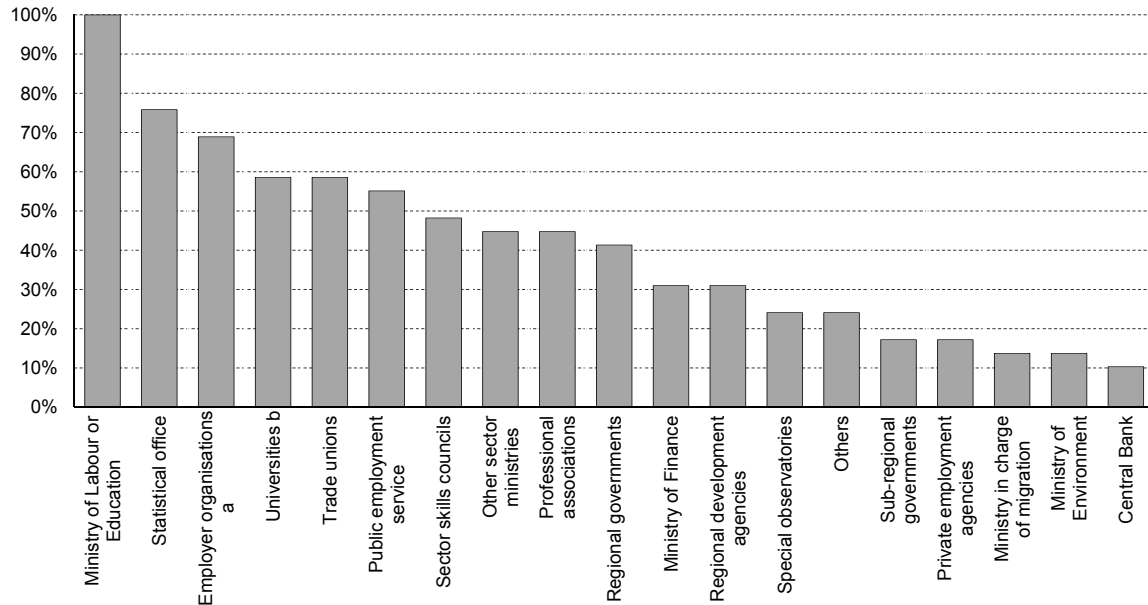
Source: OECD (2016).
Note: Percentages based on responses from 28 countries reporting at least one involved actor (Australia, Austria, Belgium, Canada, Chile, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, the Netherlands, Norway, Poland, Portugal, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey and the United States). If more than one questionnaire was received per country, involvement is considered if reported in any questionnaire received.
[a] Includes individual employers.
[b] Includes think tanks and research centres.

2. Types of governance models

Given the relative variety of stakeholders involved, it is hardly surprising that skills exercises are developed under a number of governance models which can be distributed along a continuum that has policy driven skills exercises on one end, independent exercises on the other and hybrid models in between. Policy driven skills exercises are those that are led by the end users of skills information like public employment services, VET agencies, employers and agencies responsible for developing occupational standards and qualification frameworks, and are intended to serve certain policies or programmes. Examples of this government model can be found in Denmark, Austria, France, Sweden and Canada, amongst others. Skills exercises that are governed by the independent model on the other hand, are not developed with specific end users nor policies in mind, and are led by agencies that are independent of the end users of the skills information like statistical offices or universities and research institutes such as Statistics Norway, Statistics Sweden, the Dutch research institute ROA and

the Danish research institute DREAM.[63] A number of skills exercises, however, fall somewhere in between the previous two models and they are referred to as hybrids. The skills exercises in this category remain relatively independent of their ultimate users despite having a specific ministry, with a specific policy field, leading them. This is the case in for example Canada where the Economic Policy Directorate (EPD) part of Employment and Social Development Canada (ESDC) leads skills exercises which results are also used for migration and education purposes.[64] Another example can be found in Germany where two government bodies, the Federal Institute for Vocational Education and Training (BIBB) and the Institute for Labour Market and Career Research (IAB) jointly lead the Germany projections of future qualifications and occupations known as the *QuBe* project.[65] Yet another hybrid government model form can be found in Austria, where the AMS qualifications barometer is led by the public employment services and executed by a consultancy firm and a research institute.[66] And again, the results are used beyond the public employment services domain.

The variety of existing government models in the development of skills exercises on the policy – independent continuum is due to the trade-off between focus and fit on the one hand and a wide scope and general use on the other. Skills exercises that are developed under a policy model will tend to be more focused to a certain policy field and better fitted to the requirements of the end users in that field, as they are leading the exercise. Independent model exercises, in contrast, can be used by end users of various policy fields, i.e. these exercises tend to have a wider scope.

B. Stakeholder involvement in discussing results and developing policy response

After having developed and having ran a skills exercise, stakeholders enter into the next stages of discussing the results, especially deciding on what skills are in need and subsequently the stage in which an adequate policy response is being developed.

Figure 2 provides an overview of the ministerial stakeholder involvement in both stages and Figure does the same for non-ministerial stakeholders and furthermore this figure shows whether this involvement concerns the results phase or the policy development stage. As in the exercise development stage discussed previously, the Ministries of Labour and Education are the most involved in at least one of these consecutive stages. In about half of the countries interviewed, one of the following ministries was involved as well: Ministry of Economy, Industry, Agriculture or Treasury. When changing to the non-ministerial stakeholders in Figure 3, one can immediately notice that all stakeholders are more frequently involved in discussing the results than in developing an adequate policy response. This difference is especially noticeable with regards to the VET providers who participate in discussing the exercises results in all but one of countries in the sample (96%), however, only in 3 out of 4 countries they also participate in the policy development process.

---

[63] More information about the organizations and their approaches can be found: for Statistics Norway in (Cappelen, Gjefsen, Gjelsvik, Holm, & Stølen, 2013), for ROA in (Researchcentrum voor Onderwijs en Arbeidsmarkt, 2015) and for DREAM see http://www.dream.dk/?q=en accessed June, 22nd 2016.

[64] See chapter 0 for a more detailed discussion of these projections.

[65] Source: https://www.bibb.de/en/11727.php accessed June 24th, 2016.

[66] Source: http://bis.ams.or.at/qualibarometer/hilfe.php?load=methodik2 accessed July 4th, 2016.

Figure 2
Ministerial stakeholder involvement in discussing results from skills exercises
and/or in developing a policy response
(As a percentage of all countries)
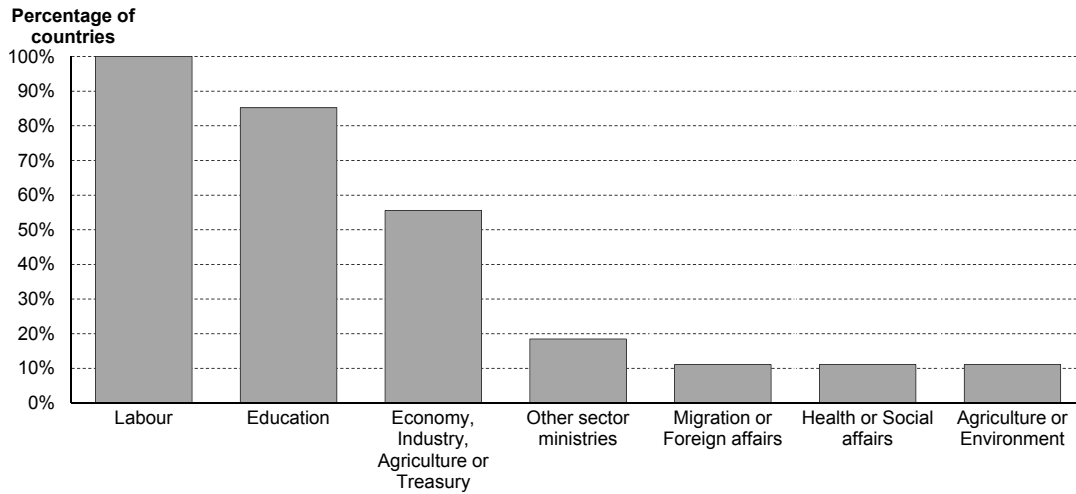
Source: (OECD, 2016).
Note: Percentages based on responses from 26 countries that identified at least one ministry as involved (Australia, Austria, Belgium, Canada, Chile, the Czech Republic, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Japan, Korea, the Netherlands, Norway, Poland, Portugal, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey and the United States). If more than one questionnaire was received per country, involvement is considered if reported in any questionnaire received.

Figure 3
Non-ministerial stakeholder involvement in discussing results from skills exercises
and in developing a policy response

■ Discussion of findings   □ Development of policy response
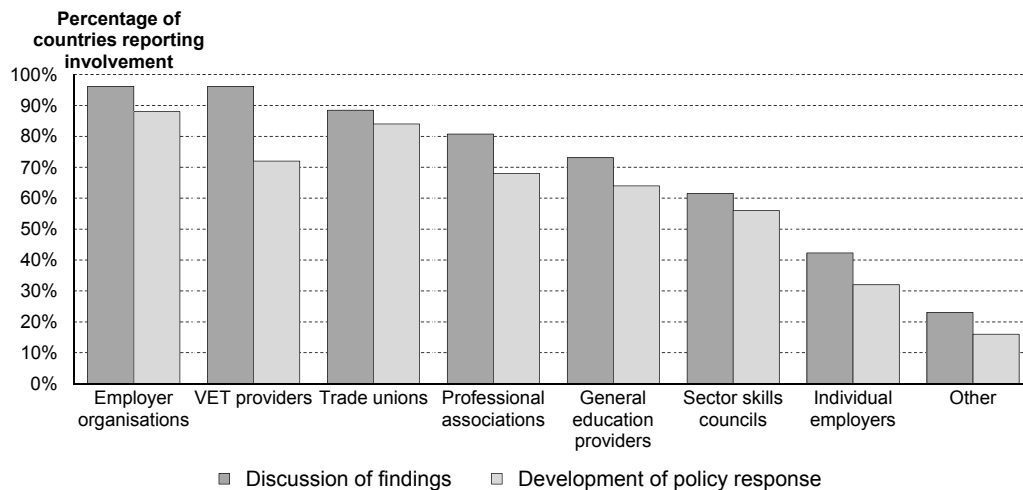
Source: (OECD, 2016).
Note: Percentages for the discussion of findings based on responses from 25 countries reporting at least one stakeholder involved (Austria, Belgium, Canada, Chile, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Korea, Japan, the Netherlands, Norway, Poland, Portugal, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland and Turkey). Percentage for the development of a policy response based on responses from 24 countries reporting at least one stakeholder involved (Austria, Belgium, Canada, Chile, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Japan, Korea, the Netherlands, Norway, Portugal, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland and Turkey). If more than one questionnaire was received per country, involvement is considered if reported in any questionnaire received.

1. Sources of stakeholder conflicts

Stakeholders might run into conflicts in all three stages of the skills exercise process due to the number and variety of the stakeholders who might have very different interests and objectives. Furthermore, stakeholders may be hampered in their contribution to the dialogue concerning skills exercises due to lack of available time, changing priorities and resources, lack of mutual benefits and the desire to avoid duplication. When looking more closely at the discussion phase, it turns out that stakeholders do not always agree on the skills needed because of the fact that various skills exercises are sometimes executed within the same country, at times even producing conflicting results. Another source of conflict in this phase is caused by stakeholders having unrealistic expectations of what skills exercises are capable of, or if the results are opposite to some stakeholders' perceptions. Lastly, the same results are sometimes interpreted differently by various stakeholders. As the skills exercise process moves into the final phase of creating an effective policy response, other reasons for disagreement between stakeholders emerge. Firstly, stakeholders might not achieve consensus about what policy measure would be best, simply because they pursue different interests. Other causes are how responsibilities concerning skills policy are distributed among stakeholders and finally the social dialogue process itself differs between countries making it sometimes harder to reach agreement.

2. Consensus building / conflict reducing mechanisms

As discussed above, the reasons why stakeholders might not come to an agreement in various moments in the skills exercise process are quite different. Therefore, the countries reviewed have come up with various solutions to enhance coordination and/or reach consensus between the stakeholders involved ranging from informal/ad-hoc ones to more structural/ formal ones. One of these approaches is making sure the agencies developing and executing the skills exercises are independent and are well respected by all stakeholders like Statistics Norway and ROA in the Netherlands. Another one is to invite stakeholders to workshops where skills exercises and their results are explained and discussed like the Canadians do. Some countries use a more formal or structural approach and provide stakeholders with a formal position in the agencies that develop and execute skills exercises or in their advisory boards as has been done. Examples of this mechanism can be found in Denmark, Belgium, Finland, Ireland, Norway and the USA. Such participation in governance works even better if those involved are high-level political representatives like in the USA. In case of various skills exercises on various levels, coordination and/or consensus can be facilitated by either a network or a central agency. An example of a network can be found in Germany where the federal government signed an Alliance for Initial and Further Training together with representatives of business, trade unions and Länder by the end of 2014. The Alliance documentation includes a number of objectives, and strategic fields of action and measures to achieve these.[67] To improve coordination between the myriad of exercises taking place in France, the Réseau Emploi Compétences or REC was launched mid-2014. This voluntary network includes the agencies producing skills forecasts (observatories OREF and OPMQC) and the policy makers for economic development, employment and education from state level, regional level, as well as union and business representatives.[68] An example of a central agency is under development in Ireland as part of the new National Skills Strategy launched at the beginning of 2016. A National Skills Council "will be established to oversee research, advice on prioritisation of identified skills needs and how to secure delivery of identified needs" (Department of Education and Skills, 2016, p. 111). A national skills strategy by itself is another mechanism to improve coordination and consensus as it generally provides

---

[67]   This Alliance replaces the National Pact for Training and Skilled Recruits that expired at the end of 2014. (Source: http://www.bmwi.de/EN/Topics/Tackling-the-skills-shortage/alliance-for-initial-and-furtherraining,did=697072. html accessed July 4th, 2016).

[68]   Source: http://www.strategie.gouv.fr/travaux/presentation-reseau-emplois-competences accessed July 4th, 2016.

direction via the objectives formulated and in general it will provide a framework for all stakeholders involved. Besides Ireland, national skills strategies can found in Austria, Germany, Sweden, and the USA for example.[69] As opposed to the voluntary networks described earlier, some countries underpin the skills arrangements by a legal framework. In Italy for example, systematic stakeholder consultation is required by legal norms when defining skill needs and when policies need to be developed. And the Workforce Innovation and Opportunity Act (WIOA) in the USA enforces consultation among federal agencies of Labour and Education and "required collaboration between agencies at the state level through joint strategic planning efforts" (OECD, 2016, p. 89). A final approach to facilitate coordination and/or consensus that has worked in a few countries is to first set clear objectives and realistic time tables and centre the following discussions on achieving them.

From the former discussion it can be concluded that involving relevant stakeholders is a beneficial although complicated process. Coordination amongst different stakeholders and consensus building can be achieved and improved in numerous ways. Hence, the "right" approach will depend on factors like the country's social dialogue characteristics, the skills exercise government model it uses and the number and type of stakeholders involved.

---

[69]   The OECD is currently working with the following countries to develop and implement a national skills strategy: Austria, Italy, Korea, The Netherlands, Norway, Peru, Portugal, Slovenia and Spain. (Source: http://www.oecd.org/ skills/nationalskillsstrategies/buildingeffectiveskillsstrategiesatnationalandlocallevels.htm accessed July 4th, 2016.).

III. Case studies

In the previous chapters several approaches to skills exercises and their elements have been discussed separately and in detail. In this chapter four national and four international skills exercises will be analysed and presented holistically as to show how each of them functions in their respective national and international settings and how the different elements work together. The cases that will be discussed are the pan-European model by Cedefop, followed by the national approaches of Canada, the USA, the United Kingdom and France. The chapter concludes with the approaches used by the international organizations the World Bank, ILO and the EU, and the OECD.

A. A pan-European approach: the Cedefop model[70]

1. Description

Since 2008 the European Centre for the Development of Vocational Training (Cedefop), is in charge of producing pan-European skill forecasts as requested and funded by the European Commission. In that same year, Cedefop forecasted the skill needs up to 2015, followed by a forecast of the skill supply a year later. In 2010 this European institute produced a forecast of the skills demand and supply at European level up to 2020 based on the MRA and it repeats this exercise every two years, the latest one being the 2015 Skills forecast for 2025 that includes all current 28 EU-member countries plus Norway, Iceland and Switzerland.[71] These forecasts are important building blocks of the EU Skills Panorama under the flagship initiative 'Agenda for New Skills and Jobs' of the 'Europe 2020 strategy'. The Cedefop's forecasts are intended to add value to existing national initiatives and not replacing them. Forecast results include labour demand, labour supply and job opportunities, all disaggregated by EU member country, and then by qualification level, occupation and industry.

---

[70]   This section is mainly based on the following sources: (Cedefop, 2012, 2012, 2012) and http://www.cedefop. europa.eu/en/events-and-projects/projects/forecasting-skill-demand-and-supply accessed May 2nd, 2016.

[71]   Source:http://www.cedefop.europa.eu/en/news-and-press/news/european-and-national-skill-supply-and-demand-forecasts-2025-now-online accessed May 2nd, 2016.

At the heart of the Cedefop model[72] sits the module E3ME that links the labour market to the wider economy. E3ME is a pan-European multi-sectoral macroeconomic model that produces labour demand forecasts by country and for 42 economic sectors[73] and labour supply forecasts disaggregated by five-year age groups and gender. The input data for this module are principally obtained from the national accounts in Eurostat, however other data sources are the OECD STAN[74] database, the European Commission's annual macroeconomic database AMECO, and data obtained from the IMF and the World Bank. Skills demand is approximated by employment "per industry and region as a function of industry output, wages, hours worked, technological progress and energy prices" (Cedefop, 2012, p. 34).[75] In contrast, skills supply depends on the working age population and the active labour force; the latter depends on the working age population and the labour participation rates. Participation rates differ by gender and age and furthermore depend on economic output, wage rates, hours worked, benefit and pension rates, qualifications and the ratio of service activity to manufacturing.

The second module (EDMOD) uses data from the EU Labour Force Survey (EU-LFS) to produce sector by occupation employment matrices. When these matrices are combined with the aggregate labour demand forecasts by sector produced by the previous module (E3ME), labour demand by occupation can be projected expressed in number of jobs. The expansion demand is projected again in the third module (QMOD) but this time by qualification levels (low, medium and high based on ISCED 1997).[76] Although the design of this module allows more detailed disaggregation of educational levels, skills and qualifications, these are not feasible due to data limitations. To complete the demand side of the Cedefop approach, RDMOD, the fourth module projects the replacement demand, i.e. the demand for workers as a result of the need to replace the ones that have left the labour force because of retirement, emigration, etc. Data on outflows from the labour market are used to calculate future replacement demand by occupation and qualification level. The previous modules together generate data on the number of job openings by level of qualification (low, medium and high) and the number of job openings by 26 occupational categories (ISCO-08 2-digit).[77]

The fifth module (StockMod) is a module at the supply side of the Cedefop model and it consists of calculations of the stock of people by their highest formal qualification achieved (low, medium or high, ISCED based), employment status (employed, unemployed, inactive), age and gender. In other words, StockMod forecasts the qualification structure of the labour supply. The objective of the accompanying module 6 (FlowMod) is to show the qualification development during the whole productive period of individuals; however, due to partial and incomplete information this module has not been able to produce useful results yet. Therefore, although a stock-flow model would be the best option, only a stock model is used at present to project the supply of skills. StockMod produces the projected population and labour force, both by qualification level (low, medium and high).

---

[72] See Annex 1 for a graphical representation of the full model.

[73] The economic sectors are based on the European statistical classification of economic activities NACE Rev. 2 (Nomenclature of Economic Activities), see more details: http://ec.europa.eu/eurostat/ramon/nomenclatures/ index.cfm?TargetUrl=LST_NOM_DTL&StrNom=NACE_REV2&StrLanguageCode=EN&IntPcKey=&StrLayout Code=HIERARCHIC&CFID=1110191&CFTOKEN=3ca0f6dadb71d377-1F2DE4F0-F7BF-BCAE-31C18C386EA88F92&jsessionid=f900daad75c14b465532m accessed May 4th, 2016.

[74] STAN = Structural Analysis data base for industrial analysis contains data about industrial performance at activity level across countries. For more details, see https://stats.oecd.org/Index.aspx?DataSetCode=STAN08BIS, accessed May 4th, 2016.

[75] Several of the factors also influence each other, e.g. technology can reduce work hours. Furthermore, wage rates are defined via a bargaining process including worker productivity, prices and wages in the wider economy, unemployment, tax rates and cyclical economic effects.

[76] ISCED = International Standard Classification of Education actually includes 9 levels, from early childhood education to doctoral level (UNESCO Institute for Statistics, 2012), however, due to data limitations Cedefop uses only the broad qualification categories low, medium and high (Cedefop, 2012, p. 2012).

[77] ISCO = International Standard Classification of Occupations; ISCO includes far more than these 10 broad categories of occupations, however these more detailed results are only available for Skillsnet members, not for the general public.

In the final module, module 7 or BALMOD, the results of the supply and demand side of the model are contrasted to calculate any future imbalances between skills supply and demand, again by low, medium and high qualification level. The available labour supply holding certain qualifications (see StockMod) is distributed into jobs. For this distribution to work properly, assumptions have to be made about trends in employment patterns and unemployment rates by qualification level. Furthermore, adjustments are made for double jobbing (people having more than one job), differences in place of residence versus place of work, participation in training, different definitions of unemployment and statistical differences.[78] What complicates this analysis even further is that many jobs are filled by individuals with qualifications different than the "norm".

So far the approach adopted by Cedefop has been entirely quantitative. However, before the results are made public, they are discussed by national experts representing a range of expertise including academics, labour market economists, econometricians and statisticians who are all part of the Skillsnet network, a network coordinated by Cedefop.[79] These discussions add local knowledge, expected developments and more specialized data to the process. Consulting with national experts is also a consequence of the fact that Cedefop's skill forecast is explicitly not intended to replace skills anticipation and forecasting initiatives already taking place at national level.

The complete forecast as described above is executed by a consortium of research institutes.[80] One of these research institutes involved is the Dutch Research Centre for Education and the Labour Market (ROA) who is in charge of assessing the replacement demand for all EU-member countries, i.e. the modules EMOD and QMOD. Other consortium members take care of calculating the expansion demand and the modules related to the supply side of the Cedefop model.

The forecast results are available online for the general public at pan European level and at country level (http://www.cedefop.europa.eu/en/events-and-projects/projects/forecasting-skill-demand-and-supply/data-visualisations). More detailed results, i.e. with more detailed levels of qualifications, occupations; sectors, etc. are available online as well, but for Skillsnet members only.

With regards to individuals with a vocational background, no special attention is given to the identification of their skills in these EU-wide skills forecasts. This is mainly due to the fact that Cedefop approximates skills by using qualification levels, not qualification types. And furthermore, with regards to qualification levels just three levels are used: Low ((Pre) primary and lower secondary education, ISCED 0-2), Medium, (Upper and post-secondary education, ISCED 3-4) and High (Tertiary education, ISCED 5-6).

---

[78] For more information on this part, see (R. A. Wilson & Kriechel, 2010)

[79] For a detailed description: http://www.cedefop.europa.eu/en/events-and-projects/networks/skillsnet accessed May 5th, 2016.

[80] Other consortium members are Warwick Institute for Employment Research (IER), Cambridge Econometrics (CE), Economix Research & Consulting (ERC), Alphametrics (AM) and Vienna Institute for International Economic Studies (wiiw) (Source: Annemarie Kuenn-Nelen, project manager at ROA).

2. Strengths, weaknesses and recent developments

The main strengths of the approach currently used by Cedefop to project skill demand and supply are the use of a similar methodology and harmonized data (like the EU Labour Force Survey) to produce results than can be compared between countries and added up to create pan-European information. Furthermore, due to its modular set up, other countries and variables or components can be easily added which enables continuous improvement and development. Results have been quite robust as they are similar to national forecasts despite differ approaches. Finally, input data and key assumptions can be changed to develop alternative policy scenarios.

Cedefop's approach has also some weaknesses. First of all, the model faces data limitations. The EU-Labour Force Survey data for example suffer from inconsistencies over time and between countries due to changes in classifications from one year to the other, moreover in some cases sample sizes are relatively small limiting the level of detail mainly regarding information by occupation. Another weakness of the model, related also to data limitations is that occupation and qualification are used as a proxy for skills. In other words, skills are not estimated directly (González-Velosa & Rucci, 2016). To improve this situation requires substantial investments. Therefore, another option Cedefop is looking into is using country specific information instead of only using pan-European data, given that the same basic definitions, sources and methods are used. This would increase the reliability of the data and level of detail for national results.

With respect to the central E3ME module, one of its challenges concerns the incorporation of technological changes in the model. Recently the scope of technological progress in the model has been broadened by including non-ICT technological progress alongside ICT technological progress. Another aspect is the relationship between skill supply and technological progress. Skills are included as a factor impacting on technological progress; however, there might be an effect of skills on technological progress via R&D expenditures. Furthermore, it is desirable to incorporate the effect of "greening the economy" on technology, however this has not been an easy task due to problems with definitions and classifications as to what "green" exactly is.[81] Lastly, questions have been raised whether the current approach is the best one, compared to alternatives like continuation of previous trends, CGE (computable general equilibrium) models or DSGE (Dynamic stochastic general equilibrium) models. However, there is currently little room nor incentive to change the central approach.

With regards to the replacement demand module (RDMOD) one weakness to be mentioned is the lack of data on inter-occupational mobility. Recent developments have been testing the panel data method as an alternative to the current cohort component method as this method allows the identification of individual decisions and the different causes of replacement demand over time. Unfortunately, not all countries can provide the necessary data and furthermore the estimates using this method with available data give roughly the same results as the current method. However, if more data become available, it is likely that the panel data approach will be used.

Concerning the supply side module (StockMod) the ideal approach would be a combination of a stock and a flow model, because such a model would be able to follow the qualification development of individuals during their productive period. Unfortunately, lack of necessary data prevents using this ideal model. However, Cedefop researchers have run some pilots with data of certain countries suggesting that it might be possible to develop a stock-flow model using data from the EU-LFS. One caveat might be that this model could be problematic for some small countries because of data issues. Another aspect concerning the forecast of the supply side is migration. Therefore, different assumptions regarding migration will be tested in the future.

---

[81]   The ILO and the EU have worked on this aspect, see section 0.I.A.1 in this chapter.

Developments concerning the ultimate module, BALMOD, are directed at a more exact definition of imbalances between supply and demand and on improving the indicators of interaction such as qualification employment shares in occupations, indicators of constraint and change based on the iterative procedure used to reconcile the supply and demand measures.

As mentioned previously, one weakness is that occupations (and qualifications) are used as proxies for skills. In order to get closer to actually forecasting skills, it is crucial to develop occupational skill profiles, including for example level and field of education and training required, but also main and supplementary requirements concerning knowledge, skills, personal abilities, attitudes and values. These profiles can be added up into occupational groups, then sectoral ones, then national economies and then at pan-European level.

Skill needs might differ substantially between sectors.[82] With this in mind Cedefop launched the Short-term Sector-Based Anticipatory System (or SBAS) project[83] in which the sectors health care, agri-food and forestry-wood, nanotechnology and tourism are analysed with more detail to identify new and emerging skill needs at EU level and at country level. The resulting information can be used as input when defining and validating skills, knowledge and competences and to implement them in curricula, training regulations and qualifications standards, and, last but not least, use them for vocational guidance.

B. Canadian Occupational Projection System (COPS)[84]

The Canadian Occupational Projection System or COPS has been used by Employment and Social Development Canada (ESDC)[85] for over thirty years to produce 10-year occupational forecasts which are updated every two years. The most recent projections cover the labour demand, supply and any imbalances. Like other models, COPS started with only projecting occupational demand, the supply side projections were added from the mid-1990s onwards. The methodological approach is mainly quantitative and rooted in the manpower requirement approach (MRA) and uses input-output matrices (see chapter 1), amongst others. The output is disaggregated for 33 industries, 292 occupational groupings and 5 skill levels. COPS utilizes data from Census, Labour Force Surveys, the Longitudinal Administrative Databank, National Graduate Surveys and other national and international sources. The analyses are executed by a governmental body Employment and Social Development Canada in cooperation with the Conference Board of Canada (CBoC). The projection results are disseminated via a governmental website and include synthesis documents describing job openings by occupation, skill level and source, job seekers by occupation, skill level and source, and projected labour market conditions by occupation and much more.[86] COPS results are used as input for labour policies (see Job Bank for example)[87] and immigration policies as to determine ones eligibility for immigration into

---

82 Previous research into skills needs per sector included a pilot analyzing 19 sectors within the European Union in 2008-2009 by Oxford Research (Oxford Research, 2010).

83 For more information, see http://www.cedefop.europa.eu/en/events-and-projects/projects/skill-needs-sectors, accessed May 9th, 2016.

84 Sources: http://occupations.esdc.gc.ca/sppc-cops/w.2lc.4me@-eng.jsp accessed 27th of May, 2016, (Thomas, 2015). For more detailed descriptions of the COPS model and its applications, readers are referred to (El Achkar, 2010; HRSDC, 2008; Ignaczak, 2011; Lapointe, Dunn, Tremblay-Côté, Bergeron, & Ignaczak, 2006).

85 ESDC is a department of the Government of Canada and that promotes "a highly skilled and mobile labour force and an efficient and inclusive labour market". Its programs and services include labour market issues, immigration, various social benefits, qualifications and children & youth programs, amongst others. (Source: http://www.esdc.gc.ca/en/esdc/index.page?_ga=1.194947176.498447.1464351930 accessed 27th of May, 2016).

86 For a full list of available documentation, go to: http://occupations.esdc.gc.ca/sppc-cops/l.3bd.2t.1ils@-eng.jsp accessed May 31st, 2016.

87 Source: http://www.jobbank.gc.ca/home-eng.do?lang=eng accessed May 31st, 2016.

Canada.[88] Due to the fact that COPS projections produce detailed occupations specific and skill specific assessments of occupational imbalances in a coherent and consistent way various organizations have adapted the basic COPS model to their own industrial or regional context as is the case for the models of the Mining Industry Human Resources Council (MiHR), Build Force Canada (Construction Sector Council), the British Columbia's Labour Market Scenario Model (WorkBC) and the Alberta Occupational Demand and Supply Outlook Models. The main characteristics of the model will be elaborated on below.

1. Occupational demand

COPS is based on the MRA (see chapter I) and uses most of the steps available in this approach. The following description emphasizes deviations of the COPS model from the general MRA approached discussed earlier and on relevant practices. The demand side of COPS starts with assessing the macroeconomic reference scenario which includes projections for 33 industries at national and provincial levels (Step 1). This scenario ignores business cycles in order to focus on long-term trends in productivity and demand and is developed with the Conference Board of Canada (CBoC) and based on data from public and private sources, both nationally and internationally, like the survey of forecasters by Consensus Economics, Finance Canada, Bank of Canada, OECD and IMF. The complex econometric model used to assess the Canadian reference scenario includes factors like "fiscal and monetary policy, the exchange rate, growth in other economies, and assumptions about industrial composition" (Thomas, 2015, p. 29). Based on the reference scenario, GDP by industry is forecasted using the demand categories as predicted by CBoC (Step 2), and then, using input-output matrices (see chapter I) this demand per industry is translated into output per industry.

To assess the change in occupational employment demand per industry over time, i.e. to assess expansion demand, firstly, labour productivity per industry is calculated using "a Hodrick-Prescott filter that extrapolates historical trends from the past two decades throughout the projection period" (Thomas, 2015, p. 30). These industry specific labour productivity data are combined with industry output to generate employment demand per industry for 33 industries based on NAISCS, the North American Industrial Classification System (Step 3). Then, industry-occupation employment matrices are constructed using data from previous Censuses and Labour Force Surveys in order to transform employment demand per industry into occupational demand per industry. For this, 292 occupational groupings at national are used which are based on the National Occupational Classification (NOC, 2011 version). The change in occupational demand per industry over time then equals expansion demand (Step 4). This change is then composed of two parts: "the industrial effect which reflects employment changes due to industry performance and the occupational effect which reflects the changes arising from the trend path of the occupational share in the industry" (Thomas, 2015, p. 30). Finally, the occupational employment shares obtained are evaluated and adjusted to ensure normalization to the industry total.

Step 5, the assessment of replacement demand, is also part of COPS and this demand is calculated by adding up replacement demand caused by any of the following four reasons: retirements, in-service mortality and emigration. Retirements make up 80% of replacement demand in Canada and are estimated using the following procedure: firstly, forecasts of aggregate employment by gender and age are calculated by assuming specific gender and age employment rates, followed by forecasts of gender- and age-based retirement rates that include the effects of wealth, education and labour demand on the probability that individuals retire. Finally, these retirement projections differentiated for age and gender are applied to the employment projections per age and gender in order to assess future retirement levels. The data needed for the described calculations are obtained from the Labour Force

---

[88] See for more information: http://www.cic.gc.ca/english/immigrate/eligibility.asp accessed May 31st, 2016.

Survey and the Longitudinal Administrative Databank. In-service mortality estimates are constructed mainly based on age related projections. And finally, emigration is assessed using a rather simple projection based on demographic factors: estimates of emigration numbers are combined with estimates for emigrants' labour force participation. To complete the process at the demand side, Step 6 consists of simply adding the expansion demand by occupation from step 4 and replacement demand obtained in step 5.

2. Occupational supply

Turning to the supply side, the projections take off with an estimation of how many school leavers will enter the labour force, disaggregated by occupation (corresponding with Step 1 and 2 of the MRA model, see chapter I). These calculations start with a projection of the number of enrolments per educational attainment level (high school, trade and vocational, community college and university) which are affected by factors like "unemployment rates, previous enrolment rates, government funding for education, source population size and per capital real personal disposable income" (Thomas, 2015, p. 33) using demographic and historical data on age- and gender-specific enrolments. Subsequently, the number of graduates is projected based on these enrolment estimates. The number of dropouts is also assessed starting with the high school dropouts by subtracting the number of graduates in the current year from the number of students enrolled in grade nine four years earlier. The post-secondary dropouts on the other hand are estimated using a fixed coefficient. Taken together, the previous estimates generate the number of graduates by four levels of educational attainment for the projection period. The second step is to eliminate those that will not participate in the labour market such as foreign students, second chancers (those who will be entering the school system again) and those that will remain out of the labour market. The third step is to transform the remaining aggregates into entrants per occupation, two different methods are used. The first one, called the ex-ante alternative, only permits school leavers to be employed in an occupation related to its field of study. The data used in this alternative are administrative data from the National Graduate Survey of Statistics Canada. The ex-post alternative on the other hand, does not put any restrictions on occupations but uses the actual labour market distribution of workers by education level and age group. The number of school leavers by occupation is obtained by applying the distribution in the Labour Force Survey data over the last three years to the projected number of school leavers by education level. Comparing the results of both alternatives gives an idea about possible education-occupation mismatches.

The next step in the forecasting process of the supply side in COPS is assessing the future amount of immigrants that are expected to enter the Canadian labour market (Step 4). It starts with an estimate of the number of people that will immigrate to Canada that is based on a fixed proportion of the current population. Then, immigrants' labour force participation data from the census and occupational choices data from recent immigrants obtained by Statistics Canada's are used to project the supply of immigrants by occupation. By expanding the category recent immigrants from people arriving in the last year to people that have arrived during the previous five years, the model now captures the job changes immigrants tend to go through shortly after arrival. Despite its simplicity, this part of the model functions pretty well, partly as immigration into Canada is relatively small, 0,75% of total population, and relatively stable. The following supply side step include future re-entrants, as Step 5 of the MRA model suggests, but also includes net occupational mobility and the unemployment add factor.[89] Net occupational mobility includes individuals changing occupations at the same skill level (horizontal mobility) and also those that switch to occupations requiring higher or lower skill levels (vertical mobility). The net entrants estimate on the other hand includes "the net inflows into the

---

[89] Thomas argues that, in case of negative supply flows, these three components should be included on the demand side and not on the supply side as is current procedure (Thomas, 2015).

economy stemming from the anticipated rise in age- and gender-specific participation rates" (Thomas, 2015, p. 37), while the unemployment add factor represents "the net inflows caused by the declining unemployment rates due to demographic shifts". Finally, the projections of school leavers, future immigrants, net occupational mobility, net re-entrants and the unemployment add factor are added up to construct the total occupational supply projections (Step 6).

3. Imbalances

Any imbalances between occupational supply and demand in COPS are treated in two ways: firstly in a quantitative way by calculating the difference between occupational supply and demand and then in a qualitative way by calculating the 'normalized future labour market situation indicator'. This indicator helps to interpret the imbalances found and is constructed as follows: "excess labour demand by occupation is divided by base year employment and by the number of years in the projection by occupation" (Thomas, 2015, p. 38). However, as this indicator assumes that the labour market is balanced in the base year in each occupation, a current labour market conditions assessment is also used to revise occupations that are not considered in balance in the based year. The results of both indicators are communicated to the public using the following rating system for each occupation: shortage, balanced or surplus. Based on the education requirements for an occupation, the projections per occupation are transformed into projections by skill level using the following five skills categories: Management Occupations (M), Skill level A (requiring university education), Skill level B (requiring college education or apprenticeship training), Skill level C (requiring secondary school and/or occupation-specific training), and Skill level D (none, as on-the-job training is provided).[90]

COPS provides Occupational Projection Summaries for each of the 292 occupational groupings which includes a ten-year labour market outlook for that particular occupational grouping. So in case of interest in the demand for people with technical or vocational education one may look for the occupation job title and then verify the labour market situation. Occupations are usually associated with a broad education requirement (expressed by one of the five skill levels) but sometimes detailed information about the education and/or training necessary for a certain occupation is provided.[91]

C. BLS Occupational Labour Demand Estimation Methodology – United States[92]

The government body Bureau of Labor Statistics (BLS) produces 10-year forecasts of occupational demand exclusively and updates these every two years. The latest available forecast covers 2014-2024. The forecasts are based on the manpower requirements approach and use economic projections, an input-output matrix and an industry-occupation matrix. The data are disaggregated for 334 occupational profiles, representing 84% of available jobs in the US economy and including self-employed and unpaid family workers as well as wage and salary workers and two sets of industry

---

[90] To see how each of the 292 occupational groupings is rated on one of those 5 skill levels, see http://occupations.esdc. gc.ca/sppc-cops/l.3bd.2t.1ilshtml@-eng.jsp?lid=59&fid=1&lang=en accessed July 29th, 2016.

[91] A ten-year labour market outlook per occupational grouping can be found here: http://occupations.esdc.gc.ca/ sppc-cops/.4cc.5p.1t.3.4n.1lf.4rc.1sts.5mm.1rys.2.1rch@-eng.jsp. For Quebec, a 5-year labour market outlook is provided per occupational grouping via the following website: http://www.servicecanada.gc.ca/eng/qc/job_futures /job_futures.shtml#SkillType, both website accessed at August 15th, 2016.

[92] Sources: http://www.bls.gov/emp/ accessed May 31st, 2016; (Thomas, 2015).

sector categorizations.[93] Future skill needs are not only assessed indirectly by projecting occupational demand, but also indirectly via an analysis of the education and training requirements of each occupation and the current level of educational attainment of workers. The data used in occupational demand forecasts are, amongst others, Census data (Census Bureau), Labour Force Survey data (Current Population Survey) and Foreign Sector data (Oxford Economics). Furthermore, education and training requirement analyses are based on data from the American Community Survey (Census Bureau), Occupational Information Network (O*NET) and the National Centre for Education Statistics. The forecasting results are distributed via the publication Occupational Outlook Handbook and corresponding websites.

1. Forecasting occupational demand

The occupational forecast of BLS only covers the demand side of the MRA model. However, it does include projections of the future labour supply, but these serve only as an input factor for the macroeconomic reference scenario (Step 1). Like in other models, these labour supply projections are based on population projections and estimates of labour participation rates of which the latter "undergo a vetting process, where they are reviewed for consistency by BLS officials" after being estimated using rigorous estimation techniques (Thomas, 2015, p. 39). The macroeconomic reference scenario is based on the assumption of full employment in the target year, in other words, unemployment is supposed to be frictional and not caused by a lack of demand. This scenario includes the typical demand categories consumption, investment, government and trade for which demand is estimated using different models, such as a life-cycle model for consumption and neo-classical models for investment. Then, the demand in these categories is assessed separately for a range of subcategories, like 76 product categories for consumption and 28 asset categories for 'private investment in equipment and software' using the historical relationship between each product type and variables like "disposable income, prices and a state variable capturing inventory or habit formation" (Thomas, 2015, p. 40). Government demand is determined by policy changes and its effects on spending and the assessment of trade demand considers factors like external energy forecasts, existing and expected shares of the domestic market, expected world economic conditions and known trade agreements. In the end, aggregate demand is converted from purchaser value to producer value to enable the separation of output from the wholesale sector, the retail sector and the transportation sector from the rest of the economy.

Converting aggregate demand into output by industry is done by an input-output model that consists of two matrices (corresponds to Step 2). The first matrix, the direct requirements table, shows how much commodities were used as input to produce 1 dollar of output, while the second, the market share table, shows the allocation of "commodity output to the industry in which it is the primary commodity output and to those industries in which it is secondary" (Thomas, 2015, p. 42) or put simply, who produces what. Both matrices are constructed using projected demand and historical relationships. Before the input-output model results are passed on to the next stage, they are revised and reviewed in order to include productivity changes which often differ between industries. This next stage (or Step 3) is all about converting output per industry into employment demand per industry which is determined by factors such as wages, prices and industry output and the historical relationships between them. These employments per industry projections are denominated in "number of jobs and hours worked for wage and salary workers and for self-employed and unpaid family workers" (Thomas, 2015, p. 43). Industries are defined using NAISCS, the North American Industrial Classification System.

---

[93]   See for a complete list of major industry sectors: http://www.bls.gov/emp/ep_table_201.htm or industries: http://www.bls.gov/emp/ep_table_207.htm, both accessed May 31st, 2016.

The change in employment per industry due to demand, as projected in the previous step, is the basic ingredient for the projections of expansion demand per occupation. 334 occupational profiles are used for this, based on the Standard Occupational Classification (SOC). Industry-occupations matrices, consisting of a base-year employment matrix and a projected year employment matrix, are constructed and used in Step 4 to achieve this. The aggregate base-year employment per occupation is determined by "pooling employment across all occupations and worker categories" (Thomas, 2015, p. 43). Then, occupational distribution ratios are calculated as follows: "occupational employment by industry divided by the total wage and salary employment within that industry" (Thomas, 2015, p. 43). Historical industry-specific staffing patterns are analysed to pinpoint variables that possibly impact the staffing patterns in the future such as "shifts in the product mix and changes in technology or business practices" (Thomas, 2015, p. 43). The previous calculations taken together generate a projected-year occupational ratio and a projected-year employment and multiplying them gives an estimate of future wage and salary occupational employment per industry, i.e. expansion demand per occupation.

As expansion demand is just one component of occupational demand, the other component, replacement demand by occupation, is also assessed in the BLS model (Step 5). Replacements are supposed to be caused by retirement only and furthermore current workers are supposed to "retire and exit from occupations at comparable ages to those individuals from recent past data" (Thomas, 2015, p. 44). In other words, retirement is seen as a consequence of simple demographics and not impacted by individual behaviour. Historical data are used to calculate replacement needs rates by age and these are subsequently applied to the base year occupational age distributions to generate the replacement demand projections. After another 'revise and review' or vetting round to check for internal consistency in the employment projections across all industries and occupations, expansion demand and replacement demand are added to calculate total projected demand per occupation (Step 6) and this completes the BLS procedure.

2. Education and training requirements

Besides the forecasts of occupational demand as a proxy for future skill needs, the BLS also provides estimates of education and training requirements for each occupation in the BLS projection system. These estimates are obtained by analysing the typical pathways of entry per occupation and by analysing the educational attainment data of current workers per occupation.

Three different groupings are used to display the education and training requirements per occupation. The first one is the 'typical education needed for entry' category which comprises of the following eight categories: Less than high school (1), High school diploma or equivalent (2), Some college, no degree (3), Postsecondary non-degree award (4), Associate's degree (5), Bachelor's degree (6), Master's degree (7) and Doctoral or professional degree (8). Next is the 'typical work experience in a related occupation' category[94] which differentiates between 'no training', 'less than five years' and 'five years or more'. The last category is the 'typical on-the-job training' category which includes six levels of on the job training "needed to attain competency in the requisite occupational skills". The six levels are None, Short-term on-the-job training: 1 month or less, Moderate-term on-the-job training: 1-12 months, Long-term on-the-job training: more than 12 months, Apprenticeship, and Internship/residency.[95] For some occupations, the typical pathways of entry are determined by legal regulations, however, for others various paths of entry are used and as the system does not allow multiple pathways, analysts pick the most frequently chosen path for that occupation.[96] This

---

[94]   Work experience in this context refers to work experience that is "commonly considered necessary by employers for entry into the occupation, or is commonly accepted as a substitute for formal types of training" (Thomas, 2015, p. 45).

[95]   Source: http://www.bls.gov/emp/ep_education_tech.htm accessed August 15th, 2016.

[96]   The alternative pathways are described in the Occupation Outlook Handbook.

assignation process is based on quantitative information from the American Community Survey, O*NET and the National Centre for Education Statistics on the one hand and on qualitative information obtained from discussions with "educators, employers, workers in given occupations, training experts, and representatives of professional and trade associations and unions" (Thomas, 2015, p. 45) on the other.

The American Community Survey also provides the data used by BLS analysts to create a picture of the educational attainment levels of current workers in their respective occupations. The results show the percentage distribution of the highest levels of educational attainment of the workers in a certain occupation. As the procedures described above are about analysing and identifying the current situation, the resulting education and training requirements estimates by itself do not reveal what skills (approximated by education and training requirements) are needed in the future. However, if one assumes that the current situation will hold in the (near) future, as has been done at various points in the BLS occupational demand projections, individuals can use these results as a guide for their choices regarding education, training and work.

With regards to individuals with a VET background, either at secondary or tertiary level, the three different educational requirement groupings as stated above, offer limited opportunities to determine what will be required now and in the future of this group.

3. Limitations

A great part of the BLS projection model is based on historical patterns that are assumed to "maintain their trends throughout the projection period" (Thomas, 2015, p. 46). In other words, BLS assumes that the past is the best predictor of the future. This implies that a first limitation of this approach is its sensitivity to shocks like major armed conflicts, major natural disasters and shifts in laws and policies that influence the economy especially demand.[97] Moreover, a second limitation is that concrete historical knowledge (i.e. data) is needed for accurate and efficient projections. However, if one takes into account that the BLS model is about projections, not forecasts, the limitations described above are less serious. After all, "projections are focused on the underlying long-term trends" and their users "are typically more interested in analysing the plausible scenarios so as to better understand the ramifications of the long-term trends" (Thomas, 2015, p. 46).

D. A holistic approach - UKCES (UK)

As advocated in chapter I by Cedefop and others, in the UK a rather holistic approach is used which is lead and funded by the UK Commission for Employment and Skills or UKCES, a publicly funded, industry-led organisation that includes commissioners representing employers, trade unions, the third sector, and further and higher education across all four UK nations. The UKCES approach can be considered holistic because it includes skills identification (the Employer Skills Survey or ESS) as well as skills anticipation exercises in a coordinated way; and when it comes to skills anticipation both forecast (Working Futures) and foresight techniques (the Future of Work study) are used. Furthermore, a wide spectrum of qualitative and quantitative methods is used like econometric models, employer surveys, and expert interviews, adding to the holistic character of this approach. Results are produced at the aggregate UK wide level but also at rather detailed levels such as for a certain local area or sector. The exercises put more emphasis on the demand side of skills than the supply side, and studies are performed at regular intervals of 2 to 3 years, with the foresight study

---

[97] The BLS methodology explicitly assumes that "New major armed conflicts will not develop; There will be no major natural disasters [and] Existing laws and policies with significant impact on economic trends will continue to persist" (Thomas, 2015, p. 46).

being the exception. The time horizon varies from the current situation or past year to 10 years for the forecast exercise and 15 years for the foresight exercise. Various stakeholders are involved in the different exercises representing all four national governments, various policy areas with an emphasis on employment and education and training, local area representatives such as Local Enterprise Partnerships (LEPS) and Sector Skills Councils and Bodies.

1. Skills identification: employer surveys

The skills identification exercises performed in the UK emphasize the demand side, i.e. they reflect the employers' perspective. The exercise consists of two complementary UK-wide surveys which are repeated biannually, i.e. the two surveys run in alternate years. The Employer Skills Survey or ESS is inward looking as its focus is on current employer skills demand, skills shortages and training within organizations. The Employer Perspective Survey or EPS on the other hand, is outward-looking and describes how and why employers currently "engage with training providers, schools, colleges and individuals in the wider skills system, to get the skills they need" (Shury et al., 2014a, p. 3). As the focus of the latter is not on skills identification *an sich* but the skills system as a whole, the ESS will be discussed in more detail below, while the EPS will be discussed in Annex 2.

(a)   Employer Skills Survey (ESS)[98]

The ESS in its current UK-wide form has been performed in 2011, 2013 and 2015, since UKCES became responsible for the National Employer Skills Survey in England in 2009 and harmonized the various skills surveys previously held by each of the four nations, some going back to 1999. This survey aims to provide an insight into the skills issues employers face and the actions they take to deal with them and it consists of a core survey and a follow-up survey. The core survey covers the following topics: recruitment and skill-shortage vacancies, internal skills challenge, under-use of skills and qualifications, working practices and product market strategies. Over 90.000 individuals responsible for recruitment, human resources and workplace skills at their 'business establishment' were interviewed by telephone for this survey.[99] A follow-up telephone survey then is held under 13.000 of the previous establishments, which delves into the investments employers make in the training of their employees over the previous 12 months. For the ESS 2015 the skills categories were extended from 13 to 24: 14 technical and practical skills and 10 people and personal skills[100] based on the ones used in international skills surveys like OECD's PIAAC and Cedefop's Employer Survey on Skill Needs.[101] The survey results are disaggregated by nation, sector, establishment size and occupation.[102] The nine occupational groups, based on the Standard Occupational Classification (SOC 2010), are Managers, Professionals, Associate Professionals, Administrative staff, Skilled Trades, Caring, Leisure and Other Service Occupations, Sales and customer service occupations, Process, plant and machine operatives and lastly, Elementary occupations.[103] These results not only provide an

---

[98]   This section is based on (Vivian et al., 2016; Winterbotham et al., 2016) and https://www.gov.uk/government/organisations/uk-commission-for-employment-and-skills accessed July 7th, 2016.

[99]   Population statistics were obtained from the Inter-Departmental Business Register (IDBR) of the Office for National Statistics (ONS) and the establishments were sourced from the Experian's National Business Database (Winterbotham et al., 2016).

[100]   More details on these skills categories can be found in (Vivian et al., 2016).

[101]   See section 0.I.A.1 for a more detailed description of OECD's PIAAC and for Cedefop's Employer Survey on Skill Needs see http://www.cedefop.europa.eu/en/events-and-projects/projects/employers-surveys accessed August 16th, 2016.

[102]   Four nations England, Wales, Northern Ireland and Scotland are distinguished; 15 sector categories based on two-digit Standard Industrial Classifications (SIC 2007) are used; five size categories are used based on the number of workers in the establishment: 2-4, 5-9, 10-24, 25-99 and 100+ (Winterbotham et al., 2016).

[103]   Examples of specific occupations for each of the nine occupational groupings for the primary sectors, service sectors and the public sector can be found in (Winterbotham et al., 2016).

overview of the current skills situation but also aim to explain why this situation exists. ESS output is presented in various reports and national toolkits which all freely available on the UKCES website.

2. Skills anticipation: working futures and the future of work study

Besides the skills demand identification exercise ESS discussed previously, the UK also tries to predict what skills are needed and supplied in the future and why. It does this via two complementary studies: the Working Futures labour projections and the Future of Work foresight study. The first study generates "detailed projections of quantitative changes in the labour market and occupational structure, including growth in employment in the private services sector, and the anticipated employment growth in higher skilled occupations" while the second provides an "understanding [of] the underlying drivers and factors (including disruptive and discontinuous factors) that shape the future demand for skills in the UK" (Stormer et al., 2014, p. 1). In other words, the labour projections answer the What? and How many? questions regarding skills while the foresight study answers the Why? question. Both studies will be discussed in more detail below.

(a)   Working Futures – labour projections[104]

The Working Futures labour projections have started in 2002 are repeated every 2-3 years. The latest and sixth edition has been published in 2016 and covers the usual 10-year period, in this case the years 2014-2024.[105] The projections involve skills demand and supply and are considered to be an "indication of likely trends and orders of magnitude, given a continuation of past patterns of behaviour and performance, rather than precise predictions of the future" (Rob Wilson et al., 2016, p. ii). They are mainly based on a quantitative approach using econometric models as shown in Annex 2. However, the analysis of trends in occupational structure for example is based on qualitative approaches. The input data for the models consists of data on output, employment and various economic indicators from the Office of National Statistics (ONS), furthermore, Labour Force Survey data, Census data and government policies are also taken into account, especially government spending measures.

The projection process starts with the regional Multi-sectoral Dynamic Model of the UK economy (or MDM-E3 for short) which consists of separate models for 87 regions including equations explaining consumption, investment, employment, exports, imports and prices. Its centre piece is "an input-output matrix, which deals with the flows of goods and services between industries and determines total industrial outputs" (R. Wilson, May-Gillings, Pirie, & Beaven, 2016, p. 4). The 5.000+ equations of the regional models are solved together in order for the final results to be consistent with the national accounts. Aggregate labour supply by age and gender is also estimated via this stage. The results of MDM-E3 then feed into separate demand and supply modules (See Annex 2) similar to the EU-model of Cedefop and the Canadian COPS model. The last step of the process takes place in module 6 where the independent projections of employment (i.e. demand) and supply are reconciled by sorting six different levels of qualification (based on the Regulated Qualifications Framework, RQF) into 25 occupations[106] based on "certain assumptions about unemployment rates by highest qualification held, and then reallocating people to jobs until all those available are employed"

---

[104]   This section is based on (R. Wilson et al., 2016; Rob Wilson et al., 2016).
[105]   UKCES commissions the development and execution of the projections to the Warwick Institute of Employment Research (IER) and Cambridge Econometrics (CE).
[106]   The six qualification categories used are based on the Regulated Qualifications Framework or RQF levels: RQF 0 (or entry level), RQF 1, RQF 2, RQF 3, RQF 4-6 and RQF 7-8. RQF is the National Qualification Framework (NQF) and the Framework for Higher Education (See Box 5.1 in Rob Wilson et al., 2016, p. 89). The 25 occupation categories are based on the two-digit Standard Occupation Classification or SOC 2010 (See Figure 5.5 Rob Wilson et al., 2016, p. 105).

(Rob Wilson et al., 2016, p. 104). This reconciliation process produces a comparison between the qualification intensity of demand and that of actual supply in which qualification density refers to the distribution of the highest qualification held by individuals with a certain occupation. The latest numbers for example showed that for several occupations the percentage of individuals with RQF levels 4-6 available in 2024 is lower than the demand for them (See Figure 5.5 Rob Wilson et al., 2016, p. 105).

The output consists of employment prospects by region, industry, occupation, qualification level, gender, and employment status, while labour supply results are presented by gender, age and highest qualification held. Besides general reports using more broad categories for the before mentioned dimensions, an abundant amount of data with higher levels of detail is publicly available in the Working Future Workbooks and in various online datasets as well (https://data.gov.uk/dataset/working-futures accessed July 11th, 2016). For example, data are available at local level for 39 Local Enterprise Partnerships or LEPS in England,[107] 4 Economic Areas in Wales, 13 Regional Skills Assessment Areas and 5 City Deal Areas in Scotland, and 6 Workforce Development Forum Areas in Northern Ireland. A variety of stakeholders is involved in overseeing the Working Futures projections: UKCES, Welsh Government, Department for Business, Innovation & Skills (BIS, England), Scottish Government and the Department for Employment and Learning Northern Ireland (DELNI). The projections results are used by individuals considering career choices, employers, education and training providers, national and local policy makers. This exercise is explicitly aimed to assist in policy and planning for the provision of education and training as well as individual career choices and decisions.

(b)   The Future of Work study – foresight study[108]

The labour projections discussed above give an idea about what skills will be in demand (and supply) in the years to come, however in order to respond properly to these projections, one also has to understand the underlying drivers and factors. This is where a foresight exercise comes into play. The Future of Work Study has been published for the first time in 2014 and paints a picture about what the UK's work landscape in 2030 might look like and what skills will be required by then. It follows an entirely qualitative approach involving various steps and a variety of stakeholders. Roughly the foresight study involves six sequential steps. The first step uses a systematic literature analysis alongside expert interviews[109] to get an overview of the relevant societal, technological, economic, ecological and political factors impacting future UK-specific jobs and skills. The next step involves the identification of major trends and disruptions that are likely to affect the jobs and skill until 2030. Subsequently, researchers have analysed what drives these trends and disruptions and this has resulted in a list of key factors in the third step of the process. These key factors are further analysed on their likelihood, direct and indirect impact and their level of activity. Furthermore, various projections are created for the development of each key factor which are subsequently discussed and refined during a workshop with internal experts of UKCES. Step four then consists of looking for consistent combinations of projections using software which results in four raw scenarios. Once this step is completed, the four selected scenarios Forced Flexibility, The Great Divide, Skills Activism and Innovation Adaptation are being enriched by "making more detailed assumptions about the causalities or underlying logics of a scenario and explaining possible paths leading to the scenario's future"

---

[107]   More information on Local Enterprise Partnerships or LEPS can be found on https://www.lepnetwork.net/ accessed July 11th, 2016.

[108]   This section is based on (Stormer et al., 2014) and https://www.gov.uk/government/publications/jobs-and-skills-in-2030 accessed July 8th, 2016.

[109]   The 23 experts involved are UK and global thought leaders, global and UK senior business leaders, UK trade union representatives, UK voluntary organization representatives, policy makers and representatives of education and training providers (Stormer et al., 2014, Appendix A on pp. 110-111).

(Stormer et al., 2014, p. 13) which comprises the fifth step. The final step includes looking at the implications of the four scenarios for labour market stakeholders and these are developed in collaboration with the latter during a conference with high-level contributors representing employers, employees, education and training providers and policy makers.[110] These implications are disaggregated by stakeholder and by sector, however, a selection of seven sectors have been covered: health and social care, professional and business services, retail and logistics, education, creative and digital, manufacturing, and construction.

Beside implications that differ per scenario, several implications are found in all scenarios and must be responded to. Therefore, actions are formulated for employers, individuals, education and training providers and policy makers.[111]

Apart from the UK-wide studies discussed above, UKCES also runs a program of sector research which started with a series of Sector Skills Insight reports in 2012 and has continued with a rolling programme of sector-specific studies covering a variety of topics and sectors. This programme is currently in its third round[112] where "sector skills and performance challenges [are examined] with an emphasis on the mix of skills needed in specific occupations, as well as employer awareness of and engagement with National Occupational Standards" (Vokes & Limmer, 2015, p. 8). These sector studies are performed based on a review of the existing literature, data gathered in the previously discussed UK-wide studies, and expert interviews with representatives of sector employers, and Sector Skills Councils and Bodies amongst others.

With regards to skills identification and anticipation for individuals with a VET background, the exercises discussed differ considerably. In the Employer Skills Survey, skills there are not identified for education levels directly. However, the skills (gaps) identified for the nine occupational groups (Managers, Professionals, etc.) might be used as proxies for individuals with a certain type and level of VET formation. The Working Futures labour projections on the other hand are disaggregated by six qualification levels which can be linked to individuals with a certain level of VET. The foresight exercise Future of Work study, then, explicitly states what changes to expect for jobs and skills. However, no attention is paid to individuals with a VET education, as the envisioned changes are discussed per scenario for the stakeholder categories employees and education and training providers. Furthermore, changes in skills are discussed for the sector as a whole.

---

[110] See for a full list of conference participants: (Stormer et al., 2014, Appendix B on pp. 112).

[111] An overview of the guiding questions in each step can be found in 3.

[112] The first round covered the "role of technology in driving high level skills in the digital, off-site construction, aerospace and automotive industries", while the second round "addressed skills and performance challenges in the logistics and wholesale and retail sectors" (Vokes & Limmer, 2015, p. 8).

E. The French model

The French system of skills identification and anticipation exercises can also be classified as a rather holistic system with regular analyses at macro-, meso- and micro-levels plus some ad hoc studies (ITC-ILO, 2012). Most studies involve skills anticipation exercises with time horizons varying between five to ten years, although employers generally identify skills as well and look at skills changes in the nearer future. Furthermore, the exercises are repeated every three to six years. Overall, both skills demand and supply are considered in France; however, this depends on the actual level of analysis (macro, meso or micro). Various methods are used including quantitative methods such as econometric modelling are used and qualitative methods like consultations and discussions with stakeholders, especially in the observatories at regional and sectoral level. A broad array of stakeholders is involved depending on the type and level of the skills exercise such as numerous ministries, sectoral organizations, social partners, regional partners and (large) employers. Their involvement includes extensive consultation, information dissemination, but also funding and execution as in the case of skills analysis by mid-sized and larger companies. The results can be disaggregated by sector or domain, occupation, dominant occupational level, and region, amongst others. Most results are disseminated by online available reports and in discussions with stakeholders and are mainly used for VET and labour policies. The main skills exercises will be discussed below ordered by level of analysis.

1. Macro-level exercises – Prospective des métiers et de qualifications (PMQ) (Occupations and skills outlook)[113]

The projections of futures occupations and skills in France are referred to as PMQ projects. Their origins go back to the 1980s; however, serious progress was made when the prime minister requested three waves of forecasting in 1997, 2000 and 2003. Since then five PMQ projections with a time horizon of 8-10 years have been published every 5-6 years, the latest one, PMQ V with the official title "Les metiers en 2022", was published in 2015.[114] The PMQ's objectives are threefold: "enrich the strategic thinking [process] of the State, social partners, economic operators and public debate on VET and the labour market […], [take advantage of] the regional exercises […], and to respond to questions from users of orientation" both in the educational sphere (students and their parents) and the labour market (job seekers and employees) (Klein, 2011). It aims to achieve these objectives by "anticipate economic changes at regional and sectoral level, and identify [which] sectors and occupations [are] dormant, emerging or in tension (Klein, 2011).

The occupations and skills forecast is part of a larger coordinated system of analyses as is shown in Annex . Firstly, the figure shows how these forecasts depend on quantitative and qualitative input from various partners such as labour force forecasts, macroeconomic scenarios, sector scenarios and discussions with industrial occupational observatories about their sector forecast results. Secondly, the occupational and skills forecasts themselves are input for the youth professional integration forecasts. Although the tools and methods used from one PMQ version to the next have varied, employment and exits of labour market forecasts by occupation using a specific classification crossing statistical and administrative approach have always been used. The macroeconomic analysis varied over time and was often separated from the detailed employment forecasts. In the past, the exercises were very close to the demographic projections made by the French institute of statistics (INSEE) and focused on trends. Nowadays three scenarios, a baseline, a crisis and a target scenario and three employment forecasts based on a multisectoral macroeconomic model

---

[113] This section is based on (France Stratégie & DARES, 2015; Klein, 2011).

[114] PMQ II (2002) includes forecasts up to 2010, PMQ III (2007) includes forecasts up to 2015, PMQ IV (2012) includes forecasts up to 2020. No specific year of publication could be found for PMQ I (Klein, 2011).

(Nemesis from Erasme Team) are developed. Projection results are disaggregated by occupational level using the French "Familles Professionnelles" or FAP classification, by skills level (Indépendants, Ouvriers peu qualifies, Employés peu qualifies, Ouvriers qualifies, Employés qualifies, Professions intermediaries and Cadres),[115] and by sector.

As can be seen in Annex 3 several institutions have been involved in developing and executing the PMQ forecasts which are principally CAS (Centre d'analyse stratégique) and DARES (Direction de l'animation de la recherche, des études et des statistiques) who fall under the Prime Minister and the Minister of Labour and Vocational Education respectively. However, since 2013 CAS has been replaced by France Stratégie and as such as performed the latest PMQ in the series. The PMQ project is run by two broad committees: a Technical Committee and a Strategic Committee. As executors of the projections, France Stratégie (and formerly CAS) and DARES are represented in the Technical Committee alongside INSEE (French institute of statistics), DG Trésor (Minister of Finance), and Pôle Emploi (Public Employment Service), just to name a few. The Strategic Committee then consists of a broad range of social partners, ministries, consultative bodies, public employment service, research institutes and regional observatories.[116]

The PMQ forecasts have encountered several challenges over the years: an important input data source, the labour survey, has changed and therefore is nowadays less suitable to analyse occupations an occupational mobility. Other challenges stem from recent trend breaks, lack of studies on occupations and skills in France especially by economists, political constraints, and a lack of economic knowledge in labour market debates. Notwithstanding, or even because of these challenges, interesting lessons have been derived from the previous two decades of PMQ projections. For starters that qualitative analysis and key messages are as important as quantitative results, modelling should insist on potential job creations and replacement of departures at retirement, and finally that reports should include an update on the developments in occupations and skills. These lessons will help when attempting to assess the impact of the digitalization of the economy of skills demand, a topic that has reached a lot of attention in (and outside) France. In 2016 for example, *France Stratégie* has organized a series of debates about "Technological changes, social changes" bringing together experts from various fields to discuss the impact of emerging technology on employment and public policy.[117]

2. Meso-level exercises – Regional Observatories[118]

The skills exercises at meso-level are influenced by the autonomy of the currently 18 regions in France regarding topics like vocational education and employment. In every region sectoral observatories have been set up by social partners, an initiative later transformed in to law, in order to execute forecasting studies on branch-specific employment, occupations, specific professions, recruitment, and demand for qualifications. 120 (2012 count) of these "Observatoires Régionaix" are in place in different sizes, age and therefore experience level when it comes to skills forecasting. Another type of relevant regional observatories has been put in place since the end of the 1980s: the regional employment and training observatories (or Observatoire Régional Emploi-Formation, OREF). Their main objective is to assess the available regional employment developments and prospects data every five to seven years including a range of stakeholder perspectives from the areas of economics, education and research to facilitate the regional government´s decision making on

---

[115] Translation of the category labels: independents, low-skilled workers, low-skilled employees, medium-skilled workers, medium-skilled employees, associate professionals and managers. See also footnote 55.

[116] A complete list of members of the Technical Committee (Groupe de Travail) and the Strategic Committee (Comité d'Orientation) can be found in the Annexes 3 and 4 in (France Stratégie & DARES, 2015).

[117] This series of debates is called "Mutations technologiques, mutations socials" and more information can be found here: http://www.strategie.gouv.fr/mutmut accessed July 30th, 2016.

[118] This section is based on Country Sheet France in (ITC-ILO, 2012).

training and regional economic planning. The intention of using such a broad approach to the OREFs is not missing out on any important tendency or emerging issue.

3. Micro-level exercises[119]

Apart from the regional focus of the French skills exercises, a strong company focus is present as well due to Law Borloo or Law 2005-32[120] that was put in place in 2005 and has created that a management of jobs and skills or in French Ge*stion Prévisionnelle des Emplois et des Compétences* or GPEC for short. The law stipulates that companies with over 300 employees are obliged to establish and discuss an employment anticipation report with employee representatives ever three years. The underlying idea is to anticipate and act on possible economic, technological and legal changes the company might face so as to create a smooth transition. The GPEC report must include "statements on enterprise's environment (market evolution), its strategy (product, externalization etc.), envisaged organizational and technological change, and the expected impact of these modifications on occupations, functions, professions, recruitment, and training policies)" (ITC-ILO, 2012). The analysis of the current (skills) situation in the company and the impact of future changes on this (skills) situation are supposed to lead to training programs covering all employees. Some companies, who due to their limited size are not obliged to perform the GPEC, do it anyway because, according to The Gris Group with only 180 employees, it improves their human resources management.[121]

The studies presented above provide information on the current and anticipated skills levels of individuals with a VET education. The most detailed information is likely to be found in the PMQ projections at macro-level as its results are disaggregated at seven skills levels. The results of the skills exercises at meso- and micro-level might include the sought after information, however, this is not clear from the documentation available at present.

F. Other approaches by international organizations

Although the pan-European Cedefop approach is widely recognized, it is certainly not the only effort taking place at international level. Other initiatives will be discussed in this section and they include, in order of appearance, the STEP and SABER programs of the World Bank, 'Skills for Green Jobs', a joint project by the International Labour Organization (ILO) and the European Union (EU) and the 'Better skills, better jobs, better lives' program of the Organization for Economic Cooperation and Development (OECD).

1. World Bank – Skills toward Employment and Productivity[122]

The 'Skills toward Employment and Productivity' or STEP framework is a conceptual model developed by the World Bank to guide relevant actors when designing a system of skills development that includes skills diagnostics and policy design. The framework consists of five interlinked steps: (1) Getting children off to the right start, (2) Ensuring that all students learn, (3) Building job-relevant skills, (4) Encouraging entrepreneurship and innovation and (5) Facilitating labour mobility and job matching. STEP is aimed at low and middle-income countries to help them building a skilled workforce as a means to end poverty and promote shared prosperity. The actual use of this framework varies between countries as it is adjusted to country characteristics like the level of development,

---

[119]   This section is based on Country Sheet France in (ITC-ILO, 2012).
[120]   The complete text of this law can be found here: https://www.legifrance.gouv.fr/affichTexte.do?cidTexte= JORFTEXT000000806166&categorieLien=id accessed July 13th, 2016.
[121]   Source: http://www.gris-decoupage.com/en/human-resources/gpec.aspx accessed July 13th, 2016.
[122]   This section is mainly based on the following sources: (The World Bank, 2010, 2014), (Del Carpio, Ikeda, & Zini, 2013), http://microdata.worldbank.org/index.php/catalog/step/about, accessed May 9th, 2016.

demography and resource base, and institutional capacity.[123] The programme includes finance, knowledge and technical assistance to individual countries provided by the World Bank.

Given the objectives of this report, the most relevant component of this framework is the included measurement tool that consists of two surveys. The first one is a household survey to collect data on cognitive skills (reading, numeracy, literacy and writing),[124] socio-emotional skills (personality, behaviour and time and risk preferences), and job relevant skills (interpersonal skills, use of technology, job specific skills, language, autonomy, solving & learning).[125] Put differently, the data generated by this survey allow for the identification of skills supply, while skills demand is assessed by an employer survey generating data concerning workforce characteristics, skills used by its workforce, hiring practices, training and compensation and background characteristics. So far, the household survey has been applied in twelve countries and the newer employer survey in four countries, all in the period 2012 to 2014.[126] The World Bank intends to survey more countries in the future.

The results of both surveys are disaggregated by industry, occupation, skill level and educational attainment level, amongst others. Industry includes three industry groupings: agriculture, manufacturing and services. Occupation includes nine major groups based on ISCO-08, and furthermore these are grouped into four different skill levels, as follows: highly skilled occupations include managers, professionals and technicians, skilled non-manual occupations include clerical, service and sales workers, semi-skilled manual occupations include crafts and trades workers and plant and machine operators, and finally the elementary occupations. The educational attainment categories, finally, include university, vocational, secondary, primary and 'no education or dropped out from primary education'. In short, these instruments generate some information about the current skills need and supply of individuals with a VET background.

The STEP measurement tool can be characterized as a qualitative method producing information about current skill supply, demand and mismatches in low and middle-income countries on an ad-hoc basis. As such, the World Bank claims it is the first attempt to measure skills in these countries. It uses surveys and provides output that is disaggregated by occupation, skills level, education level, sector and firm size. The skill mismatch information is based on perceived adequacy of education and skills by workers and a comparison between revealed preferences of employers and current stock of workers. The framework and its output are directed at policymakers, analysts, and researchers in low and middle income countries. The information is distributed via reports and the World Bank website.

---

[123] Countries in Africa and the Middle East for example experience a "youth bulge" of new job-seekers while countries in Eastern Europe and Central and East Asia are faced with a demographic transition of shrinking labour forces (The World Bank, 2010).

[124] The scales used are similar to the ones used in the International Assessment of Adult competencies, part of the OECD's PIAAC project. See section 0.I.A.1 in this chapter for more information on this research project.

[125] Other data collected are so-called background data such as household characteristics, educational attainment, training, health, employment history, and family background.

[126] Household survey: Armenia, Bolivia, Colombia, Georgia, Ghana, Kenya, Lao, Macedonia, Sri Lanka, Ukraine, Vienam and Yunnan, province in China. Employer survey: Armenia, Azerbaijan, Georgia and Vietnam. Source: http://microdata.worldbank.org/index.php/catalog/step#_r=&collection=&country=&dtype=&from=1890&page=2 &ps=&sid=&sk=&sort_by=titl&sort_order=asc&to=2016&topic=&view=s&vk= , accessed May 9th, 2016.

2. International Labour Organization and European Union-Skills for Green Jobs[127]

The International Labour Organization (ILO), the United Nationals Environmental Programme (UNEP), the International Organization of Employers (IOE) and the International Trade Union Confederation (ITUC) joined forces in the Green Jobs Initiative aimed at helping governments and social partners to capture the potential for decent work resulting from the efforts to tackle climate change. One element of this initiative has been a global research project into the identification of skill needs for greener economies in 21 developed and developing countries[128] executed by ILO and the EU agency Cedefop. This global research project is of a qualitative nature and is based on an ad-hoc analysis of existing cases in order to select best practices and to give recommendations or directions for improvements. No new instrument or tool has been designed nor proposed. The initiative seems to be mainly directed at influencing labour and education and training policies and at the institutional sector. Results have been disseminated by means of reports.

This global research project about green skills identification discovered that measuring and classifying green jobs and related skills is quite a challenging task due to the fact that green jobs are (purposely) not well or uniformly defined and that these definitions are dynamic due to technological changes and innovation. On top of this, skills are not easy to define either and its proxies like occupations, qualifications and fields of activities tend to complicate things even further as their classifications (ISCO, ISIC) frequently do not include green occupations nor activities. Approaches to improve this situation are rooted in estimates and/or partial snapshots based on ad-hoc surveys. The researchers involved in this project therefore call for a more standardized and rigorous approach including a taxonomy of green jobs/occupations and related skills. In this respect statistical departments of labour ministries or employment services are critical in updating the occupational taxonomies and collecting relevant data on green occupations. When additional activities using alternative tools are developed, they have to be complementary to the established system without duplication of functions.

Another main finding of this 'green' skills identification project is that combined with or in the absence of (quantitative) labour market information systems most countries tend to rely on qualitative methods such as enterprise surveys, sectoral analyses, occupational research, job analyses and consultations with experts. It is therefore advised to take advantage of the benefits of social dialogue, especially in the absence of established labour market information system, which should preferably take place at regional and local level as skills identification at these levels is more cost efficient and practical concerning organization and using its findings than a centralized approach. Another aspect emphasized is the fact that green activities often do not fit neatly in the existing sectors or value chains, demanding strong coordination of efforts across sectors and occupations, for example.[129] With regards to education, it was found that compulsory and general education have rather successfully integrated core sustainability skills into the curriculum, in contrast to informal, non-formal and vocational training. In other words, some attention in this study has been dedicated to individuals with a VET background.

---

[127] This section is mainly based on the following sources: (Inter-Agency Working Group on Greening Technical and Vocational Education and Training and Skills Development, 2013; Strietska-Ilina et al., 2011)

[128] Australia, Bangladesh, Brazil, China, Costa Rica, Denmark, Egypt, Estonia, France, Germany, India, Indonesia, Mali, Philippines, Republic of Korea, South Africa, Spain, Thailand, Uganda, United Kingdom and the United States.

[129] More detailed information can be found in two additional reports published in 2011 by the ILO and the EU about skills and occupation needs in 'renewable energy' and 'green building', respectively (ILO, 2011, 2011).

3. OECD – Skills Strategy framework[130]

The OECD has developed a Skills Strategy framework in order to help countries (especially governments) to "identify the strengths and weaknesses of their existing national skills pool and skills systems, benchmark them internationally, and develop policies for improvement" (OECD, 2012, p. 3). The framework consists of several instruments to analyse skills supply and demand of cognitive skills, social and emotional skills, and skills related to the interaction of cognitive, social and emotional skills such as creativity and critical thinking. The instruments give more attention to skill supply and the focus is on the analysis of the current situation and of past trends, i.e. it is more about skill identification than about skill anticipation. The methodology used is mainly qualitative and levels of disaggregation of output vary among instruments, however, results are always provided per country/economy as these are their main stakeholders. The information is purposely gathered as input mainly for education and training policies, labour policies and social policies, however, other policy fields are included as well, especially in the Education and Social Progress (ESP) project. Dissemination of results takes the form of workshops, publicly available reports and databases by means of the OECD website, amongst others. Some examples of other reports in which attention is paid to skills are the annual publications Skills Outlook, Education at a glance and the Employment Outlook. The main instruments of this framework will be discussed below.

With regards to identifying the skills supply, the OECD runs two research programmes. The oldest programme, the Programme for International Student Assessment or PISA, has been in place since 2000 and contains an international survey of 15-year old students that are questioned every three years in, currently, 70 economies about their abilities regarding reading, mathematics and science.[131] The aim of this survey is to assess to what extent students are capable of applying the knowledge they acquired in compulsory education to real-life situations and whether they are equipped for full participation in their respective societies.

In the same vein, the OECD launched the Programme for the International Assessment of Adult Competences or PIAAC in 2008 in which the skills of 16 to 65-year olds are assessed related to literacy, numeracy and information-processing skills (i.e. problem solving in technology-rich environments). The actual measurement instrument, the Survey of Adult Skills, has been applied to 40 OECD and partner countries: 5.000 adults have been interviewed in their homes in every participating country. The objective of this programme is helping countries better understand how their education and training systems can nurture the required key cognitive and workplace skills. The data generated by this programme is disaggregated by three educational attainment levels: lower than upper secondary, upper secondary and tertiary. It can be used by educators, policy makers and labour economists to develop suitable economic, education and social policies.

Both PIAAC and PISA have cognitive skills as their primary focus, whereas the social and emotional skills are at the heart of another OECD programme, the Education and Social Progress or ESP project. This project includes literature reviews, empirical analysis of longitudinal data and a review of policies and practices in OECD countries and partner economies and is directed at analysing the role of socio-emotional skills and developing strategies to raise them. Social emotional skills appear to have an effect on a variety of measures of individual well-being and social progress, such as education, labour market outcomes, health, family life, civic engagement and life satisfaction. Other results of this project show how policy makers, schools and families facilitate the development of

---

[130] This section is mainly based on the following sources: (OECD, 2012, 2015b, 2016), https://www.oecd.org/ pisa/home/, http://www.oecd.org/site/piaac/ , accessed May 11th, 2016.

[131] Every three years, the assessment includes a more in-depth assessment on one of these three subjects. Furthermore, in the latest assessment of 2012, some economies also participated in optional assessments of problem solving and financial literacy.

socio-emotional skills through intervention programmes, teaching and parenting practices. The next phase of this ESP project will be directed at enhancing the skills instruments so as to better understand the levels and developmental processes across countries and cultures.

The newest OECD activity when it comes to skills is the Anticipating and Responding to Changing Skill Needs Questionnaire, an instrument that has been co developed with Cedefop, the European Training Foundation (EFT) and ILO. This survey has an explicit policy orientation as shown by its objective of identifying "effective strategies among countries for improving skills governance and turning qualitative and quantitative information on skill needs into relevant action for policy" (OECD, 2016, p. 35). It therefore covers topics such as "the extent to which skills assessment and exercises influence labour market, education and/or migration policy; the involvement of key stakeholders including ministries of labour and education, local and regional authorities, employers and trade unions; any good practice and/or barriers which are encountered in using such exercises in policy development" (OECD, 2016, p. 35). The questionnaire has been sent to governments (Ministries of Labour, Education, etc.) and social partners (employer organizations and trade union confederations) of all 34 OECD member states.[132]

With regards to generating current or future skills information for individuals with a VET education, both PISA and PIAAC potentially can provide ample information because various skills are assessed and detailed questions are asked with regards to the respondents educational background. However, the information provided to the general public is rather aggregated: for example, the PIAAC results only specify skills scores for three levels of educational attainment, not for education types.

---

[132] Ministries and/or social partners of 29 countries responded: Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Netherlands, Norway, Poland, Portugal, Spain, Slovak Republic, Slovenia, Sweden, Switzerland, Turkey, United Kingdom and United States. The remaining OECD countries, Iceland, Israel, Luxembourg, Mexico and New Zealand did not return the questionnaire (OECD, 2016, p. 93).

IV. Use and dissemination of skills information

As mentioned in the previous chapter, many countries consider skills identification and anticipation exercises a useful input for their policy development. The extent, to which countries use the results of skills exercises and in what field of policy, is the topic of this chapter. The policy fields that will be discussed are employment policies, education and training policies, migration policies, social policies and development policies. Another topic that will be explored in this chapter is how countries disseminate the output of their skills exercises.
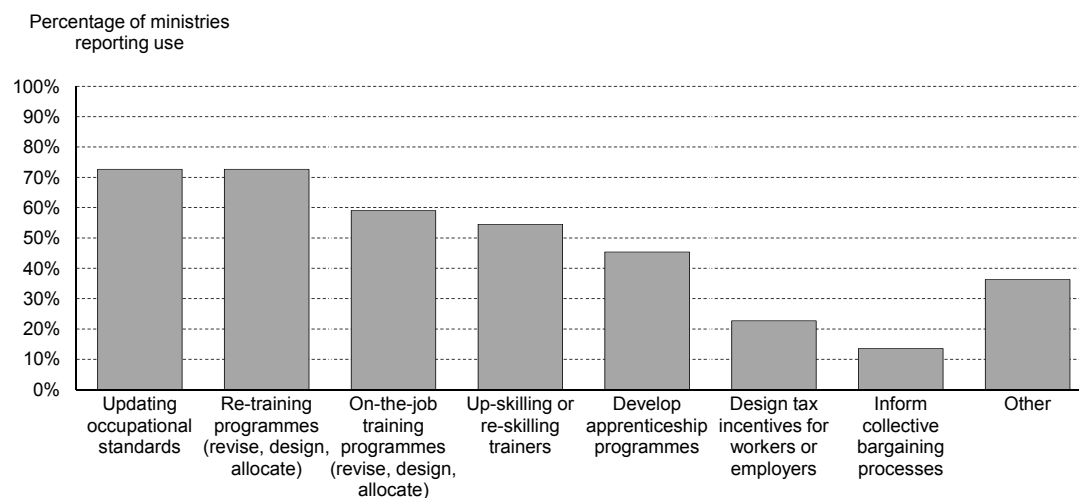
A. Employment policies[133]

The main policy field for which skills exercises provide useful input is that of employment policy. And, as can be concluded from Figure , information on current and future skills can feed into a broad range of topics of this policy field from updating occupational standards to inform collective bargaining processes. Almost three quarters of the 21 countries who use the output of their respective skills exercises for employment policy development do this to update occupational standards. Occupational standards, like the National Occupation Standards in the UK, "identify the skills, qualifications and experience required to perform an occupation" (OECD, 2016, pp. 56–57). These standards then create a blueprint for curricula and qualifications development, quality assurance and the development of employers' human development strategies.

Another main application of skills information in employment policy has to do with the revision, design and allocation of a variety of training programmes of like re-training programmes, on the job training programmes and apprenticeship programmes. Furthermore, more than half of the countries in this subsample use skill information also to (re)train the trainers. In Austria, Belgium and Estonia for example, unemployed individuals are actively stimulated by public employment services to retrain themselves for occupations which are high in demand. Noteworthy is that the Austrian public employment service is actually the driving force behind the AMS Qualification Barometer, the main instrument to identify current skill needs in Austria. France and Japan on the other hand use

---

[133] This section is mainly based on the following source: (OECD, 2016).

skills information to develop their on-the-job training programmes. Germany, with its extensive apprenticeship based education system, uses BIBB's[134] short-term forecasts to anticipate the need for apprenticeship places, while other countries "promote apprenticeships occupations and industries with greater demand for skilled labour" (OECD, 2016, p. 58) by directing funds towards these apprenticeship programmes.

Figure 4
Use of skills identification and anticipation exercises for employment policy
(Percentage of all Ministry of Labour responses)

Source: (OECD, 2016).
Note: Percentages based on 21 countries with at least one employment policy use reported (Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Japan, Korea, the Netherlands, Norway, Poland, Portugal, the Slovak Republic, Slovenia, Switzerland and the United States).

Just a few countries use skills information to shape tax incentives for employers or workers or to inform their collective bargaining processes (See Figure). Examples of tax incentives based on skills information can be found in Canada: the Canada Job Grant "supports workers and unemployed individuals to gain the skills and training they need to help fill available jobs" (OECD, 2016, p. 58) and participation in the Targeted Initiative for Older Workers[135] is now open to "communities with unmet demand and/or skill mismatches" (OECD, 2016, p. 59). Canadian Job Bank.

---

[134] BIBB is Germany's Federal Institute for Vocational Education and Training.

[135] The Targeted Initiative for Older Workers or TIOW helps unemployed workers typically aged 55 to 64, return to work. The federal initiative is cost-shared with the provinces and territories. It provides employment assistance services, such as résumé writing and counselling, and improves participants' employability through activities such as skills upgrading and work experience. Source: http://www.esdc.gc.ca/en/training_agreements/older_workers/index.page accessed June 8th, 2016.

B. Education and training policies[136]

Another policy field that uses skills information is education and training, and similar to employment policies, this information is used for quite a variety of topics (see Figure). Almost all (92%) of the 13 countries applying skills information in their education and training policies, do this in order to update, design and revise their qualifications or qualifications frameworks and curricula. Three quarters of these countries disseminate skill identification and anticipation information among students, their families and workers in order to inform them about where the best employment prospects can be found, frequently via web-based searchable databases like the Dutch Studiekeuze123 (https://www.studiekeuze123.nl/ accessed June 8th, 2016), the Australian Job Outlook (http://joboutlook.gov.au/ accessed June 8th, 2016) and the Finnish ForeAmmatti (https://www.foreammatti.fi/index accessed June 8th, 2016). In contrast, only half of the 13 countries in this sample use skill information to update career guidance or train advisors.

Figure 5
Use of skills identification and anticipation exercises for education policy
(Percentage of all Ministry of Education responses)
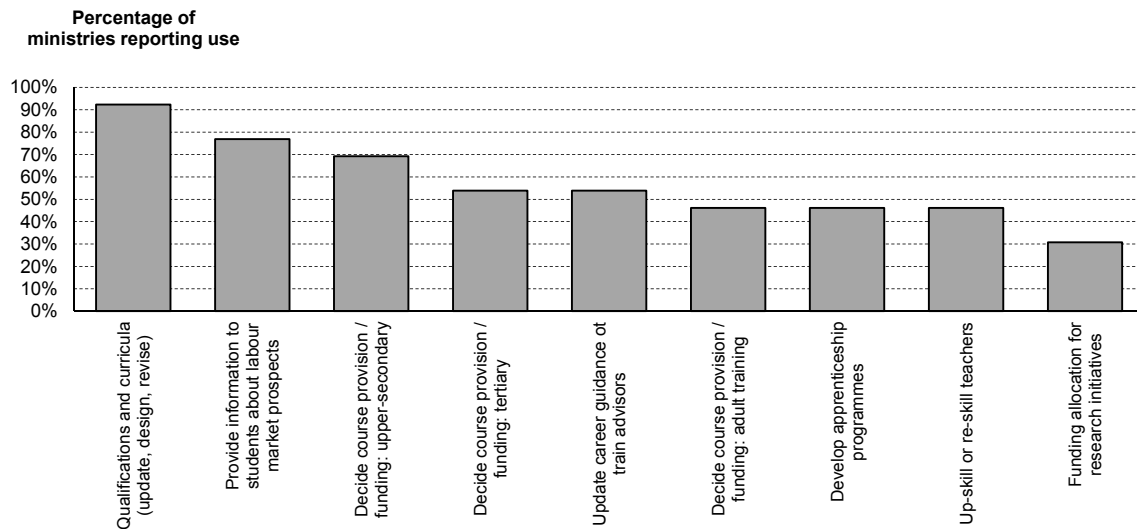
Source: (OECD, 2016).
Note: Percentages based on 13 countries with at least one education policy use reported (Austria, Belgium, Chile, Finland, Germany, Hungary, Ireland, Italy, Norway, Portugal, Spain, Sweden and Turkey).

Between half and two thirds of the countries, depending on the level of education concerned (upper-secondary, tertiary or adult training), base their decisions on how many places are offered to students and what the content of the study has to be on skills information. Several countries for example found that a shortage is looming of workers in the Science, Technology, Engineering and Mathematics or STEM fields. Norway responded with a "lifelong skills development strategy in STEM fields" (OECD, 2016, p. 59), New Zealand "increased university vacancies and reduced tuition fees for [STEM] related programs" (OECD, 2016, p. 59) and in the Netherlands several ministries joined forces with social and regional partners to stimulate students to enrol in one of the STEM fields.[137]

---

[136] This section is mainly based on the following source: (OECD, 2016).
[137] This initiative is called the Techniekpact. See for more information: http://www.techniekpact.nl/ accessed June 8th, 2016.

In several countries, the providers of postsecondary education perform their own skills exercises in order to adapt their offers to students like in Italy and Sweden. Furthermore, in Austria vocational post-secondary education providers have to show projected demand for each qualification if they want to receive accreditation for a new programme.

C. Migration policies[138]

Another application of current and future skills information can be found in migration policies of countries like Australia, Belgium, Canada, Denmark, Ireland, France, New Zealand, Sweden and the United Kingdom. Some of these countries produce lists[139] with occupations that are or will be in high demand. Examples of these lists are the Skilled Occupations List (SOL) in Australia, the Skill Shortage List (SSL) in New Zealand and the Labour Shortage List in Sweden. Immigrants who can fulfil these highly demanded occupations generally have to fulfil fewer requirements when applying for visas and/or can apply to long-term permits or even citizenship earlier than others.

In Australia, the Department of Education and Training provides advice to the Minister for Immigration and Border Protection on the composition of the Skilled Occupations List (SOL). SOL "identifies occupations that would benefit from skilled migration for the purpose of meeting the medium to long-term skills needs of the Australian economy" (https://www.education.gov.au/skilled-occupations-list-sol, accessed June 13th, 2016) and is updated annually. The list is composed by, firstly, shortlisting occupations that fit one or several of the following criteria: long lead time, high use, high risk and high information.[140] Secondly, the medium to long-term skill needs for each occupation selected in the first step are assessed using a wide range of indicators and input from various stakeholders.[141] If no surplus is expected for a shortlisted occupation, generally speaking, it will be included into the SOL.

The approach used by New Zealand is considerably different. Firstly, two lists are prepared using different criteria and serving different purposes.[142] The Immediate Skill Shortage List or ISSL lists occupations that are in shortage in particular regions in New Zealand and is used to evaluate temporary work visa applications.[143] The Long Term Skill Shortage List (LTSSL) on the other hand lists skilled occupations that are in sustained shortage all over New Zealand and is used in the Work to Residence instructions and in the Skilled Migrant Category.[144] Both lists are updated every six months and are based on suggestions and evidence provided by industry stakeholders like employer groups, trade unions and industry training bodies, amongst others.

---

[138] This section is mainly based on the following source: (OECD, 2016).

[139] Australia's SOL and New Zealand's SSL are discussed in detail in the following paragraph. For more information on the Swedish Labour Shortage List, see: https://www.migrationsverket.se/English/Private-individuals/Working-in-Sweden/Employed/If-you-are-in-Sweden/Visiting-an-employer.html and https://www.migrationsverket.se/download/18.23e76fe91505855cf762e35/1447860197285/MIGRFS+092015.pdf, both accessed June 13th, 2016.

[140] Long lead time refers to occupations with specialized skills that are acquired after extended education and training; High use refers to the fact that there is a good occupational fit between qualification and occupation; High risk means that not fulfilling these occupations imposes a considerable risk to the Australian economy and society; High information signifies that enough information is available to evaluate the first three criteria. (Source: https://www.education.gov.au/skilled-occupations-list-methodology accessed June 13th, 2016.).

[141] Indicators used are derived from labour force data, recruitment experiences of both employers and workers, outcomes of new entrants and student commencements and completions. (Source: https://www.education.gov.au/skilled-occupations-list-methodology accessed June 13th, 2016).

[142] In fact, there is a third list, the Canterbury Skill Shortage List (CSSL) which contains occupations in critical shortage in the Canterbury region following the 2010 and 2011 earthquakes. It draws on the occupations on the Immediate and Long Term Skill Shortage Lists (LTSSL) relevant to the Canterbury rebuild. (Source: http://skillshortages.immigration.govt.nz/ accessed June 13th, 2016).

[143] Source: http://dol.govt.nz/immigration/knowledgebase/item/1016 accessed June 13th, 2016.

[144] Source: http://dol.govt.nz/immigration/knowledgebase/item/1017 accessed June 13th, 2016.

D. Development policies

This section will focus on two fields of development that are relevant for many countries. Firstly, the transition to a greener economy, frequently also referred to as sustainable development and secondly, the transition to digital economy

1. Transition to a greener economy[145]

A considerable amount of countries use their skill identification and anticipation exercises as a tool in the transformation process towards a greener economy, although not every country has made this relationship explicit.[146] Several of these have been stimulated to do this by the Green Jobs Initiative, a collaborative project of the International Labour Organization (ILO), the United Nations Environmental Programme (UNEP), the International Organization of Employers (IOE) and the International Trade Union Confederation (ITUC). The idea behind this project is that "climate change and environmental degradation are jeopardizing the sustainability of many kinds of economic activity around the globe", however, "moving towards a greener economy is creating opportunities for new technologies, investments and jobs" (Strietska-Ilina, Hoffmann, Duran Haro, & Jeon, 2011, p. v). Anticipating which skills will be in demand due to a greener economy and which ones will become obsolete will provide countries with a powerful tool to execute this transformation as smoothly as possible. Research in 21 countries at various stages of development[147] showed that work needs to be done in order to achieve more "standardized and rigorous approaches for the preparation of taxonomies of green jobs and related occupations" (Strietska-Ilina et al., 2011, p. xxiii) i.e. what exactly are green jobs, for example. Another challenge is to adapt current skills anticipation instruments to include environmentally driven (changes in) competencies, qualifications, courses and curricula. Thirdly, skills exercises are often performed at sector-level (see the chapter 1 section about Sectors for more details), however, this can be quite challenging when green activities do not fit neatly into the traditional sectors. In those cases, "there is a great need for better coordination of labour market analysis and monitoring across sectors and occupations" (Strietska-Ilina et al., 2011, p. xxiv). An example of this appears in a related ILO-EU study of the renewable energy sector in 33 countries. This sector consists of five traditional sectors (wind energy, solar energy, hydropower, geothermal and bio energy), however, employment in renewable energy goes beyond these energy producing sectors as the renewable value chain also includes manufacturing and distribution of equipment, project development, construction and installation, just to name a few.

Another interesting example is the French Observatoire national des emplois et métiers de l'économie verte (National observatory for green economy jobs and skills) founded in 2010 in order to execute part of the Sustainable Development programme of the Ministry for Environment, Energy and the Sea.[148] The observatory's members include representatives of several ministries, statistics offices, research institutes, the public employment service, education and training institutes and regional VET organizations. This organization's main goal is to monitor "the sectoral and macroeconomic impact of the transition towards a greener economy, with special attention to its implications for jobs and skills" (OECD, 2016, p. 63). One of its members, the public employment service (Pôle Emploi) has studied

---

[145]   Main sources: (ILO, 2011; OECD, 2016; Strietska-Ilina, Hoffmann, Duran Haro, & Jeon, 2011).

[146]   OECD countries that have explicitly linked the results of their skills exercises to a transition towards a greener economy are Austria, Belgium, France, Germany, Greece, Hungary, Ireland, Italy, Norway, Portugal and Turkey (OECD, 2016).

[147]   The countries included are Australia, Bangladesh, Brazil, China, Costa Rica, Denmark, Egypt, Estonia, France, Germany, India, Indonesia, Mali, Philippines, Republic of Korea, South Africa, Spain, Thailand, Uganda, United Kingdom and the United States (Strietska-Ilina et al., 2011).

[148]   Source: http://www.developpement-durable.gouv.fr/L-observatoire-national-des,18551.html#2 accessed June 17th, 2016.

"the supply and demand for green skills to create programmes to up- or re-skill jobseekers to better meet the requirements of this transition" (OECD, 2016, p. 64).

2. Transition to a digital economy

Another long-term development that affects a great number of countries is the digitalization of their economies. Similar to what has been discussed in the previous part about the transition to a greener economy, the transition to a digital economy will "change the skill needs in occupations directly related to the ICT sector as well as those unrelated to the ICT sector" (OECD, 2016, p. 63). Skills identification and anticipation exercises can help with this transition by "reducing job displacement and ensuring the skills needed in these transitions are available in the labour market" (OECD, 2016, p. 63). Examples of countries that include the transition to a digital economy in their regular skills exercises can be found in Europe[149] and in Canada. A couple of them will be discussed in more detail hereafter.

Recently, Germany has produced the results of an ad hoc foresight exercise that looked into the potential impacts of digitization on labour and employment in Germany over the next fifteen years exploring six different scenarios (Landmann & Heumann, 2016). The effect of the digitization on skills needs plays an important part in this exercise. A few months later another forecast was published in which the qualitative and quantitative effects of digitization under ongoing digitization and accelerated digitization have been investigated with regards to occupations, qualification requirements and formal education (Kurt Vogler-Ludwig, Nicola Düll, & Ben Kriechel, 2016). A couple of years earlier, a study into the need for high level ICT skills for 2013-2018 took place in Ireland (Forfás & EGFSN, 2013). The results of this study have led to a revision of the ICT Skills Action Plan for which representatives of several ministries, of the educational sector and the industry have formulated specific actions to achieve a much needed increase of ICT graduates by 2018 in order to reach the overall objective of making Ireland a global leader in ICT talent (Department of Education & Department of Jobs, Enterprise and Innovation, 2014). Around the same time, the Norwegian government discussed the Digital Agenda for Norway that included actions on how to improve advanced ICT competences based on skills needs projections of Statistics Norway that showed an increased demand towards 2030 for highly qualified technology specialists (Norwegian Ministry of Government Administration, Reform and Church Affairs, 2013). Canada has included occupations related to the digital economy into COPS[150] and an expert panel has examined how well prepared Canada is to meet future skill requirements in science, technology, engineering and mathematics (STEM) (Council of Canadian Academies, 2015). And recently, in 2016, *France Stratégie* has organized a series of debates about "Technological changes, social changes" bringing together experts from various fields to discuss the impact of emerging technology on employment and public policy.[151]

E. Social policies

Skills demand and supply information can also be used for a wide array of social policies as it show where skills shortages and mismatches currently are or might arise in the future. One can think of social policies regarding demography, youth, social inclusion, care policies, social assistance and pensions for example.

In case of present or expected shortages of certain skills, there are a number of sources of skills supply one could tap into: women, elder workers, youth and the remaining inactive part of the

---

[149] These countries are Austria, Belgium, Denmark, France, Hungary, Ireland, Italy, Norway, Portugal and Turkey (OECD, 2016).

[150] See chapter 4 for more information about COPS or the Canadian Occupational Projection System.

[151] This series of debates is called "Mutations technologiques, mutations socials" and more information can be found here: http://www.strategie.gouv.fr/mutmut accessed July 30th, 2016.

workforce. The labour participation of women with children will increase when they (re-)enter the workforce or work more hours, which can be achieved by providing compensation for day care and other child benefits for example. The labour participation of older workers increases when they postpone retirement or work more hours which can be stimulated by providing tax incentives, changing the retirement age, reducing pensions and ensuring that the older worker's tasks fit his or her physical and mental abilities and that these tasks foster the knowledge transfer from the older worker to other colleagues. Increasing young people's participation in the labour market in case of skill shortages requires development of policies that enable youngsters to enter the labour market with the demanded set of skills, for example by sending them to the right education and training program. In case of skills shortages it is even more important to develop policies that are directed at individuals who are inactive in order to stimulate them to become active through for example job coaching, education and training, compensation of work related costs, mobility enhancement, etc.

Another aspect of skills that can foster social policies is the fact that studies have shown that the development social and emotional skills are beneficial from a labour market participation perspective as jobs in todays and especially tomorrow's world do not require solely cognitive skills anymore (OECD, 2015b). However, possessing social and emotional skills is also beneficial for an individual's health, relationships and civic engagement (OECD, 2015b).

F. Dissemination of skills information

As can be concluded from the previous discussion about the development and execution of skills exercises, determining the results and developing an adequate response to these results, that skills information has a large number and variety of (potential) end users such as government policy makers in different fields and at various levels, social partners, education providers, sector organizations, public employment services, learners, families of learners, job seekers and immigrants.

This variety makes it a rather challenging task to provide the skills information in such a way that it satisfices the need of this wide variety of users and that the information reaches them. Generally speaking, most skills exercises' results are disseminated by means of reports, publicly available through organizational websites, sometimes accompanied by searchable databases or original data output files. Some countries use skills information as input for their occupational profiles database. Public media are used to attract attention to the skills publications via press releases, Twitter messages[152] and media appearances on TV and radio, for example. Lastly, skills information is spread in a face to face manner via workshops, seminars and conferences aimed at experts and/or policy makers representing various stakeholders. The various ways of dissemination of skills information will be discussed in more detail below with several examples.

1. Reports

All cases discussed in chapter III, publish reports on their websites, that include at least the general results for several broad categories with regards to occupations, sectors, skill levels. This is the case for the EU-wide results developed by Cedefop and various skills exercises by the OECD: more detailed, i.e. more disaggregated, data is only available to Skillsnet Members or OECD project members.[153] Cedefop for example publishes short country reports that include future skill supply and

---

[152] The Dutch ROA publishes the results of its skills exercises via its Twitter account:https://twitter.com/ROAMaastricht.

[153] A similar situation occurs in the Netherlands where two online databases are available: the AIS Open Access providing information on aggregated levels of education and occupation and the AIS Restricted Access having information on detailed levels of education and occupation, but only accessible for the project funders. https://roastatistics.maastrichtuniversity.nl/.

demand for each EU member state.[154] Furthermore Cedefop runs Skills Panorama, a public information portal on skills and jobs in Europe including data, analyses, articles, events, and more.[155] The OECD distributes the skills information it generates via PIAAC, PISA and other national projects in various annual publications like Skills Outlook, Education at a glance and the Employment Outlook via its skills portal.[156] In the other national cases discussed, at least two reports are produced: one focusing on the results and the other one focusing on the methodological or technical aspects. An example of these are the labour projections in the UK for which the Working Futures main reports and the Working Futures technical reports are produced. The UK also produces reports for its four nations: England, Northern Ireland, Scotland and Wales. In some cases reports are the only source of information about skills as in the case of the French skills exercises Les metiers en 2022 and the ILO and EU Skills for Green Jobs report.[157]

2. (Searchable) Data

Frequently the reports are accompanied by detailed downloadable datasets and/or datasets that can be searched online. Examples of extensive downloadable datasets can be found in the UK. The results of its skills identification exercise the Employer Skills Survey (ESS) is provided in national toolkits which contain datasets for each of the four nations, furthermore, for England datasets are also provided for each local education authority (LEA) and local enterprise partnership (LEP)[158] and the results of the labour projections Working futures are disseminated via Workbooks and online datasets.[159] In contrast, data can be searched online for example in case of the results of the Cedefop's pan-European study consisting of three sets of results: the labour force (skills supply), the employment trends (skills demand) and the job opportunities (skill imbalances). For each of these sets, data can be filtered online by broad occupation, qualification and country[160]. The online Occupational Outlook Handbook presents detailed results for the USA. Occupations can be selected using filters for pay, entry level of education, on the job training, and projected number of jobs and growth rate[161]. A different perspective is taken in the Netherlands, where skills information feeds into the labour market prospects of education programs on a web portal designed for future students and their families to facilitate career and study choices.[162]

Instead of presenting the results in a uniform way, some countries have developed a multipurpose data portal that serves various end users. An example of this is the Canadian Job Bank.[163] It is an internet based data-base that consists of several sections each serving a different user type: Job Search, Explore Careers and Career Tool sections for individuals looking for a job or education program, the Employers section for employers with vacancies and a Job Market Trends section for policy makers, journalists, etc. In the Explore Careers section one can look up occupations in certain locations and find out the number of available jobs, the wages paid, the occupation's outlook and job requirements, or look at the labour market perspectives of a specific education program. Finally, in the Skills and Knowledge sub section, one can find fill out a Skills and knowledge checklist to explore jobs or career options that match one's skills and knowledge.[164]

---

[154] http://www.cedefop.europa.eu/en/publications-and-resources/country-reports/skills-forecasts.

[155] http://skillspanorama.cedefop.europa.eu/en.

[156] http://www.oecd.org/skills/.

[157] See chapter III for full reference to sources.

[158] https://www.gov.uk/government/collections/ukces-employer-skills-survey-2015.

[159] https://data.gov.uk/dataset/working-futures.

[160] http://www.cedefop.europa.eu/en/events-and-projects/projects/forecasting-skill-demand-andsupply/data-visualisations.

[161] http://www.bls.gov/ooh/.

[162] https://www.studiekeuze123.nl/.

[163] http://www.jobbank.gc.ca/home-eng.do?lang=eng.

[164] Besides the federal Job Bank one can find the Job Future portals of Québec http://www.servicecanada.gc.ca/ eng/qc/job_futures/job_futures.shtmlandOntario http://www.tcu.gov.on.ca/eng/labourmarket/ojf/.

Alongside the Job Bank, skills information also feeds into the Canadian immigration programme as to determine eligibility for Express Entry into the Federal Skilled Worker Program (anyone with skills level O, A or B), Federal Skilled Trades Program (certain occupation groups at skill level B) and the Canadian Experience Class and this information can be searched for in a special website.[165] Related to the skills information used in the Canadian immigration programmes, is the searchable internet based Skill shortage list checker of New Zealand. It shows individuals if their occupation is needed in New Zealand and if so, getting a visa might be easier.[166]

3. Occupational data bases

Several countries have developed extensive occupational data bases consisting of detailed descriptions of various occupations ranging from nearly a hundred (France) to nearly a thousand (USA). Frequently, these descriptions include skills information required or found in the particular occupation. The most extensive by number of occupations (974) and the number of aspects described per occupation (300) is the American internet based searchable O*NET database. The description includes skills, knowledge, abilities and education (level and field) required, amongst others.[167] In Italy descriptions of 800 occupational groups based on the O*NET methodology have been developed including knowledge and skills, and the descriptions can be searched online.[168] In Canada, information regarding 500 occupations, including five skill levels, can be found in the National Occupational Classification (NOC).[169] And lastly the French 87 Familles Professionnelles (FAP 2009) for which the *nomenclature* includes qualifications.[170]

4. Workshop, seminars and conferences

The most interactive channel for dissemination of skills information are the face to face workshops, seminars and conferences. The USA[171] and Canada have been organizing skills summits for several years already and the OECD organized their first one this year in collaboration with the Norwegian government. The Canadian Skills and Post-Secondary Education Summit involves business, education, labour and policy leaders from all around the country,[172] while the OECD 2016 Skills Summit included the participation of 26 ministers from 15 countries and the European Commission.[173] In some cases, workshops, seminars and/or conferences are part of the skills information generation process, as is the case with the pan-European skills exercises and the Future of Work foresight study in the UK. Results and methodology are discussed internally and externally for validation purposes.[174]

---

[165] http://www.cic.gc.ca/english/immigrate/skilled/apply-who-express.asp.

[166] http://skillshortages.immigration.govt.nz/ Australia has developed a similar list, the Skill Shortage List, but it is not interactive, which can be found here: https://docs.employment.gov.au/collections/skill-shortage-lists-0.

[167] http://www.onetonline.org/find/.

[168] http://fabbisogni.isfol.it/.

[169] http://www.cic.gc.ca/english/immigrate/skilled/noc.asp.

[170] http://dares.travail-emploi.gouv.fr/dares-etudes-et-statistiques/statistiques-de-a-a-z/article/la-nomenclature-des-familles-professionnelles-fap-2009.

[171] http://www.nationalskillscoalition.org/resources/events/2016-skills-summit.

[172] http://www.conferenceboard.ca/conf/education/default.aspx.

[173] https://skillssummit2016.no/.

[174] The list of events including internal and external dissemination events organized by Cedefop can be found here: http://www.cedefop.europa.eu/en/events-and-projects/projects/forecasting-skill-demand-and-supply/events.

V. Choosing and developing a suitable approach to skill identification and anticipation exercises: some aspects to consider

From the previous chapters, it is clear that a variety of approaches is used when it comes to identifying and anticipating skills demand and supply. To synthesize the previous analyses of the various approaches and how they work out in practice, this chapter will be focused on the aspects one should take into account when selecting and developing a suitable approach to skills exercises. These aspects are the research objectives, characteristics of the approaches themselves, stakeholder involvement, and resource availability.

A. Research objectives

A key factor in choosing and developing the right approach are the research objectives. What is it that one wants to know and then, how will the resulting skills information be used and by whom? To start with the first element, one should ask oneself if one wants to know what skills are needed versus how many individuals with a certain skill are needed, or both? In the first case, the approach should put more emphasis on qualitative methods, in the second case on quantitative methods and in case of the latter, both methods are equally important.

The second question in this respect is how wide or narrow in scope the skills information has to be. Does it need to give information about the country as a whole, only some regions or sectors, or a full picture of the country as a whole and of all separate regions and sectors? Information on the country as a whole is useful for policy makers on national level, but not so much for regional and sectoral policy makers and other stakeholders at these levels, especially when regions and sectors differ greatly from each other within a country. If resources such as data and time are limited, one could focus on one or more key sectors. However, as discussed in chapter I, if one wants to capture the full employment effect, one should include other sectors in the analysis as well to capture the indirect and induced employment effect apart from the direct employment effect in the focal sector.

The third question to be answered is about time: is one interested in the current situation or is information about the future preferred and in case of the latter, should it be the short, medium or long term future? Investigating the current situation generally has the advantage of higher data availability

and not having to deal with uncertainty. From a policy perspective however, skills information about the future is more useful, for example if one wants to direct VET students at secondary and tertiary level into certain fields of study that will provide them with the skills that are needed in the labour market by the time they graduate. The longer the time horizon of a skills anticipation exercise is, however, the greater the uncertainties the exercise has to deal with and the less certain the results are. Uncertainties are for example related to will happen to such as factors as the labour productivity, price levels, supply constraints, technology, industry structure and occupational structure.

Another aspect with regards to time, is the frequency with which a skill exercise should be held. An ad-hoc exercise might generate useful information at that point in time, but will not be very useful as input for medium to long term policies and strategies. If the most up to date information is needed and one wants to register developments over time, skill exercises should be repeated regularly, as a rule of thumb: the shorter the time horizon of the exercise, the more frequent it should be held.

With regards to the second element, i.e. how the skills information will be used, firstly, one has to consider the policy field(s) that will use the information, which are usually related to employment/labour, education and training and migration. However, skills information can also provide useful input when formulating development and social policies. In case of development policies, several countries have applied skills exercises to figure out how a greener and/or a more digital economy affects the future demand for skills. With regards to social policies, one can think of policies aimed at stimulating labour participation amongst women, elderly or minorities. If skills information is requested as input for labour/employment policies, one will generally be more interested in skills related to certain occupations (labour/employment policy field) while for education and training policies skills related to certain education types (general versus vocational) or levels (secondary versus tertiary) will be considered more useful.

Not only the policy field, but also the type of end user of the skills information should be taken into account when developing skills exercises and also when the results are presented and distributed. As end users are not only (governmental) policy makers, but also for employers, trade unions, providers of education programmes, students to be and their families and researchers, data on current and future skills demand and supply can provide valuable information. One has to consider though that the information needed by each of these type of end users can differ considerably with regards to level of detail/disaggregation, scope, demand or supply data, interpretation, etc. It might therefore be hard to serve all these end users by one single skill exercise, one probably needs to combine several approaches and then one has to be careful in how the information is presented. In chapter III F some examples have been presented of how skills information can be presented, including to multiple end users using a single channel.

From the above, it could be concluded that the most suitable approach would be an all-inclusive approach in order to satisfy as many end users in a wide variety of policy fields, meaning including skills exercises that generate skills information on supply and demand of skills, about the current situation and in the future, and being repeated regularly. This would also mean generating aggregate nationwide data, but also detailed data per sector and region, and finally, skills information at occupation level and at educational level. However, as will be seen in the remaining sections of this chapter, such an approach is not realistic due to the high costs related to such an approach in combination with lack of resources, such as data, time, and/or human resources that often occur in practice.

B. Characteristics of methods and sources

Another important factor in choosing and developing a suitable approach to skills exercises are the characteristics of the various methods and sources themselves, as all have their strengths and weaknesses. In chapter I and III various methods and sources have been discussed and they can be roughly separated into qualitative and quantitative methods and sources. Both types have to start with the question of what skills to include and how to measure them. One can for example only include

cognitive skills or take a wider perspective and also include social and emotional skills or even the 21st century skills (see chapter I), both types are rapidly gaining importance in today's dynamic societies. Measuring skills directly is possible, see examples in chapter III, however it is a complex and costly task, therefore occupations and educational attainment (level, field and type) are used as proxies. When detailed occupational profiles are available, describing what skills are required for a certain occupation, and also what educational attainment (level, field, type) is required, the demand for certain occupations can be translated into the demand by skills and by educational attainment. In these cases, occupational demand can determined for individuals with a vocational education background, being secondary or tertiary.

Several qualitative methods and sources have been discussed in chapter I and these are mainly suited to address research questions that are mainly qualitative in nature, i.e. the 'what' questions with regards to skills. Furthermore, qualitative methods are used to complement quantitative analyses as qualitative methods can generate input data for quantitative analyses, they fill in gaps with regards to emerging occupations and skills, and they are used to validate results from quantitative analyses and provide a context. Qualitative methods are even more important in situations where the available data has gaps or is relatively old. When the data is available at high levels of aggregation only, added research is needed to transform data into useful information.

The quantitative methods discussed in chapter I on the other hand, are suited to answer research questions related to the quantitative aspects of skills, i.e. the "how many" questions. One of these methods strengths is based on the use of standard procedures, for example with regards to classifications of occupations, sectors, education or skills. In this way highly comparable data between sectors, occupations, education, skills and over time is generated. A possible weakness of using standard classifications is that these are "blind" to upcoming occupations and skills, however, as mentioned above, this can be compensated for by adding a qualitative approach. The output quality of quantitative methods is, amongst others, dependent on the quality of the data, i.e. whether the data are complete, recent, following standard classifications, etc. Data limitations might lead to results with rather high levels of aggregation, i.e. using only a few broad occupational or educational categories, or broad sectors, which reduces the usefulness of these data for end users. The data quality generally rises when a country possesses well developed statistical systems and when it performs skills research at sector level.

Various quantitative approaches have been discussed in the following order: input-output models, social accounting matrices and computable general equilibrium models (CGE). Generally speaking, one can say that CGE models are the most comprehensive and therefore provide most possibilities, i.e. more research objectives can be achieved by using them. For example, projections can be tested for alternative scenarios and the effect of policy interventions can be analysed. CGE models are also the most complex, making them less transparent and more difficult to explain to outsiders, such as policy makers. Furthermore CGE models have the highest requirements with regards to data, human resources and are the most expensive, especially when they have to be built from scratch. However, several countries have successfully adapted existing and proven models, such as the econometric models E3ME and MDM-E3 from Cambridge Econometrics, and by doing so, reducing costs and the time needed to have their models up and running.

The manpower requirement approach (MRA) has also been discussed a the most suitable option for occupational forecasting, which includes several of the previously described quantitative methods. By using occupational profiles, such as O*NET (see section I.0) which include skills and educational attainment information, occupational forecast results can be used as proxies for future skills demand, supply and imbalances and results can be linked to education type, level and even field of study. Occupational demand generally consists of expansion demand, which is demand related to growth of the economy/sector and replacement demand which is related to demand related to workers leaving due to retirement, death and migration. Being able to generate skills demand and supply numbers (via occupational demand and supply for example) is not enough for a successful match of these in order to calculate whether there is a surplus or shortage. One needs qualitative understanding

of 1) what the existing sources of skills are, which are core, and what are the alternatives if the core supply is insufficient; 2) whether the sources are flow (graduates of initial education and training programs) or stock (people who are already in the sector, another sector or unemployed); 3) what the competing destinations are, i.e. what share will each sector attract. The answers to these questions will depend on the sector and on specific (national) institutional arrangements. Gaining this understanding is resource intensive and the analyses of imbalances are rather complex, therefore it might be more feasible to analyse skills imbalances for certain key occupations only.

From the above, one can conclude that, dependent on the research objectives, various approaches can be considered suitable. However, overall, a mixed method approach, i.e. combining quantitative and qualitative methods and sources, will provide better and more comprehensive results.

C. Stakeholder involvement

In section 0 of this chapter it was mentioned that the research objectives will be influenced by the end users of skills information, in other words, the stakeholders of the skill exercises. However, the stakeholders influence goes further than this. As discussed in detail in chapter 0, the stakeholders should not only be involved in determining the research objectives of the skills exercise as part of the development phase, but they ideally also play a role in the subsequent phases of discussing the results and formulating an adequate policy response. Which stakeholders should be involved depends partly on the scope of the exercise: if the skill exercise is exclusively aimed at a certain policy field or sector for example (referred to as the *policy driven* approach), this requires different stakeholders than a skill exercise which is designed to generate information that should be useful for a wider public or several policy fields (referred to as the *independent* approach). High involvement by (a variety of) stakeholders can benefit all phases of the skill exercise process as the exercise can be developed in such a way that it perfectly fits the stakeholders' needs, that they understand the process and know how to interpret and use the results and therefore it is more likely that the generated results can be transformed into an suitable policy response. However, stakeholder involvement in all three phases should be coordinated well, as conflicting interests, changing priorities, lack of resources (time, amongst others) and lack of mutual benefits can be sources of potential conflicts between stakeholders, seriously diminishing the previously stated benefits. Successful coordination can be achieved by a variety of mechanisms that depend on the available institutions in a country such as participation in the governance of skills exercises, using an independent agency respected by all, formulating a national skills strategy and a legal framework which stipulates each stakeholders rights and responsibilities with regards to skills exercises. Which stakeholders should be involved, in what way and how coordination between different stakeholders can be achieved best, will depend on the specific country situation with regards to existing institutions, coordination mechanisms and social dialogue customs for example.

D. Resource availability

The methods discussed as well as the different ways of stakeholder involvement each have their own requirements with regards to resources. Therefore the availability of the resources required are also an important aspect to consider when selecting and developing skills exercises. An international study has shown that lack of resources is regarded as a serious obstacle in the development of skills

exercises.[175] One can distinguish several types of resources of which the most important ones are data, human resources and financial resources.

As has been mentioned in section 0, especially quantitative methods require huge amounts of data which should be of complete, up to date and classified in a standard way. This requires a decent statistical infrastructure and these differ between countries. In general, one needs more data (time series for example) for skills anticipation exercises than for skills identification exercises. In case of insufficient (quality) data, qualitative techniques can be used to compensate, however, only to a certain level. Another solution might be to identify or anticipate skills only for certain sectors, occupations or regions for which sufficient data are available.

A second category of resources are human resources: it requires individuals with specific knowledge and expertise to be able to use the various methods and sources correctly in order to generate trustworthy skills information: performing group interviews with experts requires different skills and knowledge than performing econometric analyses for example. As the number and quality of human resources with the required specific knowledge and expertise will differ between countries, before selecting a certain approach, one should be assured that the required human resources are available, if not, whether they can be trained in time or if not, one should consider hiring foreign experts. A last option is to choose an approach to skills exercises that might not meet all the research objectives but that at least fit the human resources currently available.
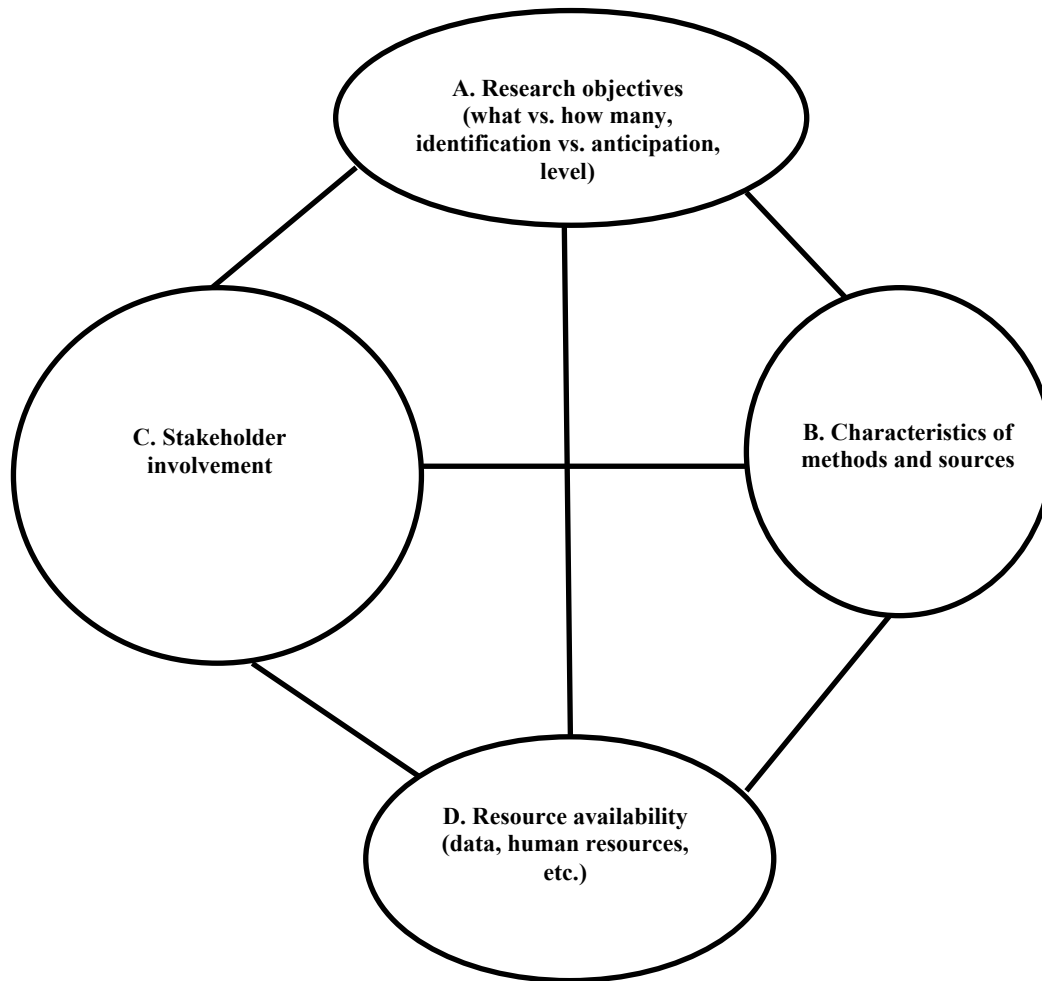
The final category to be discussed here are the financial resources needed. Setting up and especially maintaining a decent statistical infrastructure that is capable of delivering high quality data comes at a price for example. Also, educating individuals to equip them with the necessary skills and knowledge to gathering data, analyse them and interpret the results also comes at a cost. The same applies to assuring beneficial stakeholder involvement and its coordination. Furthermore, each of the quantitative and qualitative methods and sources described in chapter I and 0 have their own financial requirements. Data gathering methods can be made less costly by reducing sample size and the number of questions asked for example. However, this will possibly reduce the scope and quality of the research results. Methods themselves also differ: individual telephone interviews are more costly than a standard internet questionnaire. However, response rates, and depth of results will differ as well. Instead of gathering data specifically for a skills exercise, it is cheaper to use data gathered by others (vacancy information by public employment offices for example), however, they might need a makeover before they can be used.

Resource availability for each of the three categories described will for example depend on a country's level of development. To a certain extent, it will also depend on the priority that will be given to skills research, as a higher priority generally implies more resources will be made available. Priority might depend on one's understanding, from past experiences, of skills exercises and of what these can and cannot do. It is therefore important to ensure that skills exercises are performed in a reliable and accurate way from the very beginning, as a bad first impression is hard to correct in the future.

The four aspects discussed should be considered in conjunction with each other, as they are interrelated as shown in Diagram 3 For example, if certain stakeholders are highly involved, they are probably more willing to allocate sufficient resources to skills exercises. If specific resources are not available, certain research objectives are simply not feasible and lastly, the involvement of specific stakeholders will influence the research objectives desired. It is important to realize that choosing a suitable approach is generally a trade-off process as resources are not unlimited. How the trade-off is made will depend on the interests of the relevant actors. Past experience suggests however that is probably wisest to set up a less ambitious skill exercise that lives up to its promises and extend it later, making the best of the lessons learned along the way.

---

[175] See footnote 7.

Diagram 3
Aspects influencing a suitable approach to skills identification and anticipation exercises

A. Research objectives
(what vs. how many,
identification vs. anticipation,
level)

C. Stakeholder
involvement

B. Characteristics of
methods and sources

D. Resource availability
(data, human resources,
etc.)

Bibliography

Bureau of Labor Statistics, U.S. Department of Labor. (n.d.). Occupational Outlook Handbook, 2016-2017 Edition. Retrieved January 20, 2016, from http://www.bls.gov/ooh/.

Cappelen, Å., Gjefsen, H., Gjelsvik, M., Holm, I., & Stølen, N. M. (Eds.), (2013), *Forecasting demand and supply of labour by education*. Oslo: Statistisk sentralbyrå.

Castiglioni, C., & Tijdens, K. (2014), Skills and occupational needs: labour market forecasting systems in Italy, (142). Retrieved from http://dare.uva.nl/record/1/432278.

Cedefop (2012), *Building on skills forecasts - Comparing methods and applications*. Luxembourg: Publications Office of the European Union. Retrieved from http://www.cedefop.europa.eu/en/publications-and-resources/publications/5518.

———(2012), *Future skills supply and demand in Europe: Forecast 2012* (Cedefop research papers No. 5526). Luxembourg: Publications Office of the European Union. Retrieved from http://www.cedefop.europa.eu/en/publications-and-resources/publications/5526.

———(2012), *Skills supply and demand in Europe: Methodological framework* (Cedefop research papers No. 5525). Luxembourg: Publications Office of the European Union. Retrieved from http://www.cedefop.europa.eu/en/publications-and-resources/publications/5525.

———(2013), *Piloting a European employer survey on skill needs: Illustrative findings* (Research paper No. 36). Luxembourg: European Centre for the Development of Vocational Training (Cedefop). Retrieved from http://www.cedefop.europa.eu/node/11966.

Council of Canadian Academies (2015). *Some assembly required: STEM skills and Canada's economic productivity*. Ottawa (ON): The Expert Panel on STEM Skills for the Future, Council of Canadian Academies. Retrieved from http://www.deslibris.ca/ID/247031.

Del Carpio, X., Ikeda, Y., & Zini, M. (2013), *Lao PDR - Skills for quality jobs and development in Lao PDR : a technical assessment of the current context* (No. ACS6593) (pp. 1–202). The World Bank. Retrieved from http://documents.worldbank.org/curated/en/2013/11/19300212/lao-pdr-skills-quality-jobs-development-lao-pdr-technical-assessment-current-context.

Department of Education and Skills. (2016), *Ireland's national skills strategy 2025*. Dublin: Department of Education and Skills. Retrieved from http://www.education.ie/en/Publications/Policy-Reports/pub_national_skills_strategy_2025.pdf.

Department of Education, & Department of Jobs, Enterprise and Innovation. (2014), ICT Skills Action Plan: Government, Education and Industry working together to make Ireland a global leader in ICT talent 2014-2018. Dublin: Department of Education / Department of Jobs, Enterprise and Innovation. Retrieved from http://www.skillsireland.ie/Publications/2014/ICT-Skills-Action-Plan.html.

El Achkar, S. (2010), *A companion guide to analyzing and projecting occupational trends* (CSLS Research Report No. 2010–7). Ontario: Centre for the Study of Living Standards (CSLS).

ESDC. (n.d.). Canadian Occupational Projection System (COPS). Retrieved December 8, 2015, from http://occupations.esdc.gc.ca/sppc-cops/w.2lc.4me@-eng.jsp.

Forfás, & EGFSN. (2013), *Addressing Future Demand for High-Level ICT Skills*. Dublin: Expert Group on Future Skills Needs c/o Forfás. Retrieved from http://www.skillsireland.ie/Publications/2013/ Addressing-Future-Demand-for-High-Level-ICT-Skills.html.

France Stratégie, & DARES. (2015), *Les métiers en 2022* (Prospective des métiers et qualifications). Paris: Commissariat général à la stratégie et à la prospective. Retrieved from http://dares.travail-emploi.gouv.fr/dares-etudes-et-statistiques/etudes-et-syntheses/synthese-stat-synthese-eval/article/les-metiers-en-2022-prospective-par-domaine-professionnel.

González-Velosa, C., & Rucci, G. (2016), *Métodos para anticipar demandas de habilidades* (No. IDB-TN-954). Banco Interamericano de Desarrollo.

Honkatukia, J. (2013), The VATTAGE Regional Model VERM - A Dynamic, Regional, Applied General Equilibrium Model of the Finnish Economy. *SSRN Electronic Journal*. http://doi.org/10.2139/ssrn.2284665.

HRSDC. (2008), *Looking-ahead: a 10-year outlook for the Canadian labour market (2008-2017)*. Gatineau, Que.: Policy Research Directorate, Strategic Policy and Research Branch, Human Resources and Skills Development Canada.

Ignaczak, L. (2011), Projecting labour market needs in Canada: The COPS national model after 30 years. Presented at the Warwick International Symposium on Employment and Skills Forecasting, Warwick Institute for Employment Research. Retrieved from http://www2.warwick.ac.uk/fac /soc/ier/research/forecast/forecastingsymposium/agenda/draft_luke_ignaczak_warwick_cops.pdf.

ILO. (2011), Comparative analysis of methods of Identification of skill needs on the labour market in transition to the low carbon economy (Report). Retrieved from http://www.ilo.org/ skills/pubs/WCMS_166824/lang--en/index.htm.

———— (2011), *Skills and occupational needs in green building* (Report). Retrieved from http://www.ilo. org/skills/pubs/WCMS_166822/lang--en/index.htm.

———— (2011), *Skills and occupational needs in renewable energy* (Report). Retrieved from http://www.ilo.org/skills/pubs/WCMS_166823/lang--en/index.htm.

Inter-Agency Working Group on Greening Technical and Vocational Education and Training and Skills Development. (2013), *Meeting skill needs for green jobs: policy recommendations* (p. 10). Switzerland: International Labour Organization. Retrieved from http://www.ilo.org/wcmsp5/ groups/public/---ed_emp/---ifp_skills/documents/publication/wcms_234463.pdf.

International Labour Office. (2012), *International Standard Classification of Occupations 2008: ISCO-08. 1, 1,*. Genève: International Labour Office.

ITC-ILO. (2012), *European high-level meeting on skills anticipation in adult learning: Summary report of the meeting*. Turin, Italy: International Training Centre of the ILO. Retrieved from http://emsaal.itcilo.org/the-event/the-synthesis-report.

Klein, T. (2011, September), *Rationale and Uses: Lessons from French PMQ (Prospective de métiers et des qualifications) Exercises*. Presented at the International symposium on Employment and skills forecasting, Warwick. Retrieved from http://www2.warwick.ac.uk/fac/soc/ier/research/forecast/ forecastingsymposium/agenda/.

Kurt Vogler-Ludwig, Nicola Düll, & Ben Kriechel. (2016), Arbeitsmarkt 2030 - Wirtschaft und Arbeitsmarkt im digitalen Zeitalter - Prognose 2016. http://doi.org/10.13140/RG.2.1.5023.6407

Landmann, J., & Heumann, S. (2016), *Toward the labor market 4.0? Potential impacts of digitization on labor and employment in Germany until 2030*. Gutersloh / Berlin: The Bertelsmann Stiftung / stiftung neue verantwortung.

Lapointe, M., Dunn, K., Tremblay-Côté, N., Bergeron, L.-P., & Ignaczak, L. (2006), *Looking-ahead: a 10-year outlook for the Canadian Labour Market (2006-2015)* (p. 139). Quebec, Canada: Human Resources and Social Development Canada. Retrieved from http://nwolabourmarketinfo.ca/wp-content/uploads/2011/05/Looking_ahead.pdf.

ManpowerGroup. (2015), *2015 Talent Shortage Survey*. Retrieved from http://www.manpowergroup.us/ campaigns/talent-shortage-2015/.

Norwegian Ministry of Government Administration, Reform and Church Affairs. Digital Agenda for Norway - ICT for Growth and Value Creation, Pub. L. No. Meld. St. 23 (2012-2013) Report to the Storting (white paper) (2013). Retrieved from https://www.regjeringen.no/en/dokumenter/meld.-st.-23-2012-2013/id718084/.

OECD, (2012), *Better Skills, Better Jobs, Better Lives*. Paris: Organisation for Economic Co-operation and Development. Retrieved from http://www.oecd-ilibrary.org/content/book/9789264177338-en.

——— (2015a), *OECD Skills Outlook 2015: Youth, skills and employabiity*. Paris: Organisation for Economic Co-operation and Development. Retrieved from http://www.oecd-ilibrary.org/content/book/9789264234178-en.

——— (2015b), *Skills for Social Progress*. Paris: Organisation for Economic Co-operation and Development. Retrieved from http://www.oecd-ilibrary.org/content/book/9789264226159-en.

——— (2016), *Getting Skills Right: Assessing and Anticipating Changing Skill Needs*. OECD Publishing. Retrieved from http://www.oecd-ilibrary.org/employment/getting-skills-right-assessing-and-anticipating-changing-skill-needs_9789264252073-en.

Oxford Research. (2010), *Transversal Analysis on the Evolution of Skills Needs in 19 Economic Sectors*. DG Employment, Social Affairs and Equal Opportunities.

Quintini, G. (2011), *Over-Qualified or Under-Skilled* (OECD Social, Employment and Migration Working Papers). Paris: Organisation for Economic Co-operation and Development. Retrieved from http://www.oecd-ilibrary.org/content/workingpaper/5kg58j9d7b6d-en.

Researchcentrum voor Onderwijs en Arbeidsmarkt. (2015), *De arbeidsmarkt naar opleiding en beroep tot 2020*. Maastricht: Researchcentrum voor Onderwijs en Arbeidsmarkt. Retrieved from http://roa.sbe.maastrichtuniversity.nl/roanew/wp-content/uploads/2016/01/ROA_R_2015_6.pdf.

Shah, C., & Burke, G. (2005), Skills Shortages: Concepts, Measurement and Policy Responses. *Australian Bulletin of Labour*, *31*(1), 44.

Stormer, E., Patscha, C., Prendergast, J., Daheim, C., Rhisiart, M., Glover, P., & Beck, H. (2014), *The future of work: jobs and skills in 2030* (Evidence Report No. 84). London, UK: UK Commission for Employment and Skills (UKCES). Retrieved from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/303334/er84-the-future-of-work-evidence-report.pdf.

Strietska-Ilina, O., Hoffmann, C., Duran Haro, M., & Jeon, S. (2011), *Skills for Green Jobs: A Global View*. International Labour Organization. Retrieved from http://www.ilo.org/global/publications/ilo-bookstore/order-online/books/WCMS_159585/lang--en/index.htm.

The World Bank. (2010), *Stepping Up Skills for More Jobs and Higher Productivity*. Retrieved from http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTEDUCATION/0,,contentMDK:22640776~menuPK:4995933~pagePK:148956~piPK:216618~theSitePK:282386,00.html.

——— (2014), *STEP skills measurement surveys : innovative tools for assessing skills* (No. 89729) (pp. 1–104). The World Bank. Retrieved from http://documents.worldbank.org/curated/en/2014/07/19894104/step-skills-measurement-surveys-innovative-tools-assessing-skills.

Thomas, J. (2015), *Review of best practices in labour market forecasting with an application to the Canadian Aboriginal population*. Centre for the Study of Living Standards. Retrieved from http://www.csls.ca/reports/csls2015-16.pdf.

UNESCO Institute for Statistics. (2012), *International standard classification of education: ISCED 2011*. Montreal, Quebec: UNESCO Institute for Statistics. Retrieved from http://www.uis.unesco.org/Education/Documents/isced-2011-en.pdf.

Vivian, D., Winterbotham, M., Shury, J., Skone James, A., Huntley Hewitt, J., Tweddle, M., … Leach, A. (2016), *Employer Skills Survey 2015: UK results* (Evidence Report No. 97). London, UK: UK Commission for Employment and Skills (UKCES). Retrieved from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/525444/UKCESS_2015_Report_for_web__May_.pdf.

Vokes, C., & Limmer, H. (2015), *Sector insights: skills and performance challenges in the retail sector* (Evidence Report No. 95). London, UK: UK Commission for Employment and Skills (UKCES). Retrieved from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/466696/151008_Retail_SLMI_report_edited.pdf.

Wilson, R. (2013, October), *Forecasting skills supply and demand - Cedefop modelling approach*. Presented at the Expert seminar on Methodology and new ideas, Thessaloniki. Retrieved from http://www.cedefop.europa.eu/files/01_wilson_presentation.pdf.

Wilson, R. A., & Kriechel, B. (2010), Forecasting skill supply and demand in Europe: imbalances and mismatches - reconciling the demand for and supply of skills (Technical Report No. 8). Brussels: Cedefop.

Wilson, R., May-Gillings, M., Pirie, J., & Beaven, R. (2016), *Working Futures 2014-2024: Technical report on sources and methods* (Technical Report). London, UK: UK Commission for Employment and Skills (UKCES).

Wilson, R., Sofroniou, N., Beaven, R., May-Gillings, M., Perkins, S., Lee, M., … Leach, A. (2016), *Working Futures 2014-2024* (Evidence Report No. 100). London, UK: UK Commission for Employment and Skills (UKCES).

Winterbotham, M., Shury, J., Vivian, D., Skone James, A., Huntley Hewitt, J., Tweddle, M., … Glynn, T. (2016), *Employer Skills Survey 2015: Technical Report* (Evidence Report No. 98). London, UK: UK Commission for Employment and Skills (UKCES). Retrieved from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/525450/UKESS_2015_Technical_Report__May_.pdf.

Annexes

Annex 1

Diagram A.1
Overview of Cedefop model of demand for and supply of skills
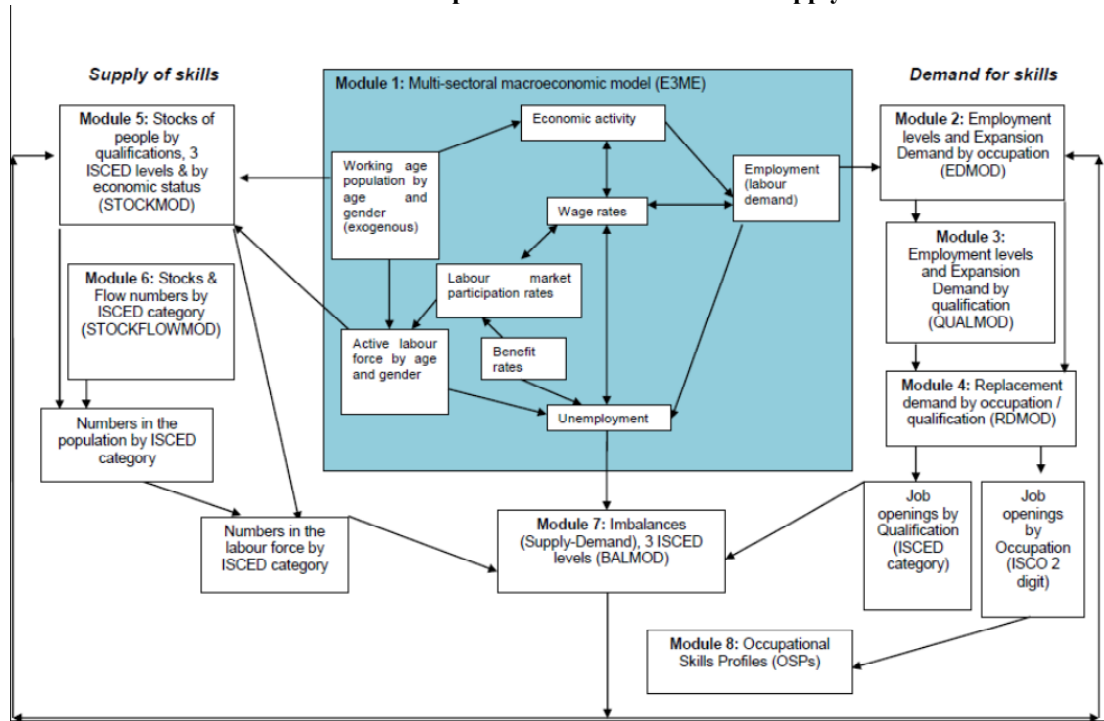
Source: (Wilson, 2013).

Annex 2

Employer Perspective Survey (EPS) - UK[176]

The EPS in its current UK-wide form has been performed in 2010, 2012 and 2014[177] by UKCES. It is based on an earlier survey introduced in 2004 by the Sector Skills Development Agency (SSDA). The survey aims to describe the employers' perspective on the skills system, both public and private. It therefore includes the following topics: employer interactions with colleges and universities through offering apprenticeships, work experience and vocational qualifications, employer behaviour in terms of recruitment, training, people development activities, and in terms of collaboration and networking with other employers. 18.000 individuals responsible for human resource issues at their business establishment were interviewed by telephone for this survey.[178] The EPS 2014 survey was based on its predecessor with revisions to reflect the changes in the skills and employment policy context, however, taking care of still being able to build time series using the results from previous EPS editions and the ESS. The survey results are mainly disaggregated by nation, sector and establishment size,[179] however, some results, considering recruitment for example, are reported by occupation and school type as well.[180] EPS output is presented in various reports, data tables and national toolkits which all freely available on the UKCES website in order to support policy development and evaluation in various areas. These areas are represented by the variety of stakeholders who are involved in the EPS via the Steering Group: the governments of all four nations[181] and furthermore the Department for Work and Pensions (DWP), the Department for Education (DFE), and the Department for Communities and Local Government (DCLG). The Steering Group oversees the design and execution of the ESP, for example, the changes in the questionnaire were done after consultation within this group and UKCES.

With regards to results concerning individuals at post-secondary VET level, these are not easily distinguished in this survey as it is mainly directed at the institutions in the skills system as opposed to individuals. An exception are the recruitment behaviour results that are disaggregated by school leaver type, however Higher Education leavers are combined with University leavers. Furthermore, the provision of work experiences and apprenticeships are discussed, which are relevant for individuals at post secondary VET level, however, the results are only broken down by nation, sector, establishment size and sometimes age. The latter could be indicative, however crudely, as the age categories applied are under 16-18, 19-24, and 25 and older.

---

[176] This section is based on (Shury et al., 2014a, 2014b) and https://www.gov.uk/government/organisations/uk-commission-for-employment-and-skills accessed July 7th, 2016.

[177] At the time of writing this report, UKCES launched the fieldwork for the 2016 edition of the Employer Perspective Survey.

[178] Population statistics were obtained from the Inter-Departmental Business Register (IDBR) of the Office for National Statistics (ONS) and the establishments were sourced from the Experian's National Business Database (Winterbotham et al., 2016).

[179] Four nations England, Wales, Northern Ireland and Scotland are distinguished; 12 sector categories based on two-digit Standard Industrial Classifications (SIC 2007) are used alongside a broad 6 category sector definition used in the UKCES Working Futures project; five size categories are used based on the number of workers in the establishment: 2-4, 5-9, 10-24, 25-99 and 100+ (Shury et al., 2014a).

[180] Nine specific occupations are used based on the one-digit Standard Occupation Classification (SOC) 2010 and education leavers are categorized as school leavers, Further Education leavers or University/Higher education leavers (Shury et al., 2014a).

[181] The four UK Governments are represented by members from the Department for Business, Innovation and Skills (BIS) for England, the Department for Employment and Learning Northern Ireland (DELNI), the Welsh Government and the Scottish Government (Shury et al., 2014b).

Diagramm A.2
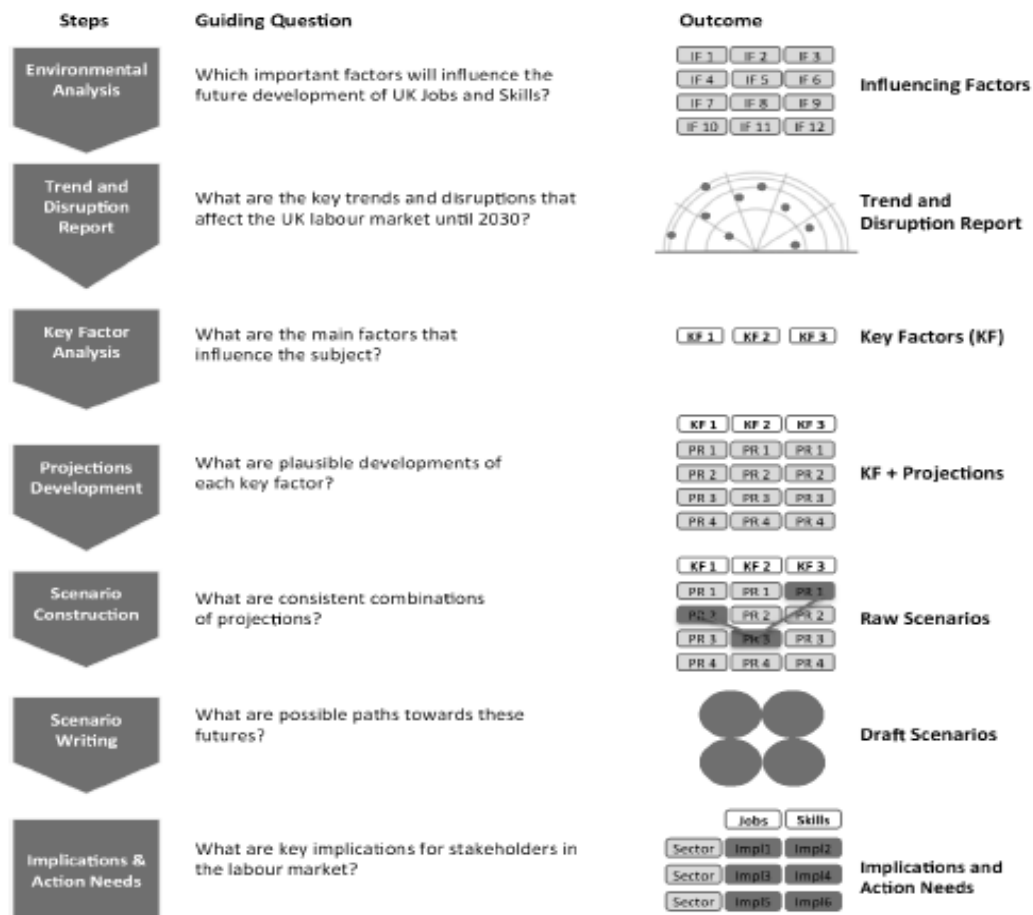**The Working Futures Models and Modules - UK**
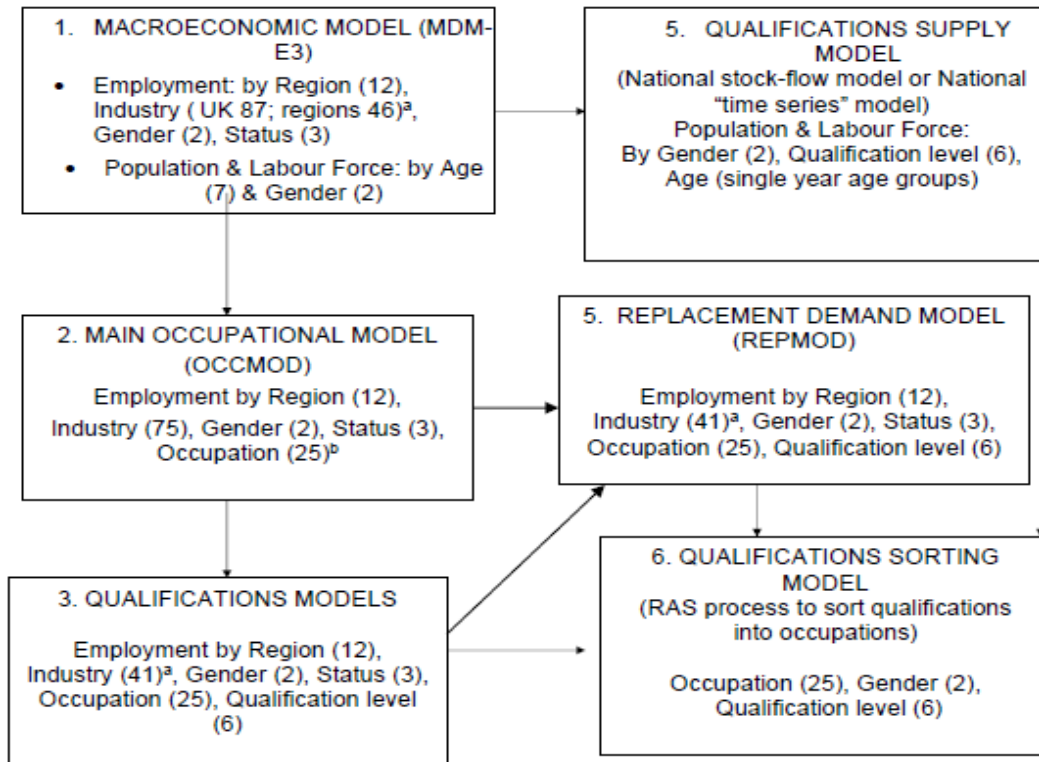
Source: (R. Wilson et al., 2016, p. 6).
Notes: These are extended to cover 75 industries defined in SIC2007.
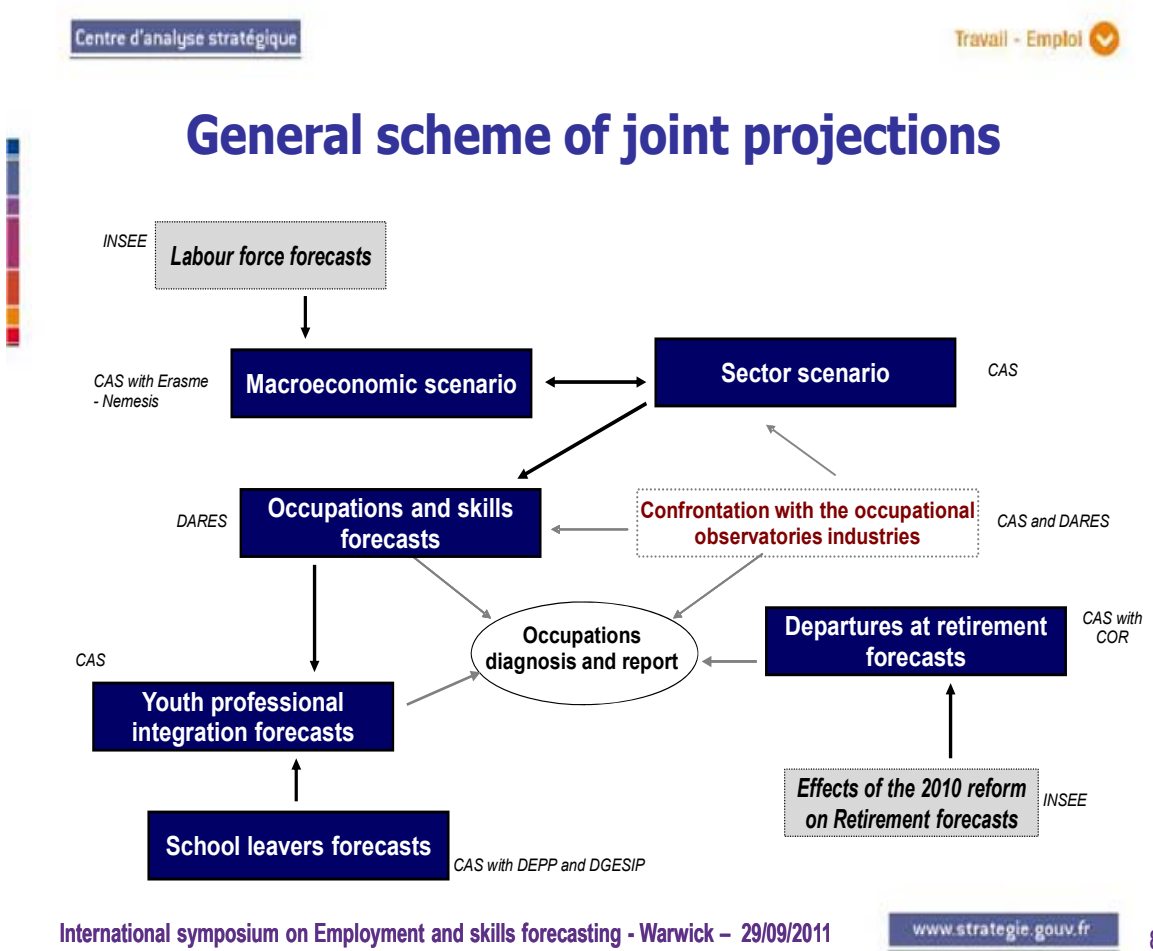   These are extended to cover 369 4 digit SOC2010 categories.

Diagram A.3
Analytical process of Future of Work foresight study – UK

Source: (Stormer et al., 2014).

Annex 3

Diagram A.4
Overview of elements of PMQ macro projections - France

Source: (Klein, 2011).

PROJECT
DOCUMENTS

Responding to the current skill needs or anticipating what skills will be demanded in the labour markets of the future requires the availability of reliable, accurate and updated labour market information. This document reviews some of the main issues related to the definition of skills and their measurement. It also summarizes some of the methods used in developed countries to identify and anticipate skill requirements and some of the methods proposed by international organizations. Many of the available quantitative and qualitative methods require a large amount of resources such as data, human resources and financial support. They also require the involvement of several stakeholders, not only from the central and local government but also from social partners, education providers, and sector skills councils, among others. Examples of the methods discussed are input-output models, computable general equilibrium models, the manpower requirement approach and qualitative methods such as informed opinion and specialist knowledge, employer surveys and scenario development. Selecting and developing the best feasible approach for skill identification and anticipation is a process in which various aspects have to be balanced. Lastly, the document reviews the policies on dissemination of this information as well as the main policy areas in which it is useful.