CHARLES UNIVERSITY IN PRAGUE
FACULTY OF EDUCATION
EDUCATION POLICY CENTRE

Occupational Skills Profiles: Methodology and application

Contribution to the concept, structure, and quantification of skill needs in Europe

In part delivery of Framework Agreement on Forecasting skill supply and demand in Europe (in response to open invitation to tender No AO/RPA/AZU-TODUN/European-skills-forecasts/009/08).
Task 10

Jan Koucký, Jan Kovařovic, Martin Lepič

July 2012

CEDEFOP
European Centre for the Development of Vocational Training

WARWICK INSTITUTE *for* EMPLOYMENT RESEARCH IER

cambridge econometrics
connecting you to the future

Alphametrics (AM)
*A*lphametrics Ltd

ROA

Preface and Acknowledgements

This report summarises some results from the Cedefop *Skillsnet* project on *Forecasting skill supply and demand in Europe* undertaken as part of the new *Framework Agreement* which extends over the 4 years 2008/09-2012/13.

These results from the project generally represent the result of a team effort, and reflect the contributions of all those working on it, including: Ilias Livanos and Derek Bosworth from IER; Terry Ward and Robert Stehrer from Alphametrics; Anthony Barker, Hector Pollitt, Unnada Chewpreecha and Jennifer Barton from CE; and Ben Kriechel and Jan Suerman from ROA. These all form part of the Core team responsible for producing the projections. In addition important contributions were made by the Country Group Experts (Pekka Tiainen, Catalin Ghinaru, Tim Grebe, Matthias Kirbach, Simonas Gausas, Haroldas Brozaitis). Jan Koucký and Martin Lepič also contributed to the review of sectoral studies and were responsible for the development of the methodology for Occupational Skills Profiles.

Thanks are also due to the various experts from individual countries who have taken time to review and comment upon the emerging findings

Rob Wilson (Project team leader)

This fifth expanded version of ***Occupational Skills Profiles: Methodology and application*** (EPC, July 2012) summarises the outcomes of our almost five-year conceptual, methodological and empirical work on this topic. It reflects comments and questions relating to its previous versions we have received personally or in writing during last months from our colleagues working on the project *Forecasting of skill supply and demand in Europe to 2020*. They have really been a great help to us.

However we are aware that a lot of work still has to be done. Not only because all important analyses have not been finished yet, but even more so because of new challenges, that could push our work significantly forward (f.i. by using the results of the OECD project PIAAC in our analyses). We hope therefore that it will be possible to continue our efforts also in the following years.

In the next stage of our work we would like very much to use all comments and recommendations that will reach our mail addresses. We will be most grateful for them as well as for any other suggestions.

Jan Koucký, Jan Kovařovic and Martin Lepič

About authors

Jan Koucký, Jan Kovařovic and Martin Lepič are from the Education Policy Centre (EPC), Charles University in Prague.

Jan Koucký – email: Jan.Koucky@pedf.cuni.cz

Jan Kovařovic – email: Jan.Kovarovic@pedf.cuni.cz

Martin Lepič – email: Martin.Lepic@pedf.cuni.cz

Contents

Abstract

The “Occupational Skills Profiles” (OSPs) approach developed in this study is intended to be a comprehensive and standardised way how to describe skill requirements of individual jobs and at the same time to link them with the macro-economic level.

Its aim is to bridge the information gap and provide essential characteristics required by the economy in terms of level and field of education and training, as well as other requirements concerning knowledge, skills, competence, occupational interests, and work values. OSPs of individual jobs can be aggregated further into a specific occupation/occupational group, sector, and even a whole economy of a country or of the European Union. Job requirements are not only defined, but also measured, are compatible with standard European statistics, and thus can be compared between sector, countries, and in time.

OSPs have been developed for analysing, projecting and forecasting skill needs; for determining and measuring education/skills matches and mismatches in different countries, sectors, or occupations; and for comparing and monitoring differences between European countries as well as for determining change over time, identifying past and future developments. However, they can also be used by all main labour market partners for matching the supply and the demand sides of the labour market.

Executive Summary

When examining available sources, we often find that existing information on skill requirements of occupations and/or on qualification – education and training attained and experience gained – of employment is fragmented, inconsistent, difficult or even impossible to compare across European countries, and usually not detailed enough to reflect the specific character of a given occupation. The Occupational Skills Profile approach aims at overcoming this situation by integrating several available European sources and by supplementing them with data gathered by sophisticated US surveys. This has been made possible by developing specific methods of data transposition and aggregation. As a result, skill requirements of occupations can be not only defined at a far more detailed level and further aggregated at higher levels as required but also compared across sectors, countries and in time.

Definition

In this study a comprehensive and standardised approach has been developed to describe requirements of an individual job – Occupational Skills Profiles (OSPs) – concerning education and training, qualification and personal qualities of prospective job holders. Their main advantage of the proposed approach is that job requirements are not only defined, but also measured, are compatible with standard European statistics (Eurostat), and can be compared between sectors, countries and in time.

An OSP summarises essential characteristics required for a given job: the level of education and training required (and hence the complexity of the occupation); the field of education and training required; and other main and supplementary requirements concerning knowledge, skills, competence, occupational interests, and work values.

OSPs of several specific occupations can be aggregated into OSPs of occupational groups, further into OSPs of sectors, then into OSPs of national economies, and finally up to Pan-European level. As they are focused on the number of jobs and their requirements, they represent the demand side of the future skill needs projections that can be easily compared with the supply side, that is with the results of standard projections (namely Cedefop projections) focused on the number and qualification of job holders.

Use

OSPs have been developed for analysing, projecting and forecasting skill needs; for determining and measuring education/skills matches and mismatches in different countries, sectors or occupations; and for comparing and monitoring differences between European countries as well as for determining change over time, identifying past and future developments.

Their application, however, can be far wider. They can also be used for preparing educational and training programmes, both school and enterprise based, for the choice of a concrete job or of the best way how to prepare for it. They can be used by all main labour market partners, as decision makers, employers, educational institutions, education and career consultants, and individual students and workers. As part of a wider information system containing not only job characteristics but also information on offer of various types of corresponding education and training, OSPs can become an important tool for matching the choice of education and training with the subsequent occupational placement at the labour market.

Construction

In order to be able to serve their key purpose at both European and national levels, OSPs have to be defined at such a level of occupational classification that allows identification of distinct, occupation-specific features adequately, while at the same time they can be transposed both to other classification levels and to other classification systems as necessary. Further, their characteristics are not only quantifiable and measurable, but they are regularly measured, that is they are supported by available statistics and data sets, allowing the creation of time series and identification of changes over time. And finally, they are consistent as far as possible with concepts, classifications, and instruments used in Europe, in particular with the ISCO classification of occupation, the NACE classification of industry, and the European Qualification Framework (EQF).

OSPs should be determined at the lowest level possible, where the job structure and job characteristics are sufficiently detailed and specific as to identify important differences between groups of jobs and make them sufficiently visible. At the same time they have to be supported by empirical data, still covered by statistics and handled in a comparable way across Europe. Both aspects are paramount – the choice of the most suitable level of classification, and the availability of empirical data at European level.

Aggregation

It is necessary not only to establish OSPs at a detailed level of individual occupations (occupational units) but also to aggregate them to higher levels as necessary. However, this is a quite complex (and also quite complicated) process. Any aggregation to higher levels of classification and the transposition to sectors cannot be realized by simply adding together the values determined at a lower, more detailed level of individual occupations. Their specificity would be lost, as a range of different values would be substituted by their average, and considerable differences in their distribution across sectors would not be respected.

A way how to maintain specific features of OSPs derived for individual occupations even after their aggregation to a considerably higher level, and overcome limitations and lack of comparable statistical data, has been found by taking into account their sector-specific occupational structure (that is different proportional representations of individual occupations in different sectors). The aggregation of OSPs determined at a more detailed level of occupations has to be sector-specific – that is, it is necessary to carry it out for each sector in question separately rather than across all sectors.

The reason is obvious: at higher levels of aggregation occupational groups contain several different occupations, the mix of occupations (their proportion, prevalence or domination) is different in each sector. Consequently there has to be a different, sector-specific OSP for each sector where the occupational group in question is represented, the number of OSPs being equal to the number of sectors concerned (that is it may be anything up to 38 sectors).

The sector-specific approach yields good proxy results that are much better than the results arrived at by using simple ways of aggregation (when only one qualification profile for any occupational group at the ISCO 3-digit level is used for all sectors). In this way, both crucial criteria could be met – the sufficiently detailed level of classification and the availability of data.

Sources

In order to find the way how to quantify OSPs, more than twenty of the most important surveys in Europe and outside of it (especially in the USA) have been examined and analysed. However, many surveys have no or only a very limited potential for use, and only six surveys

have passed a very exacting selection process assessing their availability, usability, accessibility and suitability, and could have been included into the common European model serving for the construction of OSPs: *European Social Survey ESS 1-5 (conducted during 2002-2011 in about 30 European countries), O*NET 2000-2011 (the USA), US BLS Education and Training Requirements Categories 1996-2012 (the USA), BIBB/BAuA Erwerbstätigenbefragung 2006 (Germany), Indagine sulle professioni 2007 (Italy),* and *Kvalifikace 2008 (the Czech Republic*).

The contents of OSPs, that is the sum of available data, has been taken thus from both European (e.g. the European Social Survey) and US (e.g. the O*NET) sources. The use of US data for constructing OSPs for European countries has been justified by a correlation analysis. Other minor sources have been used whenever possible.

Structure

The structure of OSPs is basically consistent with the European Qualification Framework (EQF). It has 7 dimensions forming 3 main groups. The first one, *Coordinating characteristics,* contains two basic dimensions:

1 The Level of Qualification Requirements. Its structure with eight levels of work complexity was originally taken from the EQF, where the levels are described by generally applicable descriptors, and later it has been aggregated into a three-level scale corresponding to other projections. Its contents was taken mainly from the ESS, but carefully balanced with other sources and approaches, as employee surveys, employer requirements (for example by Eures) and expert analyses.

2 The Field of Education/Training contains 14 groups of fields of education and training defined according to the International Standard Classification of Education (ISCED).

The second group, *Main characteristics,* contains three dimensions based on learning outcomes describing what the worker should really know, understand and be able to do (instead of a traditional focus on educational institutions and certificates):

3 Knowledge structured according the corresponding part of the O*NET model, but adapted to the ISCED structure.

4 Skills. Their structuring follows the EQF distinction between cognitive and practical skills, but is more detailed and includes relevant generic skills as defined by the EC (such as Communication both in mother and foreign languages, Numeracy and ICT skills, and Learning to learn).

5 Competence defined according to the EQF in terms of responsibility and autonomy, and further structured into three areas – personal, social, and methodological abilities.

The third group, *Supplementary characteristics*, focuses on the match between the job and the job holder. Both dimensions it contains are important for choosing the job.

6 Occupational Interests. This dimension links preferences for work environment to six distinct personality types. It can be used to describe both persons and work environment.

7 The orientation towards Work Values is important both for the satisfaction of the job-holder and for his satisfactory performance.

Results

An example illustrating the use of OSPs has been taken from the project *Forecasting of skill supply and demand in Europe to 2020.* OSPs have been calculated for each of 33 European

countries (EU27 countries and Croatia, FYROM, Iceland, Norway, Switzerland and Turkey) as well as for the EU27 as a whole, for each of 38 sectors and 37 occupations, and for three years – 2000, 2010 and 2020.

At a macro-economic level – that is for all jobs in the whole economy of the EU27 – the analyses have forecasted that all seven dimensions of the overall OSP would change from 2010 to 2020. As for the Level of Qualification Requirements, *average years of education required* are expected to increase by 0.12 years. The highest growth of employed is expected in the Field of Study *Economics, commerce, business and administration*; on the other hand, jobs in *Agriculture/Forestry* should decline the most. As for the three main characteristics, the highest increases are expected for Knowledge in *Engineering, Technology, Production and Processing* and *Health services*, for Skills in *Numeracy + basic SMT concepts* and *ICT/digital*, and for Competence in *Methodological abilities*. As for the two last dimensions, the highest increases are expected for Occupational Interests in the personality type *Enterprising*, and for Working Values in *Recognition* and *Achievement*.

Some analyses of three selected sectors (*Agriculture, Motor Vehicles, Health and Social Work*) showed and explained why their occupational structures and qualification requirements can differ so much in individual European countries. This can be caused, for example, by the role of subjective methodological and statistical approaches applied in these countries, it may be also caused by objective reasons, such as different overall orientation and technological level of the sector etc. Anyway all reasons mentioned above affect the resulting Occupational Skills Profiles of the sector in question.

Future development

Analyses have also shown that skill requirements may differ significantly not only in time, but also between individual countries analysed. In order to enable a more precise and usable international comparison of changing skills structures, it will be therefore necessary to modify the existing OSPs so as to be country-specific as well.

This will be achieved by using data collected for the OECD project *Programme for the International Assessment of Adult Competencies* (PIAAC) whose results will be available in autumn 2013. PIAAC assesses the level and distribution of adult skills in a coherent and consistent way across 23 countries. It focuses on the key cognitive and workplace skills that are needed for successful participation in the economy and society and required in a specific job identified by sector and occupation (in PIAAC Job Requirement Approach – JRA is applied). The size of the PIAAC database with more than 100 thousand respondents in employment is also very important.

Therefore the PIAAC data will considerably contribute to the further development of OSPs, particularly to their quantification at the level of individual countries (for all sectors and occupations and for each country). It may also bring a deeper understanding of mismatches between requirements of the labour market and actual qualification of employment. Equally important is the fact that it will be conducted in the United States as well. Its data will also serve to verify further the suitability of US data sources (particularly the O*NET) for determining qualification requirements in European countries, thus making OSPs even more robust.

1. Concept of Occupational Skills Profiles

Before describing Occupational Skills Profiles and explaining how and what for they can be applied it is necessary to clarify some fundamental concepts. The first sub-chapter is thus focused on defining the very concept of OSPs, explaining the underlying concepts of *job* and *occupation*, presenting an overview of international and national classifications of occupations and of international classifications of economic activities (sectors or industries). Further, basic requirements on data sources will be defined – their availability, usability, accessibility, and suitability, and six both international and national data sources described, crucial for the development of Occupational Skills Profiles. Finally, the degree of their consistency and comparability with other European concepts (as the European Qualification Framework) will be examined.

1.1 Definition

An *Occupational Skills Profile* (OSP) summarises essential characteristics required for a given job: the level of education and training required (and hence the complexity of the occupation); the field of education and training required; and other main and supplementary requirements concerning knowledge, skills, competence, interests and values.

In the context of this study, within the project *Forecasting of skills supply and demand in Europe*, Occupational Skills Profiles have been developed for analysing, projecting and forecasting skill needs for defining and measuring education/skills matches and mismatches in different countries, sectors or occupations, and for comparing and monitoring differences between European countries as well as for determining change over time, identifying past and future developments[1].

In order to do so, a complex process of transition from the macro-level of a national economy downwards to the level of individual jobs where OSPs are defined and then upwards to the macro-level again – that is of des-aggregation followed by aggregation – has been developed (see Figure 1). It begins by clarifying general economic relationships and factors of the labour market development, based on analysing industry and occupational structure of jobs and their mutual relationship. It goes on by defining vertical and horizontal dimensions of qualification requirements which characterise each job (as opposed to education which characterises the labour force). Then occupational skills profiles of specific occupations are determined by combining quantitative and qualitative approaches and assessments. Finally they can be aggregated into Occupational Skills Profiles of occupational groups, further into Occupational Skills Profiles of sectors, then into Occupational Skills Profiles of national economies, and finally up to Pan-European level.

[1] Details about Occupational Skills Profiles structure and its relationship to the core projections produced in the core project *Forecasting of skill supply and demand in Europe to 2020* are described in Chapter 2. The technical process how they have been generated is described in the Annex.

Figure 1.1: Labour market, job structures and qualification requirements

Their application, however, can be far wider. They can be also used for preparing educational and training programmes, both school and enterprise based, for the choice of a concrete job or of the best way how to prepare for it. They can be used by all main labour market partners, as decision makers, employers, educational institutions, education and career consultants, and individual students and workers. As part of a wider information system containing not only job characteristics but also information on offer of various types of corresponding education and training, Occupational Skills Profiles can become an important tool for matching the choice of education and training with the subsequent occupational placement at the labour market[2].

In order to be able to serve their key purpose at both European and national levels, Occupational Skills Profiles have to meet simultaneously certain specific requirements, which make them quite unique:

- they are defined at such a level of occupational classification that allows identification of distinct, occupation-specific features adequately, while at the same time they can be

[2] Similar information systems have been developed and employed particularly in the USA (f.i. see the latest version of the 2012-2013 *Occupational Outlook Handbook* linking information on individual occupations with that on opportunities how to attain the required education and training). Lately they have emerged also in Europe but they are usually fragmented, atomised and not linked into an consistent and effective system (see Occupational Outlook Handbook, 2012).

transposed both to other classification levels and to other classification systems as necessary;

- their characteristics are not only quantifiable and measurable, but they are regularly measured, that is they are supported by available statistics and data sets, allowing the creation of time series and identification of changes over time;
- they are consistent as far as possible with other relevant concepts, classifications, and instruments used in Europe, in particular with the ISCO classification of occupation, the NACE classification of industry, and the European Qualification Framework (EQF).

To meet all the requirements at the same time is not simple indeed. Many problems have to be dealt with including, in particular, problems how to define the appropriate level of classification, how to find usable and suitable data, how to transpose safely from one level and/or system of classification to another, and how to achieve reasonable consistency between conceptual frameworks and data sources coming from different sources.

1.2 Appropriate level of classification and availability of data

An Occupational Skills Profile of a specific individual occupation (sometimes the term occupational unit is used) sums up characteristics of all similar jobs, classified under the given occupation. At higher levels of classification, individual occupations are aggregated into corresponding occupational groups, thus representing all occupations with a certain degree of similarity reflecting the classification principle employed.

An Occupational Skills Profile makes sense only on condition that the respective occupational unit is not too broad, or in other words, it is still possible to take it as an individual occupation or a relatively homogenous group of occupations. Otherwise it would 'contaminated' by other occupations, and the resulting skill needs would come the closer to the average, the higher the level of aggregation. Hence Occupational Skills Profiles have to be elaborated at the level where the job structure and job characteristics are sufficiently detailed and specific as to identify important differences between groups of jobs and make them sufficiently visible, and at the same time when they are supported by empirical data. It is quite obvious that both aspects are mutually limiting – the more one is respected, the less the other one is met – and that a best possible trade-off has to be sought for. *Both aspects are paramount – the choice of the most suitable level of classification, and the availability of empirical data at European level.* This rather difficult proposition is central to the approach applied.

When choosing the level of the most suitable classification, we have to take into account the varying relationship between a job, an occupation and an occupational group at different levels of aggregation (see BOX 1).

BOX 1 Job/Occupation

A ***job*** ("a work place") represents a basic unit covering a certain set of work activities performed by one working person. Strictly taken, each job has a specific, slightly different Occupational Skills Profile. Nevertheless, there exist jobs with very or quite similar Occupational Skills Profiles and negligible differences. Those jobs then make up individual occupation.

An ***occupation*** (sometimes another term is used – "a profession") is then defined as a group of jobs with sufficiently similar characteristics to have one Occupational Skills Profile. Classifications of occupations are thus a means for grouping jobs by their similarity. Definitions of occupations vary in different countries, as well as classification systems are different.

For example, in the *USA* about 150 million of jobs in the labour market are classified. These jobs are described by 12 thousand of occupational titles and clustered into about one thousand individual occupations classified by the US Standard Occupation Classification System (SOC); their exact number is changing all over the time. Individual occupations are further clustered at several levels into still broader occupational groups (see f.i. US Department of Labor, 2010). The number of jobs and employed in all individual occupations classified by the SOC is monitored by the Occupational Employment Statistics (OES).

The new German classification KldB introduced in 2010 (see Bundesagentur für Arbeit, 2010) contains five levels, the most detailed one having more than a thousand of occupations, and identifying almost three thousand concrete jobs (*Berufs*).

The Polish Classification of Occupations and Specializations for Labour Market Needs KZiS is a national adaptation of the ISCO-08, introduced by the Minister of Labour and Social Policy in April 2010 (see MPiPS, 2010). KZiS is a hierarchical classification comprising five levels. In order not to lose the comparability with ISCO-08, the ambition has been to minimise the changes on the three highest levels.

The *Czech* Classification of Occupations (KZAM) was established in 1991 by adopting almost without a change all four levels of the international classification ISCO 1988, with about 500 groups of occupation. The Czech classification has gone beyond the 4th level of ISCO, supplementing it by the fifth more detailed national level consisting of about 3200 individual occupations. Also a quite recent classification of occupations in the Czech Republic CZ-ISCO introduced in 2010 CZ-ISCO follows the same principles**,** taking over the four levels of ISCO-08 and adding to them the fifth one (see ČSÚ, 2010).

Also the *Italian* classification of occupations, developed during the last decade as a part of the project *Indagine sulle professioni*, contains at the fifth classification level more than eight hundred basic (individual) occupations, all of them having their own Occupational Skills Profiles (see Istat, 2009). After five years the survey has been repeated by Isfol and Istat in (see Franceschetti, 2012).

Table 1.1 contains the overview of international and some national classifications, indicating the number of groups of occupation and occupational units at different levels of the classification hierarchy.

Table 1.1 International and National Classification of Occupations

Number of occupations or their group in the different level of classification

	ISCO		Germany	Poland	Italy	CZ	USA
	1988	**2008**	KldB 2010	KZiS 2010	2006	2010	SOC 2010
1 level	10	10	10	10	9	10	23
2 level	28	43	37	43	37	43	97
3 level	116	130	144	132	121	130	461
4 level	390	436	700	444	519	434	840
5 level	–	–	1286	2360	811	1362	1110

A decisive role is played by the classification system employed. The Eurostat database on occupations – as well as most comparisons of occupational structures between individual

European countries – is based on the International Standard Classification of Occupations (ISCO), (see BOX 2). As the ISCO-88 was used by the Eurostat till the end of 2010, and all available data have been based on it since the beginning of the 90s, it was adopted in this study for the construction of Occupational Skills Profiles.

Nevertheless, ISCO classification is limited to the 4-digit level with only about 500 occupational groups, and, most importantly, only about a third of European countries provides data at this level, while comparable data for most European countries are available only at the ISCO 3-digit level which defines rather broad occupational groups. It is not surprising therefore that their Occupational Skills Profiles are not clear-cut, as they include some quite similar but at the same time also some quite different occupations.

BOX 2 ISCO

The *International Standard Classification of Occupations 1988* (ISCO-88) is based on two main concepts: the concept of the kind of work performed or *job*, and the concept of *skill*.

Job – defined as a set of tasks and duties executed, or meant to be executed, by one person – is the *statistical unit* classified by ISCO-88. A set of jobs whose main tasks and duties are characterised by a high degree of similarity constitutes an *occupation*. Persons are classified by occupation through their relationship to a past, present or future job.

Skill – defined as the ability to carry out the tasks and duties of a given job – has, for the purposes of ISCO-88 the two following dimensions:

(a) *Skill level* – which is a function of the complexity and range of the tasks and duties involved; and

(b) *Skill specialisation* – defined by the field of knowledge, the tools and machinery used, the materials worked on or with, as well as the kinds of goods and services produced.

On the basis of the skill concept thus defined, ISCO-88 occupational groups were delineated and further aggregated at four levels:

1st ISCO level – major groups with 10 occupation group titles,

2nd ISCO level – sub-major groups with 27 occupation group titles,

3rd ISCO level – minor groups with about 110 occupation group titles,

4th ISCO level – unit groups with about 500 occupation group titles.

The ISCO 88 also contains a complete list of more than five thousand Occupational titles grouped under corresponding unit groups (at the 4th ISCO level).

In 2008 a new classification ISCO-08 has been introduced and since 2011 used for Labour Force Surveys in European countries. ISCO-08 is based on the same principles and constructed in the same way as ISCO-88. A new list of Occupational titles for ISCO-88 is under preparation. However, the project *Forecasting of skills supply and demand in Europe* has been naturally based on ISCO-88. The transition of OSP from ISCO-88 to the ISCO-08 will be one of most important objectives to be achieved in the next stage of our work.

Very important, however, is the fact that when adopting ISCO-08, many countries have also adopted and further applied its fifth level (and sometimes even the sixth national level). Some countries – although not adopting ISCO-88 – have constructed their new national classification so as to maintain the transferability of both classifications (among them the new British classification SOC 2010). This justifies our hope that the comparability of data coming from national classifications – so far quite limited – will markedly increase.

As an example a new Polish classification KZiS can be named that as well as the ISCO-08 is based on two main concepts. The concept of the kind of work performed – defined as a set of tasks or duties designed to be executed by one person – and the concept of skill, defined as the skill level – the degree of complexity of constituent tasks – and skill specialisation – the field of knowledge required for competent performance of the constituent tasks.

Four skill levels are defined at the most aggregate level, the major groups. These four skill levels are operationalised in terms of the educational categories and levels of the International Standard Classification of Education (ISCED 97). The use of the ISCED categories to define the skill levels does not imply that the skills necessary to perform the tasks and duties of a given job can be acquired only through formal education. The skills may be, and often are, acquired through informal training and experience.

It is very important to consider that European Labour Force Surveys (ELFS) identify each job not only by ISCO occupation, but also by sector (or *industry*),. For identifying sectors the Eurostat database uses the NACE classification (see BOX 3).

BOX 3 NACE

The *Statistical Classification of Economic Activities* in the European Community (NACE) Rev. 1.1 is the classification of economic activities corresponding to The *International Standard Industry Classification* (ISIC) Rev.3 at European level - though more disaggregated.

NACE Rev 1.1 is structured at four levels:

Level 1: 17 sections identified by alphabetical letters A to Q;

(an intermediate level: 31 sub-sections identified by two-character alphabetical codes);

Level 2: 62 divisions identified by two-digit numerical codes (01 to 99);

Level 3: 224 groups identified by three-digit numerical codes (01.1 to 99.0);

Level 4: 514 classes identified by four-digit numerical codes (01.11 to 99.00).

As the outcome of a major revision work of the international integrated system of economic classifications which took place between 2000 and 2007 the present NACE Rev. 2 (which is the new revised version of the NACE Rev. 1.1) has been introduced.

NACE Rev. 2 has been created based on ISIC Rev. 4 and adapted to the European circumstances by a working group of experts on statistical classifications from the Member States, candidate Countries as well as EFTA Countries, with the support and guidance of the classification section at Eurostat (European Communities, 2008b).

The transition from the NACE Rev.1 to the NACE Rev. 2 will be another major objective in the next stage of our work.

In Cedefop's forecasting the E3ME-CE model is based on the second level of classification NACE Rev.1.1, and the number of sectors has been reduced by different aggregations from 62 to 41. In this study we use the same classification but the number of sectors has been reduced to 38 due to data limitations. Aggregation concerns: Pharmaceuticals (10) and Chemicals (11); Electricity (22) and Gas Supply (23); Professional Services (36) and Other Business Services (37).

1.3 Finding suitable sources

The next important stage is to analyse main conceptual, methodological and empirical ways of determining skill needs in various countries. This stage is important from three aspects: (i) theoretical background and conceptual approaches to define elements of skill needs, grouping them into dimensions and linkages, and acknowledging the impact of external factors; (ii) methodological approaches to operationalise concepts (dimensions, elements) used for definition of skill needs; (iii) assessing data available suitability and usability for the new concept of Occupational Skills Profiles (OSP).

Should they be utilised for the construction of Occupational Skills Profiles, data sources (surveys) have to meet certain stringent stipulations. First, data from the survey have to be structured both by sector and by occupation. Second, occupations must be defined on the basis of the ISCO classification or on the basis of a classification convertible to the ISCO and sectors must be defined on the basis of the NACE classification or on the basis of a classification convertible to the NACE. Third, data from the survey must be quite robust and cover the bulk of the labour market.

In order to define and quantify Occupational Skills Profiles, more than twenty of the most important surveys in Europe, USA and OECD was considered. Many of them proved to have no or only a limited potential for use, and only few surveys have passed the selection process consisting of the following four steps.

1. *Availability*. All available documents, studies and other information (e.g. webpages) concerning the concept, methodology and survey in question have been thoroughly studied in order to find all necessary characteristics: what is its framework or conceptual model, main focus and scope, how is the survey conducted, whether it is periodical and at what interval it is repeated;, and how the information gathered generally fits into our theoretical and methodological concept. Only if the result of the first step has been positive, the second step has followed.
2. *Usability*. Data from the survey is analysed to determine how it would enlarge the empirical database of our project, whether and to what degree it can be mapped into a common European database, particularly what level of classification is used and whether it can be transposed to required levels of classifications used by the Eurostat – the industry classification NACE and the occupational classification ISCO (national classifications often cause problems). Again, only if results have been positive, the next step has followed.
3. *Accessibility*. Communication with experts of the country in question (or directly of the institution conducting the survey) has been established. Its objective has been to find out whether and under what conditions it is possible to obtain their data (sometimes they have been paid for) and also whether it is possible that those who had carried out the survey could assist us in solving problems mentioned in previous steps. Again, only if our negotiations have resulted in gaining access to the data, sometimes with some advice and recommendations, it has been possible to proceed to the final step.
4. *Suitability*. The final step consisted in thorough analyses of data obtained, of statistical behaviour of variables and of their role in the overall concept, of transforming national classifications to Eurostat classifications, and of including new data to the final empirical model. Also in this step the survey in question could have been abandoned when its previous positive assessments have proved to be too optimistic.

The following table (Table 1.2) indicates 25 selected surveys that have been examined and analysed.

Table 1.2 Examined and analysed surveys

	Name of the Survey	Years	Coordinator / Country	Availability	Usability	Accessibility	Suitability
International projects	IALS	1993	OECD	Yes	No		
	SIALS	1998	OECD	Yes	No		
	ALL	2005	OECD	Yes	Yes	No	
	PIAAC	2011-2012	OECD	Yes	Yes	*only 2013*	
	European Social Survey ESS 1-5	2002-2011	City University London	Yes	Yes	Yes	Yes
	CHEERS	1998	UNI Kassel	Yes	Yes	*partly*	
	REFLEX	2005-2006	UNI Maastricht	Yes	Yes	*partly*	
	HEGESCO	2008-2009	UNI Maastricht	Yes	Yes	*partly*	
	REFLEX 2010	2010	Charles Uni.	Yes	Yes	*partly*	
	Advertisements for job vacancies (Annualy)	2007-2012	EURES	Yes	*partly*		
National projects	Skill Survey	1997	Great Britain	Yes	No		
	Skill Survey	2006	Great Britain	Yes	No		
	BIBB/IAB-Erhebung	1999	Germany	Yes	No		
	BIBB/BAuA - Erwerbstätigenbefragung	2006	Germany	Yes	Yes	*partly*	Yes
	BIBB/BAuA - Erwerbstätigenbefragung	2012	Germany	Yes	Yes	*only 2012*	
	Kooperationsprojekt Absolventenstudien - KOAB	2010	Germany	Yes	Yes	*partly*	
	Absolventenstudie - ARUFA	2010	Austria	Yes	Yes	*partly*	
	Indagine sulle professioni	2006-2007	Italy	Yes	Yes	Yes	Yes
	Advertisements for job vacancies (NIVE)	1999-2010	Czech Republic	Yes	Yes	*partly*	
	Kvalifikace (EPC)	2007-2008	Czech Republic	Yes	Yes	Yes	Yes
	Uplatnění (NIVE)	2002-2003	Czech Republic	Yes	Yes	*partly*	
	Složitost práce (CAS)	2000-2005	Czech Republic	Yes	Yes	*partly*	
	Tarify (Trexima)	2008-2012	Czech Republic	Yes	Yes	*partly*	
	DOT	1950-1996	USA	Yes	Yes	No	
	O*NET	2000-2012	USA	Yes	Yes	Yes	Yes
	BLS	1996-2012	USA	Yes	Yes	Yes	Yes

Source: EPC

For instance, the large and periodical German surveys (*Erwerbstätigenbefragung. BIBB-IAB-BAuA*, 1978-2006, 2012), with about twenty thousand respondents, can be only partly used as their time series is not quite consistent due to changes in the questionnaires and only some characteristics (and some occupations, too) are comparable and can be used. Actually, only the latest survey of 2006 can be fully exploited[3].

The *British Skills Survey* (periodically conducted since the mid-eighties) is beset with even more problems: the transposition of the British classification SOC to the international classification ISCO is problematic, its consistency and hence comparability in time is not clear, the survey comprising only about six thousand respondents is not sufficiently robust for the ISCO 3-digit level. Moreover, surveys similar to those conducted in Britain up to 2006, will be most probably not repeated. On the other hand, it is important that some concepts used in British surveys have been applied also in the OECD project PIAAC, to be conducted in about thirty countries in 2011-2012 with international data available in the autumn of 2013.

[3] The data of the new 2012 survey will become available probably in 2014.

When the selection process described above has been completed (see Table 1.2), only the following six surveys have met all criteria and have been included into the model serving for the construction of Occupational Skills Profiles:

- *European Social Survey ESS 1-5 conducted during 2002-2011 (International)*
- *O*NET 2000-2011 (USA)*
- *US BLS Education and Training Requirements Categories 1996-2012 (USA)*
- *BIBB/BAuA Erwerbstätigenbefragung 2006 (Germany)*
- *Indagine sulle professioni 2007 (Italy)*
- *Kvalifikace 2008 (Czech Republic)*

The six surveys are briefly characterized in the following paragraphs. Although it has not been considered suitable for the purposes of this study, at the end of the chapter the potential of EURES database is also described.

European Social Survey ESS

The *European Social Survey* (ESS) has been an important source utilised for defining some of the main dimensions of Occupational Skills Profiles, the level and the field of education.

The European Social Survey (ESS) is a research programme of the European Science Foundation focused particularly on value orientation and the social structure of current European societies. Although the ESS is not primarily focused on skill needs and qualifications of job holders, it contains relevant information in this respect. Its major advantage is its continuing nature and opportunity to obtain data for relatively extensive samples of adult population within a wide age span, containing almost 200 thousands respondents in about 30 European countries. The ESS surveys take place every two years and five rounds have been implemented so far: the ESS-1 in 2002/2003, the ESS-2 in 2004/2005, the ESS-3 in 2006/2007, the ESS-4 in 2008/2009 and the ESS-5 in 2010/2011.

In terms of the identification of skill needs the most interesting stages were the ESS-2 and ESS-5, as both contain an additional special module, focused on education, qualification, work and employment. Only data coming from countries participating in the project as well as in the ESS-2 and ESS-5 have been used for the analysis. The ESS-2 and ESS-5 data set developed and analysed by the EPC for the purpose of this study covers nearly 100 thousand respondents from 20 European countries (Austria, Belgium, the Czech Republic, Denmark, Finland, Germany, Greece, Hungary, Ireland, Italy, the Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, and the United Kingdom).

The characteristics of the respondents (job holders) also included identification of the sector where they work in line with the 2-digit NACE/ISIC, and identification of the occupation performed according to the 4-digit ISCO, as well as the level of educational attainment (in most countries it is possible to define 6-8 comparable levels of education; some countries do not have all the levels), and the field of education (ESS surveys distinguish 14 fields of education & training defined on the basis of the ISCED classification).

In 2010, however, a new classification ES-ISCED was prepared which amalgamated existing distinct systems and defined new common educational levels. It was very carefully constructed using a very elaborate methodology (see Schneider, 2009) in a close contact with experts of individual countries. The new classification, applied in the ESS-5 and also used for

the re-classification of data gathered in in all previous surveys forming the ESS database, defines educational levels in various ways depending on how much detailed they are (compare the three columns in Table 1.3):

Table 1.3 Highest level of education, ESS – ISCED

Highest level of education, ESS - ISCED		
ELFS	**ESS-ISCED**	**ESS-ISCED subgroups (for ESS-5 only)**
Low	ES-ISCED I, less than lower secondary	Not completed ISCED level 1
		ISCED 1, completed primary education
		Vocational ISCED 2C < 2 years, no access ISCED 3
	ES-ISCED II, lower secondary	General/pre-vocational ISCED 2A/2B, access ISCED3 vocational
		General ISCED 2A, access ISCED 3A general/all 3
		Vocational ISCED 2C >= 2 years, no access ISCED 3
		Vocational ISCED 2A/2B, access ISCED 3 vocational
		Vocational ISCED 3C < 2 years, no access ISCED 5
Middle	ES-ISCED IIIb, upper secondary, vocational or no access V1	General ISCED 3 >=2 years, no access ISCED 5
		Vocational ISCED 3C >= 2 years, no access ISCED 5
		Vocational ISCED 3A/3B, access 5B/lower tier 5A
	ES-ISCED IIIa, upper secondary, genral and/or access to V1	General ISCED 3A/3B, access ISCED 5B/lower tier 5A
		General ISCED 3A, access upper tier ISCED 5A/all 5
		Vocational ISCED 3A, access upper tier ISCED 5A/all 5
	ES-ISCED IV, advanced vocational, sub-degree	General ISCED 4A/4B, access ISCED 5B/lower tier 5A
		General ISCED 4A, access upper tier ISCED 5A/all 5
		ISCED 4 programmes without access ISCED 5
		Vocational ISCED 4A/4B, access ISCED 5B/lower tier 5A
		Vocational ISCED 4A, access upper tier ISCED 5A /all 5
High		ISCED 5A short, intermediate/academic/general tertiary below
		ISCED 5B short, advanced vocational qualifications
	ES-ISCED V1, lower tertiary education, BA level	ISCED 5A medium, bachelor/equivalent from lower tier tertiary
		ISCED 5A medium, bachelor/equivalent from upper/single tier
	ES-ISCED V2, higher tertiary education, >= MA level	ISCED 5A long, master/equivalent from lower tier tertiary
		ISCED 5A long, master/equivalent from upper/single tier tertiary
		ISCED 6, doctoral degree

Source: ESS

The ESS-ISCED classification (second column of Table 1.3) has been adopted in this study. However, the seven levels as defined were supplemented with the eighth doctoral level (ISCED 6) indicated in the more detailed classification ES-ISCED subgroups (see the third column). Our new eight-level classification is closer to the new International classification of education (ISCED 2011). In some countries where the new classification has not been used,

exceptionally all levels – that is the entire classification of education – have been re-calculated.

O*NET

Analyses of various available sources have shown that the most suitable source of information about qualification and other skill needs is to be found in the US *Occupational Information Network (O*NET)*.

The Occupational Information Network (O*NET) is a comprehensive on-line system for collecting, organising and disseminating occupational data. It was launched in 1998 by the US Department of Labor, replacing the Dictionary of Occupational Titles (D.O.T.), developed more than fifty years ago and existing up to mid-nineties in a printed form. O*NET data inform of important activities in workforce development, economic development, career development, academic and policy research, and human resource management.

A new version of the O*NET database is usually published annually in late June. After some structural changes and the introduction of the version 5.0 in April 2005, data have been consistent, characteristics of about 750 individual occupations have remained quite stable, and they have been regularly updated – every year approximately 100-120 occupations. Thus it is possible to monitor and analyse their development and change. The O*NET 17.0 database, published in July 2012, represents the most recent update of the data collection program.

Table 1.4: O*NET Release History

O*NET Release History		
O*NET 98	October 1998	Release of the original 'Analyst Database' based on the Occupational Employment Statistical (OES) classification
O*NET 3.0/3.1	August 2000/June 2001	Database classification converted to conform to the new Standard Occupational Classification (SOC) standard
O*NET 4.0	June 2002	Release of the final 'Analyst Database' with a revised database structure consistent with the OMB-approved Data Collection Program
O*NET 5.0	April 2003	First update of database from Data Collection Program with a comprehensive update of 54 occupations
O*NET 5.1	November 2003	Occupational-level and item-level metadata added to the O*NET database
O*NET 6.0	July 2004	Second update of database from Data Collection Program with a comprehensive update of 126 occupations
O*NET 7.0	December 2004	Third update of database from Data Collection Program with a comprehensive update of 100 occupations
O*NET 8.0	June 2005	Fourth update of database from Data Collection Program with a comprehensive update of 100 occupations
O*NET 9.0	December 2005	Fifth update of database from Data Collection Program with a comprehensive update of 100 occupations
O*NET 10.0	June 2006	Sixth update of database from Data Collection Program with a comprehensive update of 100 occupations; release of the updated O*NET taxonomy - O*NET-SOC 2006
O*NET 11.0	December 2006	Seventh update of database from Data Collection Program with a comprehensive update of 101 occupations
O*NET 12.0	June 2007	Eighth update of database from Data Collection Program with a comprehensive update of 100 occupations
O*NET 13.0	June 2008	Ninth update of database from Data Collection Program with a comprehensive update of 108 occupations
O*NET 14.0	June 2009	Tenth update of database from Data Collection Program with a comprehensive update of 117 occupations; release of the updated O*NET taxonomy - O*NET-SOC 2009
O*NET 15.0	June 2010	Eleventh update of database from Data Collection Program with a comprehensive update of 120 occupations
O*NET 15.1	February 2011	Release of the updated O*NET taxonomy - O*NET-SOC 2010, based on the 2010 SOC standard
O*NET 16.0	July 2011	Twelfth update of database from Data Collection Program with a comprehensive update of 107 occupations
O*NET 17.0	July 2012	Thirteenth update of database from Data Collection Program with a comprehensive update of 108 occupations

Source: BLS

The two O*NET core elements are a content model and an electronic database fed by a data collecting program.

The content model[4] provides a framework for more than 400 variables describing about 1100 occupations based on the SOC. The descriptors are organised into six major domains, which enable the user to focus on areas of information that specify the key attributes and characteristics of workers (the first three domains) and of jobs (the last three domains), and are either cross-occupational or occupation-specific:

Worker Characteristics, comprising enduring characteristics that may influence both work performance and the capacity to acquire knowledge and skills, such as abilities, occupational interests, work values and work styles;

Worker Requirements, representing attributes developed and/or acquired through experience and education, such as work-related knowledge and skills, which are divided into basic skills and cross-functional skills;

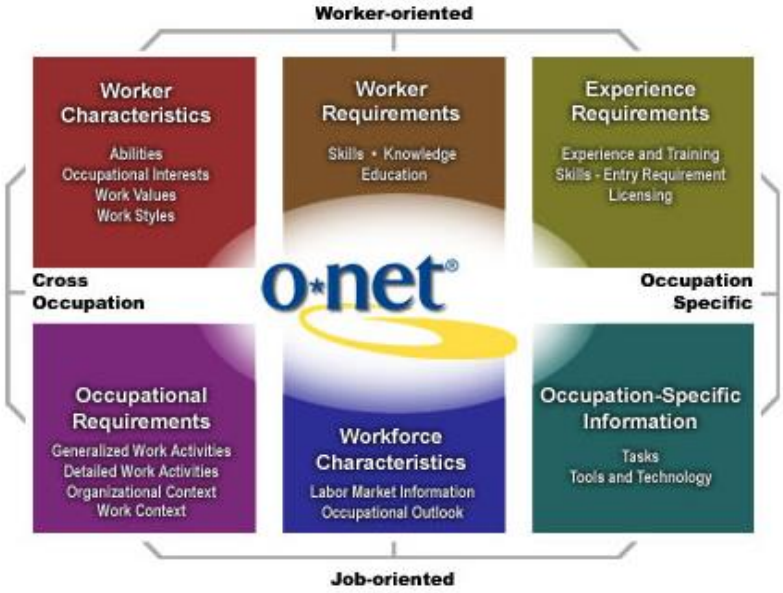
Experience Requirements, including information about the typical experiential background of workers including certification, licensure, and training data;

Occupational Requirements, describing typical activities required across occupations, as generalized and detailed work activities occurring on multiple jobs, plus contextual variables (factors physical, social and organizational);

Labour Market Characteristics, linking descriptive occupational information to statistical market information (including compensation and wage data, employment outlook and industry size information);

Occupation-Specific Information, applying to a single occupation or a narrowly defined job family.

Figure 1.2: The O*NET Content Model



Source: BLS

[4] More details at http://www.onetcenter.org/content.html

Although the O*NET has been used as a prime source for several characteristics, other sources have been used whenever possible. Among them two European surveys on occupation have closely followed the O*NET approach – the Italian survey *Indagine sulle professioni* and the Czech survey *Kvalifikace2008*.

US BLS Education and Training Requirements Categories

The Occupational Outlook Handbook, produced by the Office of Occupational Statistics and Employment Projections of the Bureau of Labor Statistics (BLS), gives detailed descriptions of the education and training requirements of about 750 occupations of the 2000 Standard Occupational Classification. Each of them is classified by education and training categories. This allows for estimates of the education and training needs for the population as a whole and of the outlook for workers with various types of educational and training attainment. Since 1994, this classification system has been used for all employment projections that are carried out by the BLS every second years, always following the publication of a new US BLS projection.

Up to the projection published at the end of 2009, the BLS identified 11 education and training categories defined as the most significant source of education or training needed to become qualified in an occupation, also including non-educational paths of entry, such as on-the-job training and work experience. By construction, these categories were intended to be mutually exclusive and exhaustive, and BLS economists and other experts in the topic were asked to assign each occupation to one of these categories based on their knowledge and judgment. In consequence, the system did not show that an occupation might have multiple entry requirements, both on-the-job training and education.

This system has proved confusing, as it combines different dimensions of education, training, and work experience in a related occupation into one classification system. For example, in some occupations both postsecondary education and a long-term on-the-job training are important, but in the existing system these are two distinct and mutually exclusive categories. Other examples are occupations where both education and work experience in a related occupation are important. Also, the system does not include any category for education below the secondary level[5].

At the end of 2011 a new system has been published, eliminating the aforementioned problems and presenting a more complete picture of the education and training needed for entry into a given occupation. All occupations are assigned an education category, a training category, and a related work experience category, and the education categories include both high school and less than a high school level[6]:

- *Entry level education* — represents the typical education level needed to enter an occupation. There are eight possible assignments for this category.
    1. Doctoral or professional degree
    2. Master's degree

---

[5] At the same time we have to be aware of the fact that American high schools are very different and have different goals than many various types of secondary education institutions in European countries.

[6] Detailed definitions for the categories are available at http://www.bls.gov/emp/ep_definitions_edtrain.pdf

3. Bachelor's degree
4. Associate's degree
5. Postsecondary non-degree award
6. Some college, no degree
7. High school diploma or equivalent
8. Less than high school

- *Work experience in a related occupation* — indicates if work experience in a related occupation is commonly considered necessary by employers for entry into the occupation, or is a commonly accepted substitute for formal types of training. Assignments for this category will be more than 5 years, 1-5 years, less than 1 year, or none.
- *Typical on-the-job training* — indicates the typical on-the-job training needed to attain competency in the occupation. Assignments for this category include internship / residency; apprenticeship; long-term, moderate-term, or short-term on-the-job training; or none.

Under the new system an education assignment for several occupations could be naturally different from the prior system. The new system assigns a *typical entry level education*, while the prior system assigned *the most significant source* of education or training. Therefore some occupations will have a different education level assigned than they did previously.

Some occupations could have more than one way to enter. The assignments under the new system describe the typical education needed to enter, and the typical type of on-the-job training required to be competent. The work experience in a related occupation assignment represents what is commonly considered necessary by employers or is a commonly accepted substitute for formal training. The three assignments complement each other in that they would represent a typical *path of entry* into the occupation, but they are not necessarily equal in importance for entry into the occupation.

BIBB/BAuA Erwerbstätigenbefragung (Germany)

Periodical employment surveys on qualification and working conditions have been conducted in Germany every 5-7 years since 1979 by the Federal Institute for Vocational Education and Training (BIBB). The last 2006 survey was conducted by the BIBB in cooperation with the Federal Institute for Occupational Safety and Health (BAuA). At present a new survey *BIBB/BAuA-Erwerbstätigenbefragung 2012* is under preparation; its data will be not available before 2013 a most probably even before 2014.

It was possible to have access to the database of all respondents of the last survey so far – *BIBB/BAuA Erwerbstätigenbefragung 2006* – that was focused both on the job and on the matching between current job skill requirements and respondent´s qualification. The representative sample of 20 thousand respondents was selected from employed persons over 15 years of age having a paid work for more than 10 hours weekly (this definition covers 96 % of active labour force). The size of the sample allowed differentiation by occupational groups and identification of diverse target groups (such as old-age, female, non-formally qualified workers).

The 2006 survey had four main research themes: activities and requirements of, and access to, jobs; changing a job, job flexibility; use of qualification attained, job satisfaction and success; participation in lifelong learning. Correspondingly, the questionnaire was structured into four parts: job characteristics (job tasks, job skills requirements, other specific requirements, work load, working conditions, health, employment status, wage, changes and innovation); job holder characteristics; (e.g. educational and career history); matching between the job and the job holder characteristics (i.e. to what degree does the job holder meets job requirements); and supplementary questions relating to the respondent and the firm.

Indagine sulle professioni (Italy)

The Italian Survey on Occupations was conducted in 2006-2007, and involved interviews with a sample of 16,000 respondents from the Italian working population in employment. Its final objective was to construct an information system capable of describing the characteristics of all existing occupations in the Italian labour market. A great advantage of the Italian survey lies in the fact that it was modelled on the O*NET system, thus making it possible to test the degree of similarity between the American O*NET and the Italian system (and in a lesser degree also the Czech survey *Kvalifikace*) and to verify the suitability of using the O*NET database for dimensions 3 through 7 also in the European context.

The survey is focused on measuring the importance and complexity level of about 400 variables for 810 individual occupations of a new occupational classification (derived from the official classification of the Italian Statistics Office) that can be transposed to the 3rd level of the ISCO classification of occupation. The questionnaire is divided into ten sections covering what is required of the worker to perform the job (education and training, occupation, knowledge, skills, abilities), what would affect his performance (aptitudes, values, work styles), and finally further characteristics of the job (transversal activities common to many different occupations, environmental conditions, specific activities not adequately represented in the questionnaire).

A new survey *L'indagine sulle professioni 2012*, again organised by Istat together with Isfol, will be carried out in 2012-2013.

Kvalifikace (Czech Republic)

An extensive survey on qualification was also conducted in the Czech Republic at the turn of 2007-2008 with a sample of nearly 6 thousand working active respondents. It followed upon a similar survey carried out in 2002-2003 and research into the employment situation of graduates implemented in 1997-1998 and again in 2011. It was informed by indicators used as part of the US O*NET and the British Skills Survey, and took account of questions used in the ESS-2 as well as of three EQF dimensions (knowledge, skills, competence). In the Czech Republic both regular surveys (f.i. the Czech LFS) and one-off research projects (f.i. the *Kvalifikace* project) use the valid ISSO classification of occupation for identifying the respondent´s job.

A substantial part of the survey *Kvalifikace* was concerned with qualification requirements for each job, the qualification of each job holder and the extent to which school education and other skills contributed to the acquisition of the qualification. The information about various aspects or dimensions of qualification requirements for a job includes some 30 characteristics and about 50 indicators. This is why it has been possible to use the survey *Kvalifikace* not

only for constructing dimensions 1 and 2 of OSPs, but – together with the Italian survey *Indagine sulle professioni* – also for testing the degree of similarity between the outcomes of the US O*NET and both European surveys, and thus to verify the suitability of the O*NET database for constructing dimensions 3 through 7 also in the European context.

EURES database and further potential sources

Besides sources already mentioned that all can be classified as *employee surveys* and/or as *expert surveys*, also *EURES* data sets coming under the category of *employer requirements* have been analysed.

The European Job Mobility Portal *EURES* (*European Employment Services*) was set up at the European Commission in 1993. Its partnership includes public employment services, trade union and employers' organisations. Its main function is to advertise vacancies entered into the system by employers, its main objectives are to inform, guide and provide advice to potentially mobile workers on job opportunities as well as living and working conditions in the EEA, to assist employers wishing to recruit workers from other countries and to provide advice and guidance to workers and employers in cross-border regions. In recent years the offering has been between 600 and 800 thousand vacancies available from more than 20 thousand employers. The EPC have been obtaining the data from the EURES web page every May since the year 2007 up to now, and it is in this way capturing the instantaneous structure of educational requirements of employers across Europe.

The use of EURES has some pros and cons. Despite the considerable size of the EURES database its use is limited to about 10 % of the original sample as in some countries many ads do not specify education required. Moreover, the occupations presented are only classified at the ISCO 2-digit level. In order to disaggregate the EURES data from the ISCO 2-digit to the ISCO 3-digit more detailed national analyses of employer advertising have been used. Still, the EURES data is appropriate for an international comparison of qualification as required by employers within various groups of occupations, and the analyses carried out have confirmed a relatively high level of consistency in qualification requirements for jobs belonging to the relevant occupational groups in various countries.

In addition, during recent years the quality of EURES data (on occupation and particularly on education required) has gradually deteriorated. The economic crisis has confirmed that requirements of employers are highly dependent on the phase of the economic cycle and therefore are not reliable for long-term predictions of skills requirements. In 2007, when labour demand for labour was very high, advertisements were numerous and education was required less often and usually of a not so high level. In 2009 that is during the first wave of the financial and economic crisis demand for labour markedly fell down, far less advertisements were published (and the proportion of web ads increased) but education was required more often and of a markedly higher level. Analysing EURES database has proved that it is not possible to include it into the model. Yet it has been most interesting to use its results for comparing with results of other surveys.

Beside EURES also other extensive surveys of employer requirements based on advertisements in newspapers, journals and on the web and conducted in the Czech Republic in 2000, 2005, 2007 and 2009 have been analysed. A sufficient number – almost 28 thousand adds – contained qualification requirements for occupations at the ISCO 3-digit. The level of education, defined on a five-degree scale the same as in the case of EURES, has been translated into the eight-degree scale. The existence of a comparatively long time series has

made possible to formulate some interesting conclusions concerning the relationship between qualification requirements and the economic cycle- They have confirmed that requirements of employers are less demanding during the economic boom and a corresponding shortage of workforce.

Finally, other international surveys and projects – such as the *International Social Survey Programme* (ISSP), the OECD *International Adult Literacy Survey* (IALS and SIALS) from the nineties, or the new OECD *Programme for International Assessment of Adult Competencies* (PIAAC) just under way in many OECD countries – have been analysed and taken into account as well. The results of the OECD project PIAAC available in the autumn 2013 will be very important for developing the concept of Occupational Skills Profiles further as well as for gaining more adequate data. They will enable not only to verify and, if necessary, modify the current model of Occupational Skills Profiles, but particularly to create and test their country-specific versions.

1.4 Consistency of OSP with other European concepts

In order to achieve a reasonable degree of consistency, the structure of occupational skills profiles as proposed by the EPC basically conforms to the European Qualification Framework (see BOX 11). Their most important dimensions (the level of qualification requirements and the three dimensions of main characteristics) are defined exactly as in the EQF, and all available information on their characteristics has been restructured accordingly. Also other important European documents have been taken into account, notably the recommendations on key competences for lifelong learning.

BOX 4 European Qualification Framework

The EQF is a common European reference framework which links countries´ qualification systems together. Its construction has three main features. First, it defines eight reference levels spanning the full scale of qualifications, from basic to the most advanced levels. Second, the eight reference levels are defined in terms of learning outcomes described by generally applicable descriptors. Third, learning outcomes – that is what a learner knows, understands and is able to do on completion of a learning process – are specified in three categories as *knowledge*, *skills* and *competence*.

Still, a certain safety-catch has been introduced into the process: the outcome of the EPC activity – the entire information describing the development of occupational skills profiles of all relevant (sector-specific) occupations in Europe in the period 2000-2020 – should be understood only as an input information to be widely shared, commented on and discussed in various networks and with various stakeholders for a sufficient length of time. Modifications may include also changes in the used methodology but certainly would lead to some changes in characteristics of various occupations. During this process of adjustment, the ESCO taxonomy will be duly considered and used if possible once it is available.

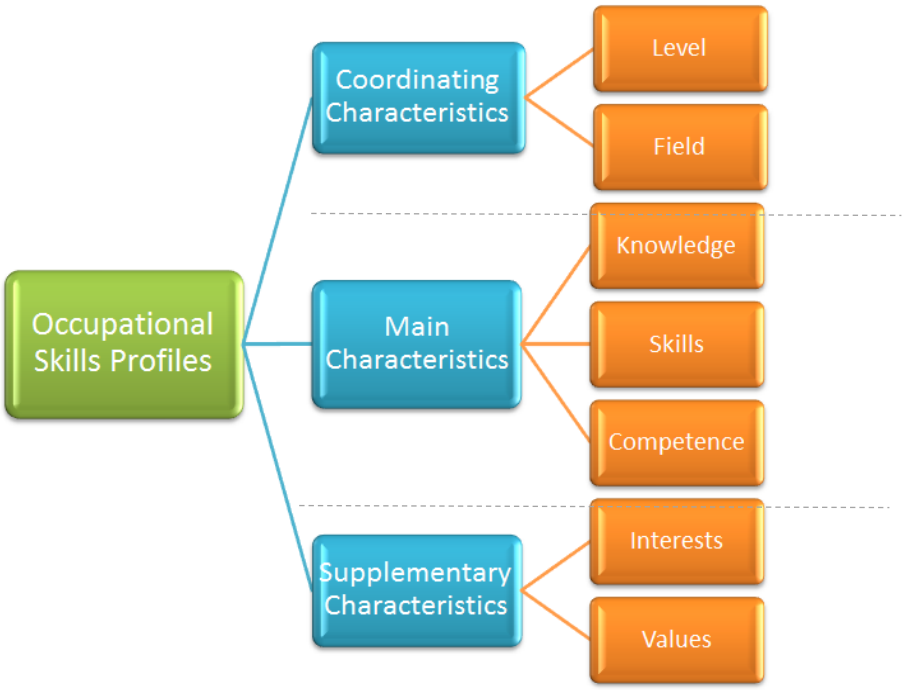
2. Structure and Contents of Occupational Skills Profiles

In this study data and information coming from different sources are used: different international and national classifications of occupations and of sectors, data gathered by the European Social Survey, American BLS data and German BIBB data and those contained in the US information system O*NET as well as in the Italian and Czech surveys.. None of them describe all jobs in a given occupation, and even when the same occupation is present in different sources it can have slightly different contents and qualification requirements even within different regions or enterprises of a country.. This is why we are convinced that information describing the contents and complexity of different jobs and occupations coming from the USA – that is from a country that is so diverse – is not necessarily worse than information coming from a European country or even from an international European survey.

In order to be able to use O*NET data also in Europe, a correspondence table for classifications of occupations has been completed using information and other support from the US Bureau for Labor Statistics. It has thus been possible to utilise the main benefit of the O*NET system that is able to define and quantify about 700-800 occupational units, far more than in Europe where only data at ISCO 3-digit level structured into 110-120 occupational groups are available.

On this basis, Occupational Skills Profiles (OSPs) summarise qualification requirements of occupations in a standard and comparable way. OSP structure is based on seven occupational dimensions forming three main groups, (see Figure 2.1). The first two Dimensions – grouped together as *Coordinating Characteristics* – relate to the level and field of education and training required (and hence to the complexity of the occupation). Three further Dimensions – together referred to as *Main Characteristics* – contain what is required to perform the job in terms of theoretical and factual knowledge, cross-functional skills, and personal, social and methodological abilities. They are defined and structured according the *European Qualification Framework* (see European Communities 2008). The last two Dimensions – under the heading of *Supplementary Characteristics* – add information relating to the profile and orientation of work, such as occupational interests (preferences for work environment) and work values (important to job satisfaction). They are important on the individual level as they allow us to compare job and job holder characteristics and matching.

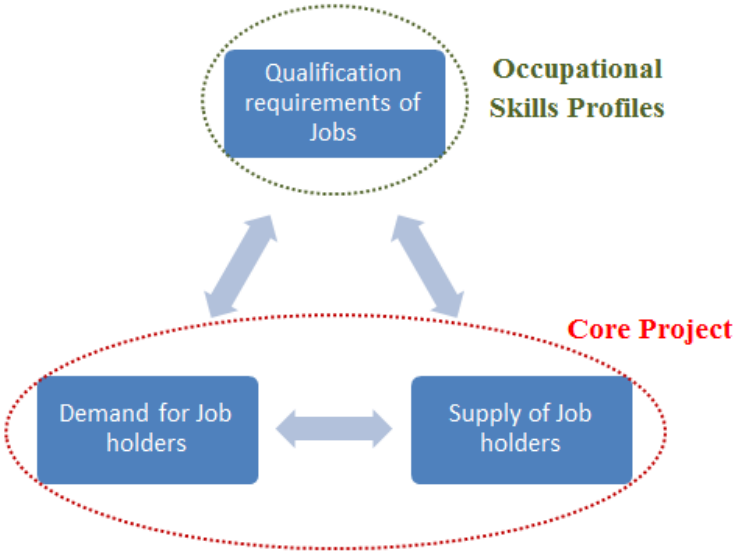
Figure 2.1: Occupational Skills Profile - Main dimensions



Source: EPC, BLS

Occupational Skills Profiles focus on the requirements of jobs, not on the qualification of job holders. Linking dynamically the characteristics of OSPs with Cedefop labour market forecasting in terms of number of jobs in sectors and occupations allows us to project also individual dimensions and characteristics of OSPs. What is important is the possibility of choosing different levels of aggregation: EU as a whole, selected countries, selected sectors etc. By comparing the estimates of labour demand with the estimates of labour supply by qualification it is possible to compare job's requirements with qualifications of job holders. (See Figure 2.2)

Figure 2.2: The OSPs and the Core Projections of Supply of and Demand for Qualifications



Source: EPC

As already mentioned the structure of Occupational Skills Profiles is basically consistent with the European Qualification Framework (EQF). The definition and contents of the most important dimensions correspond directly to the EQF: for the first dimension eight levels of reference were used originally, although later they have been aggregated into three broad levels corresponding to the aggregation used in Cedefop's forecast, and the third to the fifth dimensions are defined in terms of learning outcomes (knowledge, skills and competences).

As for the contents, this basic structure has been filled up with data taken mainly from two groups of major sources. The first one includes the European Social Survey (ESS) and other surveys whose data have been used for the elaboration of *coordinating characteristics*. The second one is the O*NET database that has been used for the elaboration of the three dimensions included in the *Main Characteristics* and the two dimensions of *Supplementary Characteristics*, and also contributed to the determination of the first dimension.

Out of the six O*NET domains (see Figure 1.1) only those have been used that concern general qualification requirements (that is those that correspond to our focus on generic skills), and definitely not those specific for a single occupation only. Theus three domains included in the O*NET – *Labour Market Characteristics*, *Occupation-Specific Information* and *Experience Requirements* – have been excluded from our analysis, together with four parts from other domains – *Detailed Work Activities, Education, Abilities* (partly), and *Organisational Context.*

The same approach has been followed by the Italian survey *Indagine sulle professioni* that used only the relevant parts of the O*NET defining them as *Knowledge, Skills, Abilities, Work Values, Work Styles,* and *Generalised Work Activities*. A similar approach has been also applied to selected characteristics in the Czech survey *Kvalifikace.*

In order to achieve a reasonable degree of consistency, the structure of Occupational Skills Profiles as proposed by the EPC basically conforms to the European Qualification Framework[7]. Their most important dimensions (the level of qualification requirements and the three dimensions of main characteristics) are defined exactly as in the EQF, and all available information on their characteristics has been restructured accordingly. Also other important European documents have been taken into account, notably the recommendations on key competences for lifelong learning.

2.1 Coordinating Characteristics

2.1.1 Dimension I – Level of Qualification Requirements

[7] The **European Qualification Framework** is a common European reference framework which links countries´ qualification systems together. Its construction has three main features. First, it defines eight reference levels spanning the full scale of qualifications, from basic to the most advanced levels. Second, the eight reference levels are defined in terms of learning outcomes described by generally applicable descriptors. Third, learning outcomes – that is what a learner knows, understands and is able to do on completion of a learning process – are specified in three categories as *knowledge*, *skills* and *competence*.

Dimension I describes the level of qualification requirements (and not of job-holders). It is defined for all groups of jobs at the level of ISCO 3 digits occupations (about 110-120 groups of occupations) and 38 industries. As it changes in time, it is defined for three years – 2000, 2010 and 2020.

Originally the eight-level scale as defined by the European Qualification Framework (EQF) was used, serving as the vertical axis of the profile. Subsequently, the eight-level scale has been aggregated into a three-level scale corresponding to the three broad levels (Low, Medium and High) adopted in Cedefop's forecast. Low level includes level 1 – 2 of the eight-level scale, Medium level includes level 3 – 5 of the eight-level scale, and High level includes level 6 – 8 of the original eight-level scale. The degree of aggregation in the Cedefop projection has also decided that Dimension I is defined for groups of jobs at the level of ISCO 2 digits occupations (only 27 groups of occupations) x 38 industries.

Two values for each occupation are indicated: the *percentage distribution* of individual characteristics (making together the profile of the occupation) across all levels of complexity (their total making 100 %) and the required *average years of education*. To fill it up, the EPC has utilised all available relevant data sources for developing one sole vertical indicator of the required level of qualification.

Data sources used

Available data sources are relatively limited. They use three different approaches. In *job holder (employee) surveys* job holders are questioned and surveyed, and in that way a description of qualification requirements of a given job is obtained. Research studies and surveys of this type are perhaps the most numerous and enjoy the longest tradition. It is therefore possible to acquire, in addition to extensive evidence from national projects, some interesting international data. Both international and main supplementary national sources used in this study – the *European Social Survey (ESS),* the US *Occupational Information Network (O*NET),* the German *BIBB Erwerbstätigenbefragung*, the Czech *Kvalifikace* and the Italian *Indagine sulle professioni* – belong to this category.

Further supplementary sources have a different character. *Expert analyses* define qualification requirements of every job in a given area on the basis of a qualified judgment of a selected group of experts. This approach has been used for the *US BLS Education and Training Requirements Categories* (and partly also for the O*NET).

Employer requirements vary from employers advertising new jobs or vacancies to special surveys concerning their current or possible future employees or expert studies of various recruitment agencies. However, most of them are not as systematic as the other two approaches, and can be used only exceptionally. EPC analyses bring further arguments why

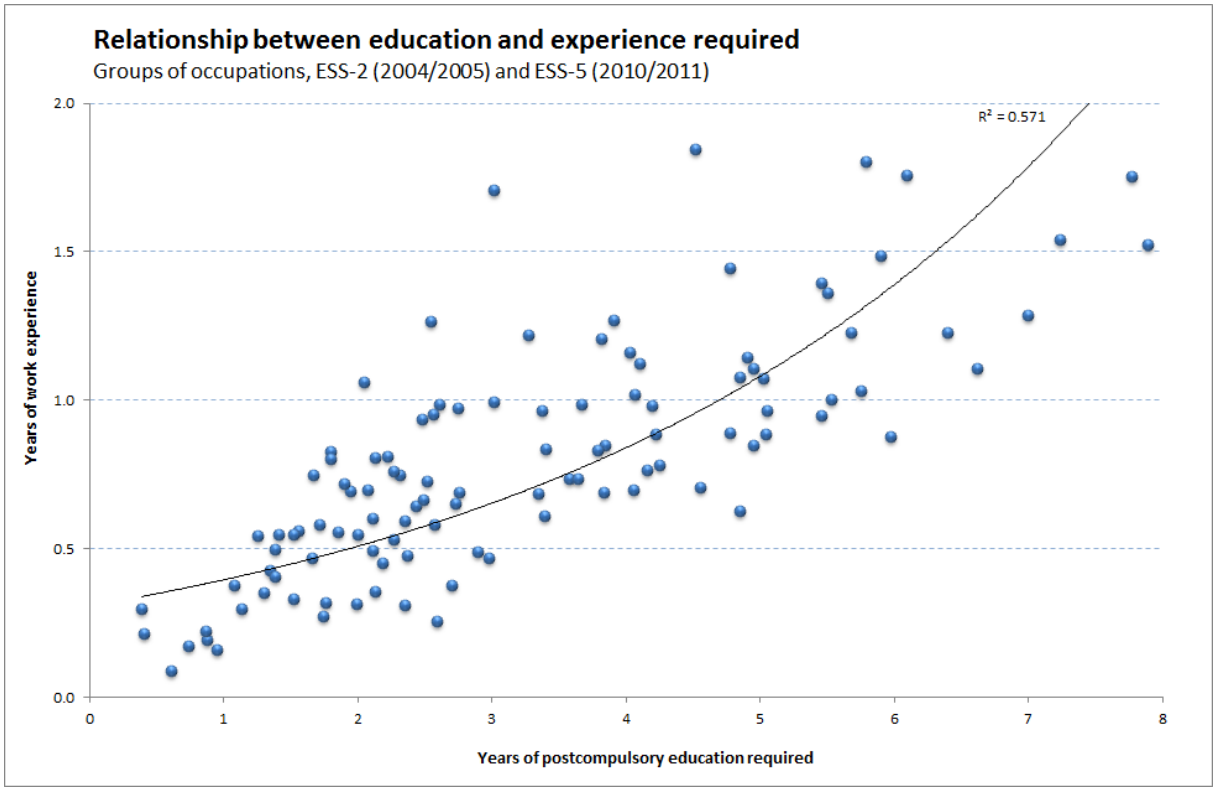
employer requirements surveys are not suitable for long-range projections (see Chapter 1.3 on *EURES, European Employment Services)*.

It is important to note that practically all sources define the level of qualification requirements in terms of the education level attained (alternatively the required number of years of education or the certificate obtained), and this information has to be transposed into the vertical EQF scale.

European Social Survey ESS

The special module of the ESS-2 and ESS-5, contained three questions influenced mainly by the British Skill Survey and US research. They focused on the identification of skill needs and other job characteristics, defined by the length of post-compulsory education and by the length of work experience. This fact has made possible to develop an overall indicator of the level of qualification requirements defined as a sum of both time-related data. Furthermore, it has enabled to analyse the relationship between the length of the necessary education or vocational training and the length of the necessary practical experience. Although the two characteristics are related, there are jobs characterized by strong demands in terms of the length of education and vocational training which do not require extensive practical experience, and vice versa. However, requirements for formal initial education also match in about 57 % requirements for practical experience (Figure 2.3).

Figure 2.3 Relationship between education and experience required



Source: EPC

A significant advantage of ESS-2 and ESS-5 is that they make it possible to analyse in a consistent way changes in time within individual occupations. As the time-lag is only six

years, it is necessary to extrapolate them to a ten-year period used in the model (2000-2010). Data from the O*NET and the BLS can be used in order to test resulting changes.

The ESS-2 and ESS-5 data also allow us to explore the relationship between education attained by employees and education required by the job (Table 2.1 for ESS-2 and ESS-3). For example, ESS data confirms that between years 2004/2005 and 2010/2011 the level of education of workers has markedly increased whereas qualification requirements have increased only little, as indicated by job holders.

Even so, the relationship between education attained and required is relatively strong as around two thirds of the employed do jobs that roughly correspond to their education. This proportion has not changed much in the period under scrutiny. Some changes, however, have occurred regarding both groups of employed with mismatches. The rate of undereducated declined from 24 % to 18 % of employed, while the rate of overeducated rose from 11 % to 16 %, proportions of both groups are becoming nearer.

Table 2.1 Relationship between education and qualification required

European Social Survey - 2 (2004/2005)	Years of education beyond compulsory needed by applicant for your job									
Highest level of education	No education needed	Less than 1 year	About 1 year	About 2 years	About 3 years	About 4-5 years	About 6-7 years	About 8-9 years	10 years or more	**Total**
ES-ISCED I , less than lower secondary	1%	0%	0%	0%	0%	0%	0%	0%	0%	3%
ES-ISCED II, lower secondary	2%	1%	1%	1%	1%	1%	0%	0%	0%	7%
ES-ISCED IIIb, lower tier upper secondary	3%	2%	2%	3%	11%	4%	0%	0%	0%	26%
ES-ISCED IIIa, upper tier upper secondary	2%	2%	2%	3%	5%	10%	1%	0%	0%	27%
ES-ISCED IV, advanced vocational, sub-degree	1%	1%	1%	1%	3%	3%	1%	0%	0%	11%
ES-ISCED V1, lower tertiary education, BA level	0%	0%	0%	1%	2%	4%	3%	1%	0%	12%
ES-ISCED V2, higher tertiary education, MA level	0%	0%	0%	0%	1%	3%	3%	4%	2%	13%
ES-ISCED V3, highest tertiary education, PhD level	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%
Total	10%	6%	7%	10%	24%	25%	9%	6%	3%	100%

European Social Survey - 5 (2010/2011)	Years of education beyond compulsory needed by applicant for your job									
Highest level of education	No education needed	Less than 1 year	About 1 year	About 2 years	About 3 years	About 4-5 years	About 6-7 years	About 8-9 years	10 years or more	**Total**
ES-ISCED I , less than lower secondary	1%	0%	0%	0%	0%	0%	0%	0%	0%	2%
ES-ISCED II, lower secondary	2%	1%	1%	1%	1%	1%	0%	0%	0%	7%
ES-ISCED IIIb, lower tier upper secondary	3%	2%	2%	3%	9%	3%	0%	0%	0%	21%
ES-ISCED IIIa, upper tier upper secondary	3%	3%	3%	3%	5%	9%	1%	0%	0%	26%
ES-ISCED IV, advanced vocational, sub-degree	1%	1%	1%	2%	3%	3%	1%	0%	0%	13%
ES-ISCED V1, lower tertiary education, BA level	0%	0%	1%	1%	3%	4%	2%	1%	0%	12%
ES-ISCED V2, higher tertiary education, MA level	1%	1%	1%	1%	1%	5%	3%	4%	2%	19%
ES-ISCED V3, highest tertiary education, PhD level	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%
Total	11%	8%	8%	9%	23%	24%	8%	6%	4%	100%

Source: EPC

Data about education required can be linked with data about occupation performed. As an example the distribution of education required in respective occupational groups at the 1st level of the ISCO classification of occupation is indicated. Results of both surveys have confirmed a relatively high dispersion of education required as assessed by job holders. Thus the assessment by job holders rather differs from that by experts.

Table 2.2 Qualification requirement and group of occupation (ISCO-88)

ESS - 2 (2004/2005) and ESS - 5 (2010/2011)	Years of education beyond compulsory needed by applicant for your job									
Highest level of education	No education needed	Less than 1 year	About 1 year	About 2 years	About 3 years	About 4-5 years	About 6-7 years	About 8-9 years	10 years or more	Total
ISCO 1	0%	0%	0%	0%	1%	3%	1%	1%	0%	6%
ISCO 2	0%	0%	0%	0%	1%	6%	3%	3%	1%	15%
ISCO 3	0%	0%	0%	1%	4%	8%	2%	1%	0%	17%
ISCO 4	1%	1%	1%	1%	3%	4%	0%	0%	0%	11%
ISCO 5	3%	1%	1%	2%	6%	2%	0%	0%	0%	15%
ISCO 6	0%	0%	0%	0%	1%	0%	0%	0%	0%	3%
ISCO 7	1%	1%	1%	1%	7%	2%	0%	0%	0%	14%
ISCO 8	2%	3%	2%	1%	3%	1%	0%	0%	0%	13%
ISCO 9	4%	1%	0%	0%	0%	0%	0%	0%	0%	6%
Total	13%	7%	7%	8%	28%	25%	6%	4%	2%	100%

Source: EPC

The comparison of quite new European Social Survey data (ESS-5, 2010-2011) containing a module that explores education required and attained in 25 European countries and ESS-2 data (2004-2005) makes possible to carry out not only detailed analyses of mismatches and imbalances between European countries involved in ESS, but also analyses of changes during the six-year period.

Data about qualification requirements generated on the basis of both characteristics as defined in the ESS-2 and ESS-5 were translated into the eight-degree scale as defined by the EQF. Based on the data from the ELFS 2004-2005 and from the ELFS 2010-2011 the characteristics of individual jobs are weighed again for the purpose of further analyses and assigned to groups of occupations in line with the ISCO 3-digit and to groups of sectors in line with the NACE 2-digit.

US BLS Education and Training Requirements Categories

The US BLS classification system can be used to estimate the number of jobs that will fall into each education and training category. This provides information on the current and future training needs of the workforce. The categorisation of occupations by qualification requirements based on *Expert analyses* significantly differs from the results of surveys of qualification requirements based on job holders. The most important difference is the fact that job holders' surveys usually put each occupation under more categories indicating their average, median and variation, whereas expert surveys indicate only one exclusive category, differing estimates of individual experts usually are not published. It is thus possible to provide for each level of qualification requirements the list of corresponding occupations, in contrast to job holders' surveys where an occupation is often listed under more levels.

Table 2.3 provides the current employment distribution for 11 education and training categories[8]. It includes not only the data from the last (2010-2020) employment projection published in 2012 but also from the previous ones starting in 1996[9]. The total numbers of occupations by education and training category are also listed.

Table 2.3 Number of occupations by education and training category, 1996-2010

[8] Detailed definitions for the categories are available at http://www.bls.gov/emp/ep_definitions_edtrain.pdf

[9] The next BLS projection for the period 2012-2022 containing analogous data for 2012 will be published in November 2013.

Most significant source of education and training	1996	2002	2004	2006	2008
First professional degree	8	9	13	13	13
Doctoral degree	6	8	9	10	11
Master's degree	9	32	35	33	32
Bachelor's degree, plus work experience	15	32	35	35	33
Bachelor's degree	69	102	107	114	112
Associate degree	15	37	42	41	42
Postsecondary vocational award	31	47	51	50	55
Work experience in a related occupation	36	47	45	48	48
Long-term on-the-job training	83	86	89	91	87
Moderate-term on-the-job training	119	186	189	183	179
Short-term on-the-job training	119	138	139	135	138
Total	510	724	754	753	750

Typical education needed for entry	2010*
Doctoral or professional degree	25
Master's degree	29
Bachelor's degree	153
Associate's degree	47
Postsecondary non-degree award	40
Some college, no degree	6
High school diploma or equivalent	353
Less than high school	97
Total	750

Source: EPC

*A new system was finalized in 2011 and is now available for use with the 2010-20 employment projections. It replaces the earlier 11-category education or training system.

The basic advantage of the BLS database is the possibility to analyse changes of qualification requirements within occupations since 1996 up to the present. The BLS database is one of the three main sources for the dynamisation of inherent changes of qualification requirements of all occupations in time.

O*NET

Four questions of the O*NET questionnaire concern directly the level of qualification required for the job. They relate to the required level of education, to the required related work experience, to the required on-site or in-plant training, and to the required on-the-job training. They cover all facets of qualification as well as their mutual relationship, which is only illustrated by Table 2.4.

Table 2.4 Average length of practical training/experience by required level of education

Required Level of Education	Average lenght of ……., in months		
	On-Site or In-Plant Training	On-the-Job Training	Related Work Experience
Less than a High School Diploma	9.2	10.9	21.9
High School Diploma	28.3	34.5	69.2
Post-Secondary Certificate	14.3	17.4	35.3
Some College Courses	8.0	9.7	26.1
Associate's Degree	9.8	11.4	30.9
Bachelor's Degree	22.0	27.5	89.0
Post-Baccalaureate Certificate	2.1	2.6	7.9
Master's Degree	5.5	7.0	27.1
Post-Master's Certificate	0.7	0.8	3.1
First Professional Degree	1.7	1.9	5.1
Doctoral Degree	3.4	3.8	12.7
Post-Doctoral Training	2.8	3.2	8.3
Total	**9.0**	**10.9**	**28.1**

Source: EPC

A great advantage of the O*NET is the fact that its database has been formed since 2003, and at least since 2005 it is consistent in time both from the point-of-view of job characteristics

examined and from the point-of-view of the classification of occupations. It is thus possible to use the O*NET database also for analysing changes of qualification requirements within occupations.

BIBB/BAuA Erwerbstätigenbefragung

Data from the German 2006 Employment Survey (see Chapter 1.3) have been also used for defining the 1st and 2nd dimensions of the OSP. The data of active respondents are transformable both to the NACE classification (38 sectors) as well as to the ISCO 3 digits occupational classification (about 110-120 groups of occupations). Table 2.5 only illustrates one aspect of this approach; the matching between qualification required and actually achieved has been acceptable for more than two thirds of respondents.

Table 2.5 Relationship between qualification required and achieved

BIBB/BAuA Erwebstätigenbefragung

What is the highest level of education you have attained?	Comparison of last qualification with present job			Total
	Present job matches with what the qualification prepares for	Present job is related to the qualification	Present job has nothing to do with the qualification	
Primary - ISCED 0+1	0.1%	0.0%	0.0%	**0.1%**
Lower secondary - ISCED 2	0.0%	0.0%	0.0%	**0.1%**
Upper secondary - ISCED 3C	15.3%	17.2%	19.2%	**51.7%**
Upper secondary - ISCED 3AB+4	3.5%	3.5%	3.4%	**10.4%**
Tertiary - ISCED 5B	4.5%	4.8%	3.5%	**12.7%**
Higher short - ISCED 5A short	3.6%	4.6%	2.2%	**10.3%**
Higher long - ISCED 5A long + 6	5.0%	6.9%	2.7%	**14.6%**
Total	**31.8%**	**37.1%**	**31.1%**	**100.0%**

Source: EPC

Kvalifikace

One of the objectives of the Czech survey *Kvalifikace 2008* was to develop, test and make an empirical map of qualification profiles of jobs. The survey replicated the three questions about qualification contained in the ESS-2 in 2004-2005 and added further two questions: *What education do you consider to be the most appropriate for the job you are currently doing?* (the answers involved 12 different levels of education or types of school ranging from incomplete basic education to a doctoral degree so as to cover the widest possible spectrum of options), and *How does your qualification meet your current job requirements?* (adequate qualification, over-qualification, and under-qualification).

The data provided by *Kvalifikace 2008* have also made possible to explore the relationship between education attained by the respondent and education required by the job. Although the analysis has confirmed a close relationship between the two characteristics, at the same time it has pointed to certain stereotypes in assessing qualification requirements that are influenced by specific traditional features of the Czech education system. This is not exclusively Czech situation, as similar stereotypes exist also in other countries. These stereotypes are manifested, on the one hand, by certain helplessness on the part of respondents as regards the

choice of less traditional levels or types of education about which they might not have enough information – e.g. follow-up courses, post-secondary studies, tertiary professional schools, bachelor programmes. On the other hand, specific levels of education are traditionally linked to a specific length of study leading to their attainment, and post-compulsory education lasting 3 and 4-5 years is required far more than in other European countries.

Table 2.6 Relationship between education required and its length

Kvalifikace 2007/08, Czech Republic

What level of education do you think is adequate for your job?	How many years of post-compulsory education does your job require?								Total	Average lenght
	0	< 1 year	2 years	3 years	4-5 years	6-7 years	8-9 years	10+ years		
Basic education suffices	5.9%	0.5%							6.4%	0.1
Upper secondary up to 3 years	3.0%	2.5%	3.1%	3.7%					12.3%	1.6
Up.Sec. without maturita, 3+ years	2.5%	2.8%	2.2%	20.6%	1.9%				30.0%	2.6
Up.Sec. with maturita - vocational		0.7%	0.9%	3.7%	4.8%				10.1%	3.5
Up.Sec. with maturita - technical		1.3%	0.7%	2.5%	15.3%	0.5%			20.3%	4.1
Up.Sec. with maturita - general		0.7%	0.2%	0.4%	2.0%	0.1%			3.4%	3.5
Maturita study for apprentices			0.2%	0.2%	0.2%	0.1%			0.7%	3.6
Post-maturita programmes			0.2%	0.2%	1.1%	0.4%			1.9%	4.5
Tertiary not HE					0.5%	0.5%	0.2%		1.2%	6.0
HE - bachelor's					1.2%	0.8%	0.8%		2.8%	6.3
HE - master's						1.6%	7.1%	1.8%	10.5%	8.5
HE - doctoral or similar							0.1%	0.3%	0.4%	10.0
Total	**11.4%**	**8.5%**	**7.5%**	**31.3%**	**27.0%**	**4.0%**	**8.2%**	**2.1%**	**100.0%**	**3.6**

Source: EPC

The data provided were translated into an eight-degree scale corresponding to EQF definitions, and then they were weighed to become representative of the working population in the Czech Republic. A comparison of the results of both the Czech ESS-2 and *Kvalifikace 2008* provided conclusions similar to those resulting from other analyses. When jobs are divided into eight levels of qualification requirements, the resulting curves expressing the intensity levels are very similar. Virtually identical is also the overall average level of qualification requirements of around four in both cases.

The synthesis

The final step in defining the level of qualification requirements has been a synthesis of all approaches under review and the development of a resultant vertical indicator on the eight-degree scale as described by the EQF. However, in this report the eight-degree scale has been transformed (aggregated) to a three-degree scale (low, medium and high qualification) as required by the Cedefop projection.

The main problem has concerned the weight that the individual approaches represented in the synthetic indicator should have, since their relevance within the Europe-wide context varies significantly. A factor analysis performed with this specific purpose highlighted some important findings.

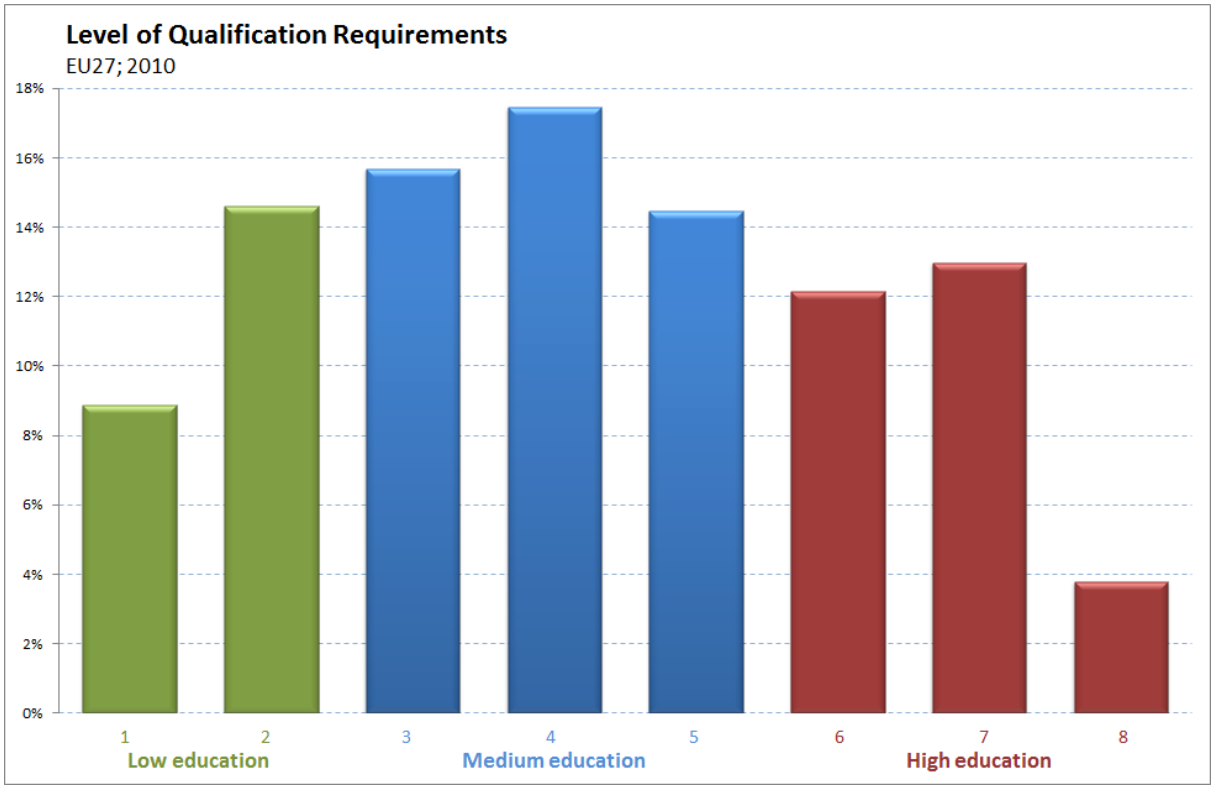
First of all, the relationship between the five approaches applied (ESS, O*NET, BLS, BIBB, Kvalifikace) is so close that they may be expressed by a single, very robust factor covering, *en bloc*, 86 % of all information about the qualification requirements. This confirms a high

level of consistency of this model, and enables us to establish an overall (synthetic) indicator of qualification requirements for each occupational group. The analysis has also shown the weight of respective surveys in the factor model which has become very important for determining the weight of each of the surveys in the final model of the 1st dimension of the OSP. Further criteria include the robustness of respective surveys, their international/national character, and the possibility to be used for the dynamisation of changes of qualification requirements within occupations.

In the final model of the 1st dimension of OSPs the most important role is played by the data from the *European Social Survey* (ESS) that account for 25 % of the information contained in the resultant indicator, and are at the core of the cluster. They are followed by the data form the German and both American surveys (20 %), and the Czech survey (15 %).

Figure 2.4 illustrates the proportion of respective levels of qualification requirements for 27 EU countries corresponding to the jobs structure for all 38 NACE sectors and for all occupations (ISCO 3 digit) and their qualification requirements in 2010. At the same time, its colour coding indicates the aggregation of the eight-level scale to the three-level scale (Low, Medium and High) adopted in the Core project.

Figure 2.4 Level of Qualification Requirements



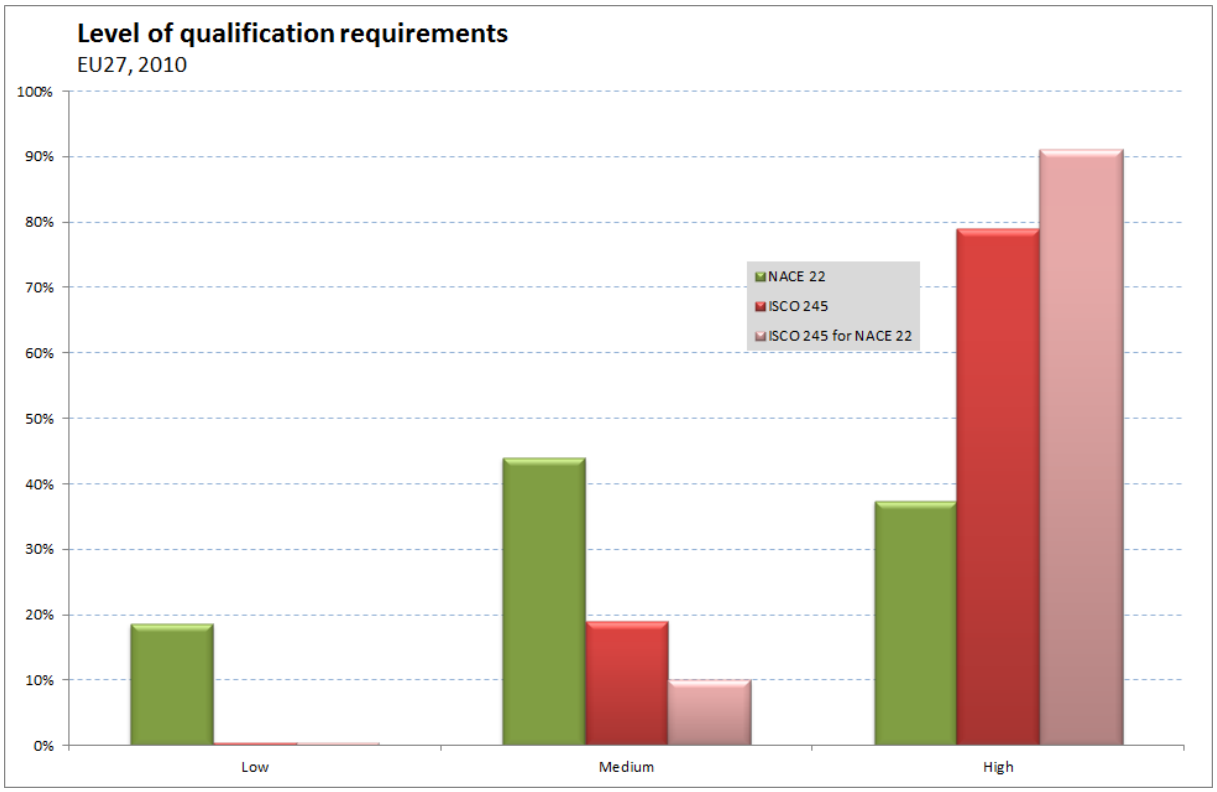
Source: EPC

Second, various approaches have led to somewhat different results as regards the ranking of qualification requirements of groups of occupations on the eight-degree scale. These differences are smaller for some occupational groups (the smallest size of the span is only 0.03 points), while for others they are larger (the largest size of the span is 1.56 points). However, the differences are not such as to impair the consistency of the evaluation of all occupational groups and their ranking on the scale (the average size of the span is 0.61). Moreover, the average level and length of education attained by job holders is closely related

to the resultant indicator of qualification requirements of their jobs. This relatively strong relationship is yet another confirmation of a high degree of the consistency and credibility of the synthetic indicator.

In order to illustrate what difference the sector-specific approach makes when determining an Occupational Skills Profile, the same example is used throughout in this chapter as well as in Chapter 3. It compares three Occupational Skills Profiles, determined for the sector NACE 22 *Publishing, printing and reproduction of recorded media* across all occupational groups, for the occupational group ISCO 245 *Writers and creative or performing artists* across all sectors, and for the occupational group ISCO 245 specific in the sector NACE 22. (The result concerning the first dimension *Level of Qualification Requirements* is indicated in Figure 2.5.)

Figure 2.5 Dimension I – Level of Qualification Requirements



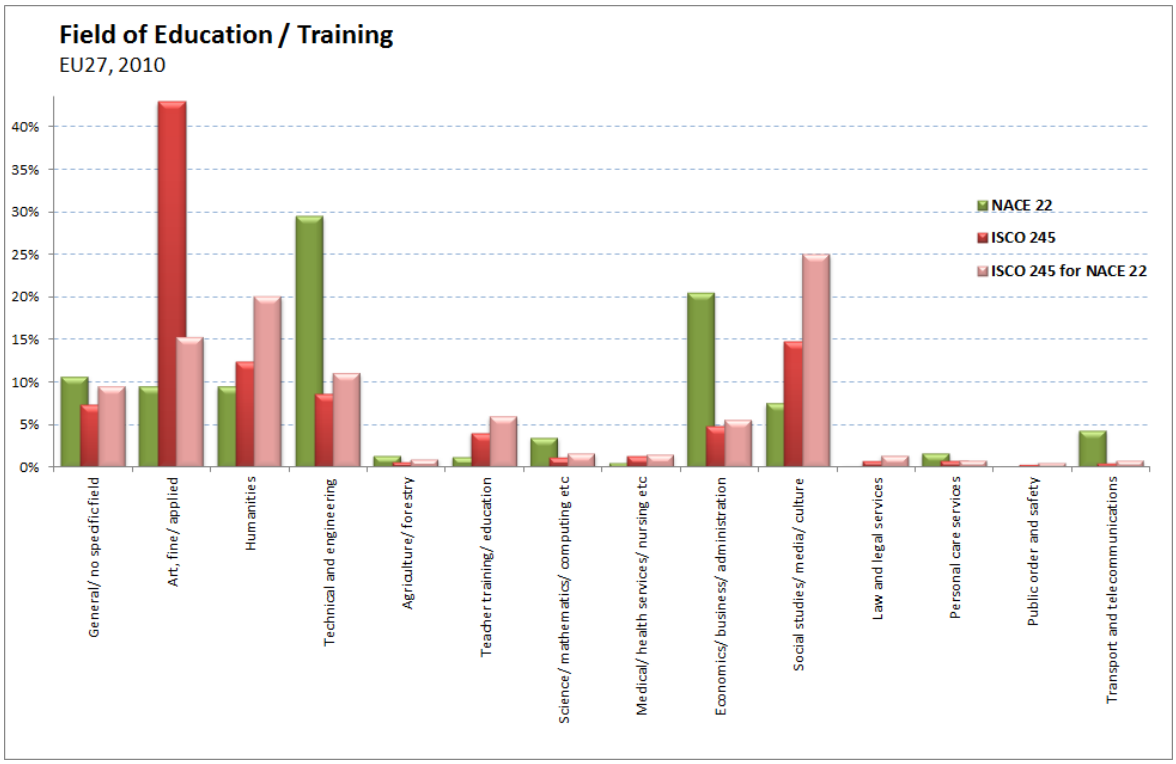
Source: EPC

Figure 2.5 clearly indicates the effect of the sector-specific approach as applied by Occupational Skills Profiles. The proportion of eight EQF levels of qualification requirements taken for the whole NACE 22 sector – that is irrespective of occupational group required – is indicated in green, and for whole occupational group ISCO 245 – again irrespective of the sector required – in red. However, when both parameters are taken into account at the same time, when qualification requirements are determined for one occupational group (ISCO 245) within one sector (NACE 22) only, that is when the sector-specific approach is applied, the results change quite markedly as indicated in mauve. (The same colour scheme is also used for other figures.)

2.1.2 Dimension II – Field of Education/Training

The second Dimension describes the field of education/training. Again, a relative, percentage distribution of the given occupation across various fields is indicated (i.e. the total making 100 %). The fourteen groups of fields of education and training (see Figure 2.6) have been defined according to the International Standard Classification of Education (ISCED). The difference made by the sector-specific approach is shown in Figure 2.6.

Figure 2.6 Dimension II – Field of Education/Training



Source: EPC

2.2 Main Characteristics

As already stated, the EQF describes qualification requirements in terms of learning outcomes (Cedefop 2009). The basic structure of qualification profiles follows the structure of the EQF not only vertically, by using its eight levels, but also horizontally, by structuring relevant O*NET data into three dimensions – knowledge, skills and competence – as defined by the EQF.

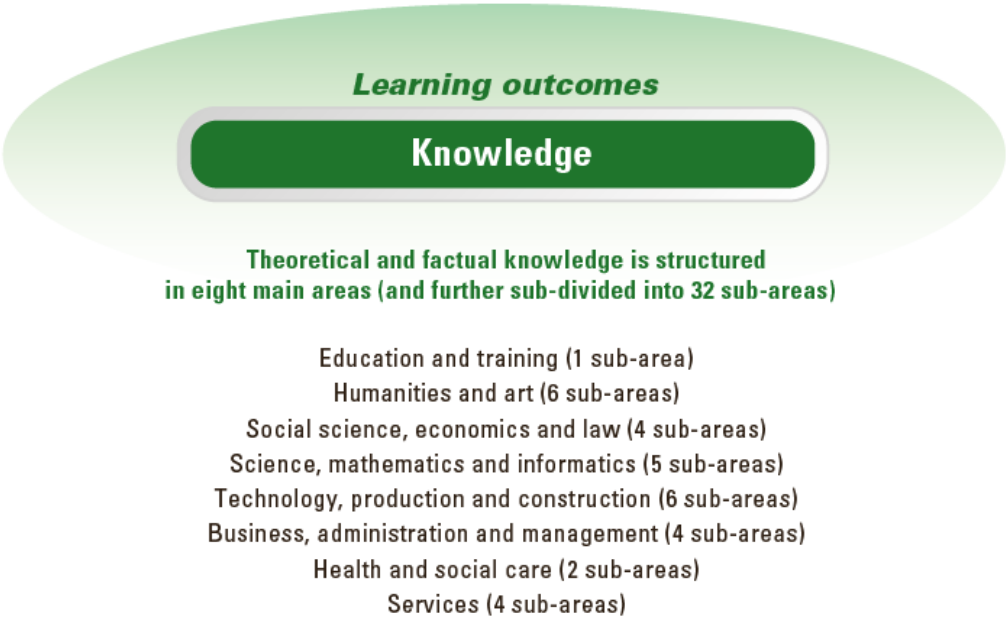
Although learning outcomes have been differentiated into three different categories (described each in a separate column), they still form a continuum, and should be "*read across*" – "*this is the knowledge that is used with the skills in this area of competence*" (Mike Coles 2007, 2). "*Reading across the EQF descriptors for the (given) level we find the knowledge acquired is first defined. This knowledge is used in ways described in the second column where cognitive and practical skills depend on it. The application of these skills (and knowledge) is carried out in contexts defined in the third column in terms, for example, of the level of autonomy and responsibility that has to be exercised*" (ibid, 13).

The structuring of O*NET data has been relatively straightforward as regards the first category, *knowledge*. As regards the other two categories, it has been necessary to differentiate between *skills* and *competence*, and to handle adequately generic skills, stressing their importance.

2.2.1 Dimension III – Knowledge

As defined by the EQF, "*knowledge* means the outcome of the assimilation of information through learning. Knowledge is the body of facts, principles and theories and practices that is related to a field of work or study. In the context of the EQF, it is described as theoretical and/or factual."

This dimension is structured into 8 main areas of knowledge, further subdivided to 32 sub-areas (BOX 5). Its structuring is based on the corresponding part of the O*NET model (originally containing 10 areas sub-divided to 33 sub-areas), however adapted to the structure of the ISCED classification (originally 8 areas further sub-divided to 25 sub-areas).



BOX 5 Dimension III Knowledge – 8 main areas and 32 sub-areas

Education and Training:

Education and training

Humanities and Art:

Fine arts, Communications and media, Design, English language, History and archaeology, Philosophy and theology

Social science, economics and law:

Psychology, Sociology and anthropology, Economics and accounting, Law and government

Science, mathematics and informatics:

Biology, Physics, Chemistry, Geography, Mathematics

Technology, production and construction:

Production and processing, Food production, Computers and electronics, Engineering and technology, Mechanical, Building and construction

Business, administration and management:

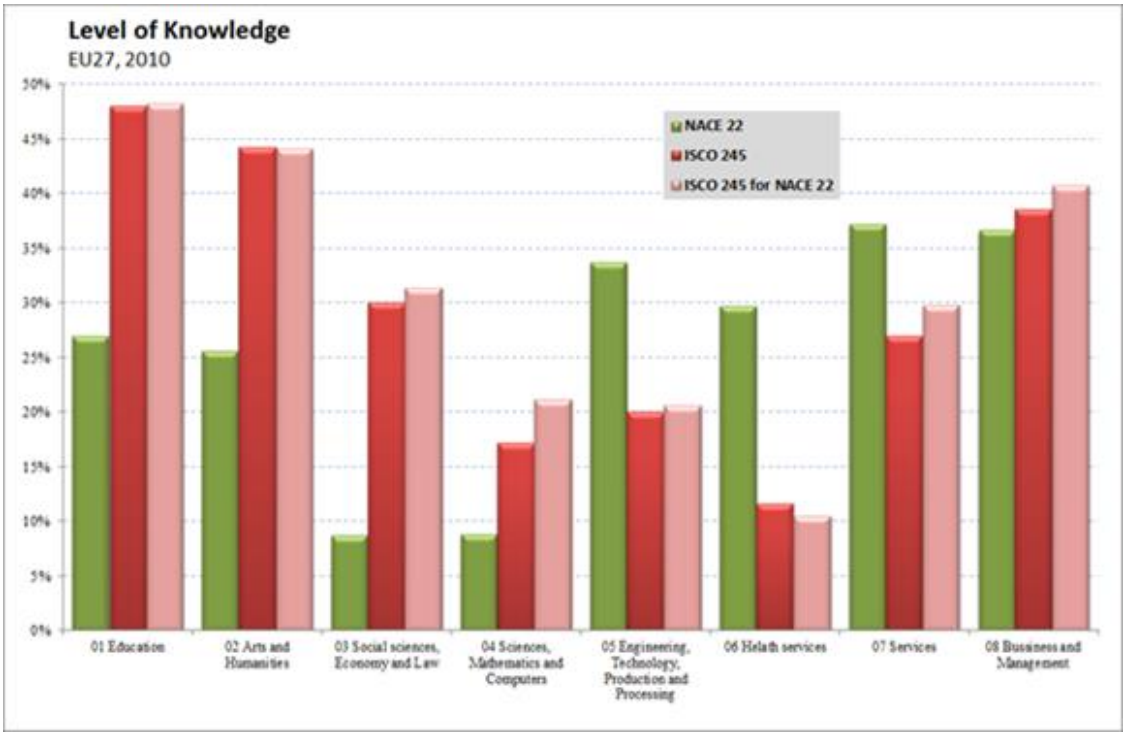
Administration and management, Clerical, Sales and marketing, Personnel and human resources

Health and social care:

Medicine and dentistry, Therapy and counselling *Service:* Customer and personal service, Public safety and security, Telecommunications, Transportation

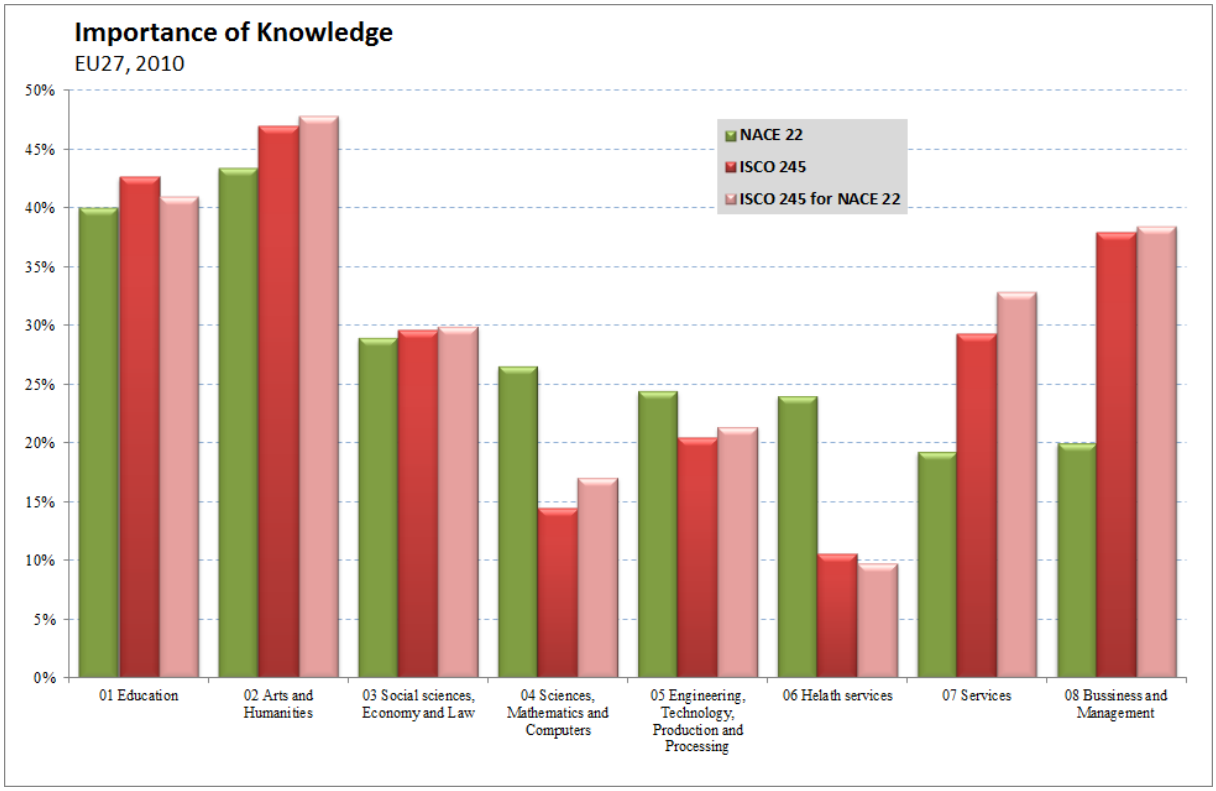
For knowledge, two characteristics are indicated (as they are defined in O*NET): the *Level* required (relating to the complexity of the occupation), and the *Importance* for the given occupation. Both characteristics are indicated as percentage values and shown in Figure 2.7 and Figure 2.8.

Figure 2.7 Dimension III – Level of Knowledge



Source: EPC

Figure 2.8 Dimension III – Importance of Knowledge

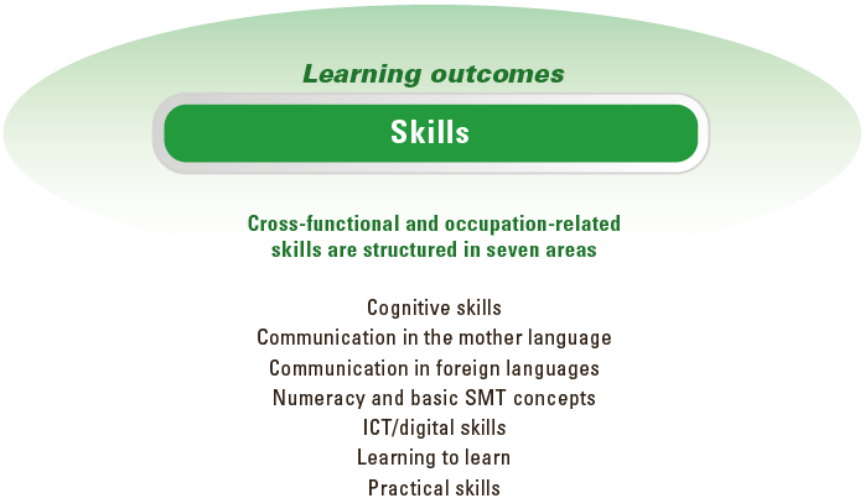


Source: EPC

2.2.2 Dimension IV – Skills

As defined by the EQF, "*skills* means the ability to apply knowledge and use know-how to complete tasks and solve problems. In the context of the EQF, skills are described as cognitive (involving the use of logical, intuitive and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments)."

While the EQF makes distinction only between cognitive and practical skills, the structuring of this category has to be more detailed and explicitly focused on relevant generic skills. Therefore key competences for lifelong learning (BOX 6) have been taken into account as far as possible – that is unless they come under the category *Competence* or are not supported by O*NET characteristics.



BOX 6 Key competences for lifelong learning

Recommendation of the European Parliament and of the Council, of 18 December 2006

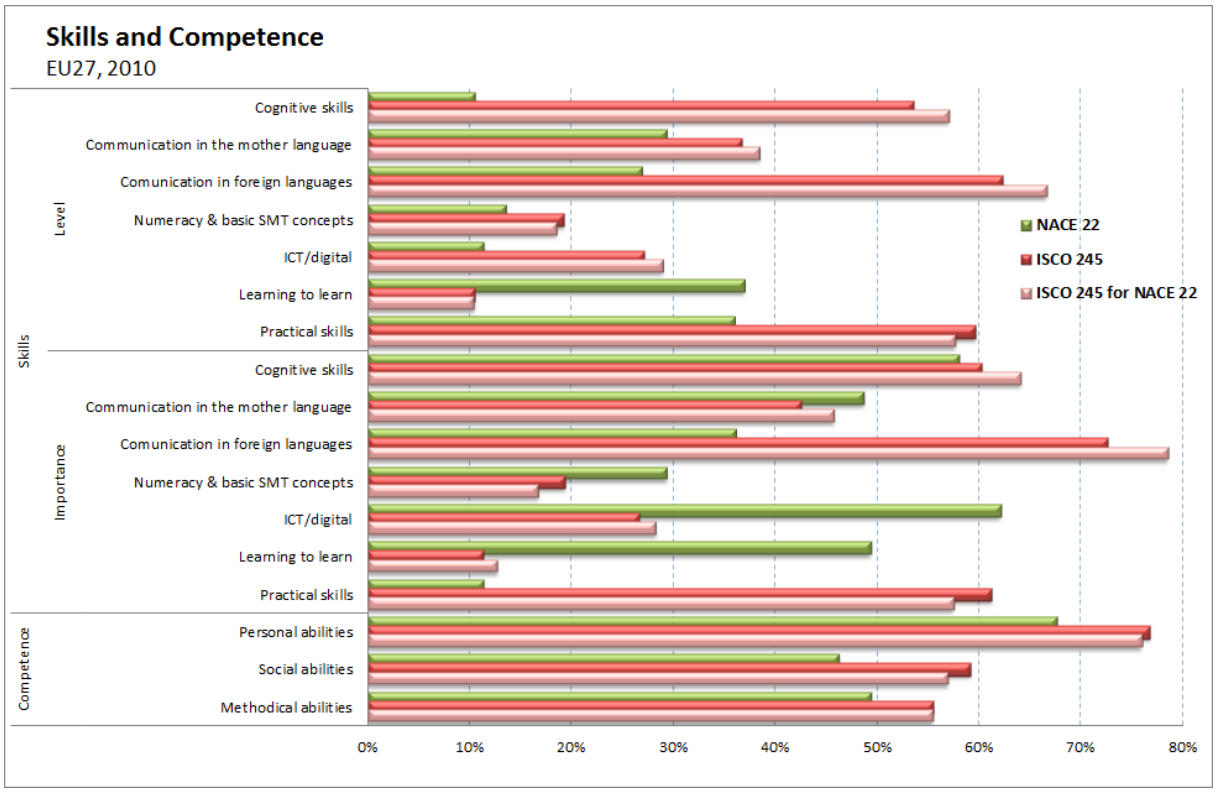
The Recommendation defines eight main domains:

- Skills – *Communication in the mother tongue, Communication in foreign languages, ICT/digital competencies, Numeracy and competencies in mathematics, science and technology, and Learning to learn*;
- Competence – *Sense of entrepreneurship and initiative, and Interpersonal/social and civic competencies*;
- one domain is not supported by O*NET – *General culture/cultural awareness and expression*.

As a result, the Dimension IV – Skills is structured as follows: *Cognitive skills, Communication in the mother language, Communication in foreign languages, Numeracy and basic SMT (science, mathematics, and technology) concepts, ICT (Information and Communication Technologies)/digital skills, Learning to learn,* and *Practical skills.*

Relevant O*NET parts *Basic Skills* and *Cross-Functional Skills* have been used. Two characteristics are indicated, the *Level* required (relating to the complexity of the job/occupation) and the *Importance* for the given job (occupation), both as percentage values. Figure 2.9 illustrates Dimension IV – Skills as well as Dimension V – Competence.

Figure 2.9 Dimension IV – Skills and Dimension V – Competence



Source: EPC

2.2.3 Dimension V – Competence

As defined by the EQF, "*competence* means the proven ability to use knowledge, skills and personal, social and/or methodological abilities in work or study situations and in professional and personal development. In the context of the EQF, competence is described in terms of responsibility and autonomy". Although the term *competence* is often used in a narrower sense (and then also in the plural), the above definition reflects the consensus that there is a certain progression between the three categories – not only knowledge, but also skills needed for its application, and also other abilities (social and personal competences, attitudes and values) indispensable for professional conduct.

Especially in European countries (as Germany, France, and the Netherlands) "competence is defined as ´capacity´ in relation to a broad occupational field. It is a multi-dimensional concept, combining different forms of knowledge and skills, as well as social and personal qualities. It relates to a person´s ability to draw on multiple resources to deal with a given work situation (Cedefop 2009, p. 19)". This broad definition is an outcome of a quite long development. Compare f.i. two short quotations (Rychen and Salganik 2001): „Competence can generally be understood as knowledge times experience times power of judgment" and "competences generally imply complex action systems encompassing not only knowledge and skills, but also strategies and routines needed to apply knowledge and skills, as well as appropriate emotions and the effective self-regulation of these competences".

In order to differentiate the abilities coming under the category *Competence* from other abilities coming under the category *Skills*, respective detailed descriptors defining the eight EQF levels of have been used for guidance (BOX 7).

Relevant O*NET characteristics relating to responsibility and autonomy (as defined by EQF descriptor) shave been further structured into *Personal abilities*, *Social abilities* and *Methodological abilities*. Only one characteristic, the importance, is indicated, again as a percentage value (see Figure 2.9 above).

BOX 7 EQF descriptors defining eight levels of the category Competence

They include e.g..: Innovation, Creativity, Integrity, Authority, Leadership, Independence, Taking responsibility for managing professional development, Taking responsibility for the evaluation and improvement, Taking responsibility for completion of tasks, Reviewing and developing performance of self and others, Exercising self-management within the guidelines, Exercising management and supervision in contexts where there is unpredictable change, Supervising work of others, Working/studying with some autonomy, Taking responsibility for decision-making in unpredictable conditions, Adapting own behaviour to circumstances in solving problems.

2.3 Supplementary Characteristics

The last two dimensions of Occupational Skills Profiles have a rather different character. They try to define certain general qualities of the job (occupation) which may (or may not) more or less correspond to those of the job holder. As both dimensions focus on the relationship between the job and the job holder, they can play a positive role in choosing the job and in the resulting match between them. Thus they can fittingly supplement the previous more specific characteristics, and considerably extend the overall use of Occupational Skills Profiles. The characteristics of both dimensions are expressed as an index with values ranging from 0 to 100, showing the strength of the given profile or orientation, and they can be aggregated at levels such as the group of occupations, the sector or the whole economy.

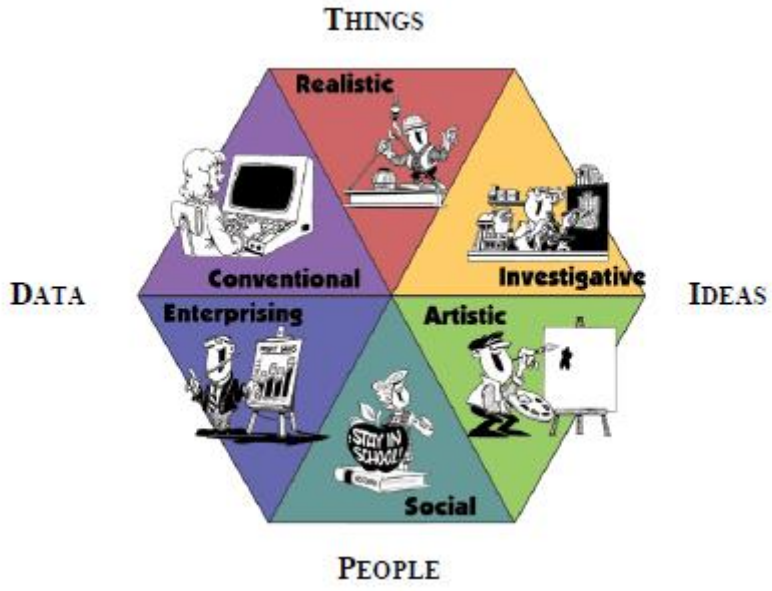
2.3.1 Dimension VI – Occupational Interests

This dimension is based on the theory of careers and vocational choice formulated by John L. Holland (1973 and 1999). According to it, preferences for work environment are related to six distinct personality types which can be used to describe both persons and work environment:

Realistic, Investigative, Artistic, Social, Enterprising, and *Conventional* (usually referred to by their first letters: R-I-A-S-E-C). Any person could be described as having interests associated with each of the six types in a descending order of preference; this assumption allows Holland codes to be used to describe 720 different personality patterns. As also description of jobs and occupations is treated in the same way, that is how it corresponds with each of the six types, the Holland model has been adopted by the U.S. Department of Labor for categorizing jobs and occupations relative to interests, and has also become an important component in a comprehensive online job search system O*NET.

Realistic
Investigative
Artistic
Social
Enterprising
Conventional

BOX 8 defines the six personality and work environment (occupation) types. As each person, also each occupation can contain characteristics of more than one type, although one type usually prevails or even dominates and defines the occupation from the point-of-view of occupational interests. According to the latest version of the O*NET, Realistic type occupations display the highest values across all 750 occupations as defined by it. Conventional type occupations are following with a distance. Conversely Artistic type occupations have the significantly lowest value.



Describing all occupations in terms of the six personality types enabled us to analyse the relationship among individual types not only of persons (job holders) but also of occupations (Table 2.7). Using O*NET data, it appears that the most opposed are the Realistic and Social types of occupations (Pearson's correlation for 750 individual occupation is –0.63), followed by a pair of Realistic and Enterprising types (–0.58) and then with a little margin Realistic and Artistic types (–0.42) and Conventional and Artistic types (–0.40). Conversely closest pair is made of Social and Artistic types (+0.32).

Table 2.7 Relationship between the six personality and work environment (occupation) types

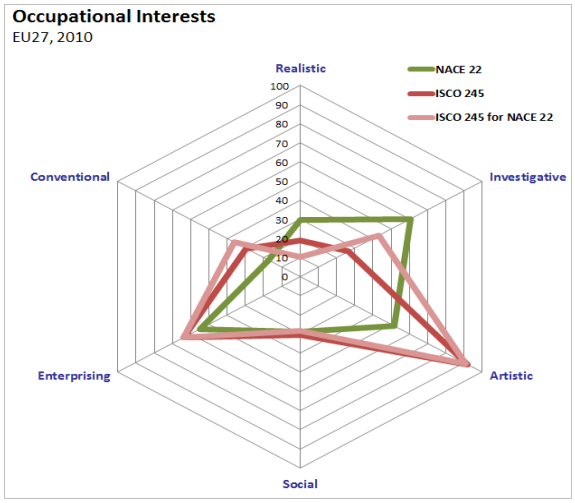
(Pearson Correlation)

	Realistic	Investigative	Artistic	Social	Enterprising	Conventional
Realistic	1.00	-0.06	-0.42	**-0.63**	**-0.58**	-0.15
Investigative		1.00	0.20	0.08	-0.30	-0.11
Artistic			1.00	0.32	0.05	-0.40
Social				1.00	0.29	-0.19
Enterprising					1.00	0.27
Conventional						1.00

Source: EPC

Figure 2.10 illustrates an example of determining and visualising this dimension.

Figure 2.10 Dimension VI – Occupational Interests



Source: EPC

BOX 8 Six personality and work environment (occupation) types

Realistic (practical, physical, hands-on, tool-oriented) occupations frequently involve work activities that include practical, hands-on problems and solutions. They often deal with plants, animals, and real-world materials like wood, tools, and machinery. Many of the occupations require working outside, and do not involve a lot of paperwork or working closely with others. Accordingly, the holders of realistic occupations like to work with animals, tools, or machines; generally avoid social activities like teaching, healing, and informing others; have good skills in working with tools, mechanical or electrical drawings, machines, or plants and animals; value practical things you can see, touch, and use like plants and animals, tools, equipment, or machines; and see themselves as practical, mechanical, and realistic.

Investigative (analytical, intellectual, scientific, explorative) occupations frequently involve working with ideas, and require an extensive amount of thinking. These occupations can involve searching for facts and figuring out problems mentally. Accordingly, the holders of investigative occupation like to study and solve math or science problems; generally avoid leading, selling, or persuading people; are good at understanding and solving science and math problems; value science; and see themselves as precise, scientific, and intellectual.

Artistic (creative, original, independent, chaotic) occupations frequently involve working with forms, designs and patterns. They often require self-expression and the work can be done without following a clear set of rules. Accordingly, the holders of artistic occupation like to do creative activities like art, drama, crafts, dance, music, or creative writing; generally avoid highly ordered or repetitive activities; have good artistic abilities in creative writing, drama, crafts, music, or art; value the creative arts like drama, music, art, or the works of creative writers; and see themselves as expressive, original, and independent.

Social (cooperative, supporting, helping, healing/nurturing) occupations frequently involve working with, communicating with, and teaching people. These occupations often involve helping or providing service to others. Accordingly, the holders of social occupations like to do things to help people like, teaching, nursing, or giving first aid, providing information; generally avoid using machines, tools, or animals to achieve a goal; are good at teaching, counselling, nursing, or giving information; value helping people and solving social problems; and see themselves as helpful, friendly, and trustworthy.

Enterprising (competitive environments, leadership, persuading) occupations frequently involve starting up and carrying out projects. These occupations can involve leading people and making many decisions. Sometimes they require risk taking and often deal with business. Accordingly, the holders of enterprising occupations like to lead and persuade people, and to sell things and ideas; generally avoid activities that require careful observation and scientific, analytical thinking; are good at leading people and selling things or ideas; value success in politics, leadership, or business; and see themselves as energetic, ambitious, and sociable.

Conventional (detail-oriented, organizing, clerical) occupations frequently involve following set procedures and routines. These occupations can include working with data and details more than with ideas. Usually there is a clear line of authority to follow. Accordingly, the holders of conventional occupations like to work with numbers, records, or machines in a set, orderly way and generally avoid ambiguous, unstructured activities; are good at working with written records and numbers in a systematic, orderly way; value success in business; and see themselves as orderly, and good at following a set plan.

2.3.2 Dimension VII – Work Values

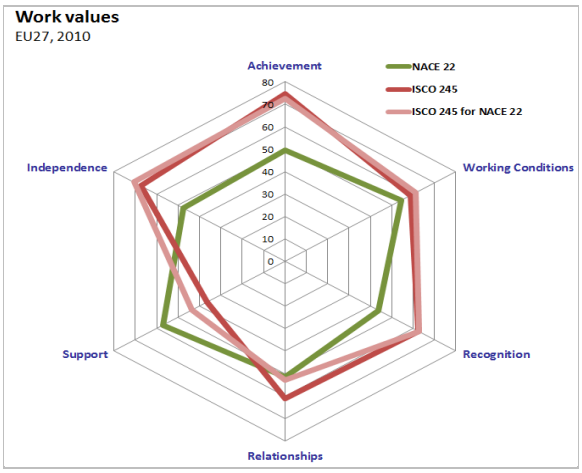
Going beyond the domain of Occupational Interests, the dimension Work Values – based on the theory of work adjustment (Davies and Lofquist 1984) – characterises another aspect of the relationship between the job and the job holder that can also considerably affect the "fit" of an individual to a particular occupation. It involves an individual's evaluation of the importance of work activities, of the nature of the work (e.g., authority, creativity), and of conditions of the work environment (e.g., compensation, advancement potential). In order to achieve a good "fit" (that is both a satisfactory performance and job satisfaction), preferences and expectations of an individual, his/her *needs*, should match corresponding stimulus conditions associated with the maintenance of work behaviour, called *reinforcers* (Smith and Campbell 2006).

For each O*NET occupational unit its *need profile* has been derived from job analysts´ ratings of the degree to which the occupational unit in question reinforces (i.e. provides employees with) each of the twenty-one defined needs. Further, six distinct meaningful values have been identified from *need reinforcers* through strategies of dimensional analyses, and finally the resulting Occupational Reinforcer Patterns (McCloy et al. 1999) have been formed. Also two identical assessment instruments for job holders (Work Importance Profiler for computerised administration and scoring, and Work Importance Locator for card sort administration and scoring), directly linked to O*NET, have been developed by the US Department of Labor.

The six Work Values can be modelled as three dimensions, where each dimension includes polar opposite work values. The three pairs of polar opposites (Rounds 1981) are: *Relationships* versus *Recognition*, *Independence* versus *Support*, and *Achievement* versus *Working Conditions*. It is thus possible to represent this dimension, Work Values, in a similar way as the preceding dimension, Occupational Interests.

BOX 9 summarises six Work Values and twenty-one Need Reinforcers together with their defining statements, and Figure 2.11 illustrates an example of determining this dimension.

Figure 2.11 Dimension VII – Work Values



Source: EPC

BOX 9 Work value: Need reinforcer and associated statements

Achievement:	Occupations that satisfy this work value are results oriented and allow employees to use their strongest abilities, giving them a feeling of accomplishment
Ability utilization	Workers on this job make use of their individual abilities
Achievement	Workers on this job get a feeling of accomplishment
Working conditions:	Occupations that satisfy this work value offer job security and good working conditions
Activity	Workers on this job are busy all the time
Independence	Workers on this job do their work alone
Variety	Workers on this job have something different to do every day
Compensation	Workers on this job are paid well in comparison with other workers
Security	Workers on this job have steady employment
Working conditions	Workers on this job have good working conditions
Recognition:	Occupations that satisfy this work value offer advancement, potential for leadership, and are often considered prestigious
Advancement	Workers on this job have opportunities for advancement
Recognition	Workers on this job receive recognition for the work they do
Authority	Workers on this job give directions and instructions to others
Social status	Workers on this job are looked up to by others in their company and their community

Relationships:	Occupations that satisfy this work value allow employees to provide services to others and work with co-workers in a friendly non-competitive environment.
Co-workers	Workers on this job have co-workers who are easy to get along with
Social service	Workers on this job have work where they do things for other people
Moral values	Workers on this job are never pressured to do things that go against their sense of right and wrong
Support:	Occupations that satisfy this work value offer supportive management that stands behind employees.
Company policies	Workers on this job are treated fairly by the company
Supervision human relations	Workers on this job have supervisors who back up their workers with management
Supervision technical	Workers on this job have supervisors who train their workers well
Independence:	Occupations that satisfy this work value allow employees to work on their own and make decisions
Creativity	Workers on this job try out their own ideas
Responsibility	Workers on this job make decisions on their own
Autonomy	Workers on this job plan their work with little supervision

3. Transposition and Aggregation

This chapter describes the complex methodological process of transposition and aggregation followed to develop the Occupational Skills Profile approach. The best way to see how it works is by using a specific example that illustrates and justifies both main assumptions: first, that it is necessary to determine Occupational Skills Profiles at the lowest possible level, preferably at the individual level as defined, for example, by the US SOC, and second, that their aggregation at the group level has to be sector-specific (using occupational weighting in order to maintain the specificity of individual occupations). It will also be shown how different results can be when considering different dimensions of Occupational Skills Profiles as defined in Chapter 2, especially concerning the Level of Qualification Requirements (the 1st dimension).

3.1 Pitfalls of Transposition

To find a way to reconcile both various systems of classification and various levels of classification is the necessary prerequisite for making use of data coming from different sources. Especially US BLS data and projections and O*NET characteristics of individual occupations based on the US classification of occupations (SOC), have opened up problems of transposition to the ISCO classification adopted by the European countries.

To this end, a correspondence table for individual occupations as defined by the SOC and the ISCO has been prepared. As Eurostat makes available data only at the ISCO 3-digit level (out of 19 countries examined by the EPC only 6 of them have data at the ISCO 4-digit level), Occupational Skills Profiles have been aggregated up to this level which currently contains about 110 occupational groups (in Eurostat database). In addition, in order to get sector-occupation employment matrices it is also necessary to map the North American classification of industries (NAIRIC) to the European classification of sectors (NACE rev.1).

However, any aggregation to higher levels of classification and the transposition to sectors cannot be realized by simply adding together the values determined at a lower, more detailed level of individual occupations. Their specificity would be lost, as a range of different values would be substituted by their average. To ground analyses and projections of qualification requirements only on aggregated groups of occupations, without having the possibility of their disaggregation, and without respecting considerable differences in their distribution across sectors is questionable, as it impoverishes the information available.

A possible way to maintain the specific features of individual Occupational Skills Profiles even after their aggregation to ISCO 3-digit and 2-digit, is taking into account their sector-specific occupational structure (i.e. the different proportional representations of individual occupations in different sectors). For some occupational groups it implies to prepare up to 38 different profiles[10]. We will illustrate it by an example showing how effective the sector-specific approach is. The same example is also used to illustrate what difference the sector-specific approach makes for each of the seven dimensions as discussed in Chapter 2.

[10] The E3ME classification contains 41 sectors but three pairs of sectors have to be united into three new sectors due to data limitations (see Chapter 1).

To sum up, the aggregation of Occupational Skills Profiles determined at a more detailed level of occupations (that is of about 800 individual occupations in the US SOC 2010) has to be sector-specific. The reason is obvious: at higher levels of aggregation occupational groups contain several different occupations, the mix of occupations (their proportion, prevalence or domination) is different in each sector (having for example a different degree of *concentration*[11] and *exclusivity*[12]). Consequently there has to be a different, sector-specific Occupational Skills Profile for each sector where the occupational group in question is represented (that is up to 38 sectors), the number of Occupational Skills Profiles being equal to the number of respective sectors.

It implies that it is necessary to carry out the aggregation process for each sector in question separately rather than across all sectors. In this way the results of the aggregation will reflect the different job/employment shares of individual occupations in occupational groups classified at the ISCO 3-digit level in different sectors. In other words, it uses different occupational weights derived on the basis of US data which reflect the situation in the US economy (and whose use has to be confined within the limits of the respective occupational group at the ISCO-3 digit level and of the respective NACE sector).

The sector–specific approach yields good proxy results that are much better than the results achieved by using simple ways of aggregation (when only one qualification profile for any occupational group at the ISCO 3-digit level is used for all sectors). In this way, both crucial criteria will be met – the sufficiently detailed level of classification and the availability of data.

In all 29 European countries, which are part of the analysis and the projection of skill needs, there exist roughly 230-240 million jobs that can be divided into several thousand of sector-specific groups of occupation at the ISCO 3-digit level. For this reason it is proposed to use the 0.01 % criterion (approximately 23.5 thousand jobs), when selecting the smallest sector-specific group of occupation for which the Occupational Skills Profile is calculated. On this basis, Occupational Skills Profiles are calculated for roughly 900 sector-specific groups of occupation. Jobs belonging to the Occupational Skills Profiles which are not calculated are assigned to similar sector-specific (either of the same occupational group in another sector or of a related occupational group in the same sector).

---

[11] **Occupational concentration of a sector** indicates to what degree it is a homogenous or heterogeneous from the point-of-view of occupations. It is high when one or only a few occupations dominate while other occupations are scarce. For instance, in the sector *Agriculture, hunting and forestry and fishing (NACE 01-05)* almost three quarters of employed come under *Skilled agricultural and fishery workers (ISCO 6)*, or in the sector *Hotels and restaurants (NACE 55)* more than half come under *Housekeeping and restaurant services workers (ISCO 512)*. An opposite example of a low concentration sector is *Electricity, gas and water supply (NACE 40-41)*, where the most numerous occupations constitute less than 10 % of employed. Another example is *Real estate, renting and business activities (NACE 70-74)* with only a slightly higher concentration.

[12] On the other hand, **occupational exclusivity of a sector** indicates to what extent a given occupation is concentrated in a given sector. High exclusivity of a sector indicates that the occupation in question is concentrated there predominantly, and can be found only sporadically elsewhere. Examples of a high exclusivity are *Manufacture of other non-metallic mineral products (NACE 26)*, where almost all *Glass, ceramics and related plant operators (ISCO 813)* are engaged, although they constitute only about 7 % of employed in the sector.

The sector NACE 22 *Publishing, printing & reproduction of recorded media* (see BOX 10) and the occupational group ISCO 245 *Writers and creative or performing artists* (one of the most important groups of occupations within the sector) have been chosen to illustrate the process of transformation and construction of sector–specific Occupational Skills Profiles (Koucký and Lepič, 2010).

BOX 10

NACE 22 ***Publishing, printing & reproduction of recorded media*** has been defined by NACE (rev 1.1) to include the following three clusters of activities: 22.1 Publishing, 22.2 Printing, 22.3 Reproduction of recorded media. This sector includes units engaged in the publishing of newspapers, magazines, other periodicals, and books. In general, these units, which are known as publishers, issue copies of works for which they usually possess copyright. Works may be in one or more formats including traditional print form and electronic form. The printing activities print such products, and perform support activities, such as bookbinding, plate-making services, and data imaging. The support activities included here are an integral part of the printing industry, and a product that is an integral part of the printing industry is almost always provided by these operations. Though printing and publishing can be carried out by the same unit (a newspaper, for example), it is less and less the case that these distinct activities are carried out in the same physical location.

ISCO 245 ***Writers and creative or performing artists*** conceive and create or perform literary, dramatic, musical and other works of art (International Standard Classification of Occupations. ILO, Geneve 1988). Tasks performed usually include: writing literary works; appraising merits of literary and other works of art; collecting information about current affairs and writing about them; sculpting, painting, engraving, or creating cartoons; restoring paintings; composing music; dancing or acting in dramatic productions or directing such productions. Supervision of other workers may be included. Occupations in this minor group are classified into the following five unit groups (ISCO 4-digit):

2451 Authors, journalists and other writers;

2452 Sculptors, painters and related artists;

2453 Composers, musicians and singers;

2454 Choreographers and dancers;

2455 Film, stage and related actors and directors.

First, we will assess overall educational requirements in the group of occupations ISCO 245 as determined by the European Social Survey 2004/2005 and 2010/2011 (ESS 2 and 5).

Two thirds of the job holders in this occupational group believe that newcomers applying for a job in their occupation will be required to have from 3 to 7 (predominantly 4 to 5) years of education beyond compulsory education. Two groups of job holders of almost the same size (about 17 % each) believe that education required will be longer or shorter (see Table 3.1). This confirms a great dispersion of requirements within occupational groups concerning individual occupations (units) or individual jobs forming the group.

Table 3.1 Years of education beyond compulsory needed

ESS - 2 (2004/2005) & 5 (2010/2011)	Years of education beyond compulsory needed by applicant for your job									Total
Highest level of education	No education needed	Less than 1 year	About 1 year	About 2 years	About 3 years	About 4-5 years	About 6-7 years	About 8-9 years	10 years or more	
ISCO 245 Writers and creative or performing artists	4.9%	1.4%	5.2%	5.7%	15.7%	30.0%	20.9%	8.6%	7.6%	100.0%

Source: EPC

Next, we assess five occupational groups at the 4th ISCO level by using the classification of education applied in the ESS and completed as described above (see Chapter 1) to have eight internationally comparable levels of education. The following table allows us to draw some conclusions.

At the 4th level of classification, the markedly largest proportion of jobs in Europe within the group of occupations ISCO 245 fall under ISCO 2451, and far less under ISCO 2452 and ISCO 2453. Hence the group of occupation 2451 is decisive for determining the level of education in the whole ISCO 245 occupational group. A large part of job holders (over 60%) have attained the master´s or the bachelor´s degree, although almost a third of job holders have attained only upper secondary (IIIa) and advanced vocational education (IV) levels.

Table 3.2 Highest level of education

ESS - 2 (2004/2005) & 5 (2010/2011)	ISCO 2451	ISCO 2452	ISCO 2453	ISCO 2454	ISCO 2455	ISCO 2450	ISCO 245
Highest level of education	Authors, journalists and other writers	Sculptors, painters and related artists	Composers, musicians and singers	Choreographers and dancers	Film, stage and related actors and directors	245 Not further classified	**Total**
ES-ISCED I , less than lower secondary	0%	1%	0%	0%	0%	0%	1%
ES-ISCED II, lower secondary	1%	1%	1%	0%	1%	0%	3%
ES-ISCED IIIb, lower tier upper secondary	1%	2%	1%	0%	0%	0%	5%
ES-ISCED IIIa, upper tier upper secondary	7%	4%	2%	1%	2%	1%	18%
ES-ISCED IV, advanced vocational, sub-degree	6%	3%	3%	0%	1%	1%	14%
ES-ISCED V1, lower tertiary education, BA level	12%	5%	3%	0%	3%	1%	24%
ES-ISCED V2, higher tertiary education, MA level	16%	6%	6%	1%	4%	1%	34%
ES-ISCED V3, highest tertiary education, PhD level	1%	1%	0%	0%	0%	0%	3%
Total	44%	22%	17%	2%	11%	4%	100%

Source: EPC

Of course, even the 4th ISCO level containing about 450 groups of occupations does not suffice to clearly specify skill needs. In our specific example the composition of the unit group of occupations ISCO 2451 *Authors, journalists and other writers* is discussed. Although it is the lowest ISCO level possible, it still contains such different occupations as *Author, Copywriter, Advertising, Critic, Editor, Journalist, Writer and Technical writer*, whose Occupational Skills Profiles can be quite different. If we go up to higher levels of classification, as for instance to the ISCO 3-digit level, far more different occupations are mixed together. The minor group of occupations ISCO 245 includes besides ISCO 2451 also other unit groups of occupations as ISCO 2452, ISCO 2453, ISCO 2454 and ISCO 2455, that are for example *sculptors, painters and related artists, composers, musicians and singers, choreographers and dancers, film, stage and related actors and directors*. This conclusion is, of course, particularly true for still higher levels of aggregation, for the 2-digit level of the

sub-major group of occupations 24 and even more for the 1-digit level of the major group of occupations 2.

Perhaps an even more complicated situation can be demonstrated when using American data, taken over from the US BLS and O*NET (more in detail in Chapter 1), and defined by the US classification of occupations SOC that contains almost a thousand of individual occupations. After linking the ISCO and the US SOC together it has become evident that under the occupational group ISCO 245 it is possible to classify 16 individual occupations as defined by the US SOC (indicated in the two tables below)[13]. And in the same way it is possible to aggregate 4 relevant individual industries as defined at the fourth NAIRIC level into the sector NACE 22 *Publishing, printing & reproduction of recorded media.*

The next tables (Table 3.3 and Table 3.4) contain data about individual occupations as defined in the US SOC falling under the ISCO 245 group of occupations, numbers of jobs in them in the US economy 2010, educational attainment of job holders 25 years old and older, typical education needed for entry into the occupation, work experience in a related occupation, and typical type on-the-job training needed to attain competency in the occupation.

Table 3.3 BLS Employment Matrix by occupation and education & training

USA 2010			Educational attainment for workers 25 years and older							Education and training assignments by detailed occupation		
SOC code (for ISCO 245)	SOC Occupation name	Employment 2010 (thousands)	Less than high school diploma	High school diploma or equivalent	Some college, no degree	Associate's degree	Bachelor's degree	Master's degree	Doctoral or professional degree	Typical education needed for entry	Work experience in a related occupation	Typical on-the-job training needed to attain compe-tency in the occupation
27-1011	Art Directors	84.2	3.0%	11.4%	19.6%	9.6%	42.4%	12.5%	1.6%	Bachelor's degree	1 to 5 years	None
27-1012	Craft Artists	13.6	3.0%	11.4%	19.6%	9.6%	42.4%	12.5%	1.6%	High school diploma or equivalent	None	Long-term on-the-job training
27-1013	Fine Artists, Including Painters, Sculptors, and Illustrators	23.6	3.0%	11.4%	19.6%	9.6%	42.4%	12.5%	1.6%	High school diploma or equivalent	None	Long-term on-the-job training
27-1019	Artists and Related Workers, All Other	21.5	3.0%	11.4%	19.6%	9.6%	42.4%	12.5%	1.6%	High school diploma or equivalent	None	Long-term on-the-job training
27-2011	Actors	56.5	3.1%	9.7%	20.8%	6.7%	45.8%	12.5%	1.3%	Some college, no degree	None	Long-term on-the-job training
27-2012	Producers and Directors	98.6	1.0%	6.4%	14.8%	6.0%	56.4%	12.9%	2.5%	Bachelor's degree	1 to 5 years	None
27-2031	Dancers	13.0	14.3%	25.9%	27.4%	7.3%	21.5%	3.2%	0.3%	High school diploma or equivalent	None	Long-term on-the-job training
27-2032	Choreographers	16.2	14.3%	25.9%	27.4%	7.3%	21.5%	3.2%	0.3%	High school diploma or equivalent	More than 5 years	Long-term on-the-job training
27-2041	Music Directors and Composers	53.6	4.6%	15.1%	22.1%	5.2%	30.7%	18.4%	3.9%	Bachelor's degree	1 to 5 years	None
27-2042	Musicians and Singers	186.4	4.6%	15.1%	22.1%	5.2%	30.7%	18.4%	3.9%	High school diploma or equivalent	None	Long-term on-the-job training
27-3021	Broadcast News Analysts	7.7	0.3%	3.0%	10.5%	3.9%	61.2%	18.3%	2.8%	Bachelor's degree	None	None
27-3022	Reporters and Correspondents	61.6	0.3%	3.0%	10.5%	3.9%	61.2%	18.3%	2.8%	Bachelor's degree	None	None
27-3041	Editors	129.6	0.6%	3.7%	10.6%	4.0%	56.6%	19.7%	4.8%	Bachelor's degree	1 to 5 years	None
27-3042	Technical Writers	48.9	0.5%	5.2%	13.7%	7.3%	47.4%	19.9%	5.9%	Bachelor's degree	1 to 5 years	Short-term on-the-job training
27-3043	Writers and Authors	151.7	0.5%	2.9%	9.2%	3.0%	49.8%	26.2%	8.4%	Bachelor's degree	None	Long-term on-the-job training
27-3099	Media and Communication Workers, All Other	34.3	3.3%	11.7%	22.8%	14.1%	30.1%	13.5%	4.5%	High school diploma or equivalent	None	Short-term on-the-job training
Total		1001.0	2.5%	9.0%	16.5%	5.9%	44.6%	17.5%	4.0%			

Source: EPC

[13] If, for instance, instead of O*NET / SOC the Italian classification – developed as a part of the project *Indagine sulle professioni* – be used, 19 occupations would be classified from more than 800 occupations, should the far more detailed Czech classification *KZAM* – established in 1991 by adopting all four levels of the ISCO-88 and extending it by the fifth national level – be used, 62 occupations of about 3500 occupational units would be classified. It is obvious that the size of about one thousand of occupational units suffices for disaggregating occupational groups defined at a higher level.

Table 3.4 O*NET Requirements by Occupation

USA 2010		Required Level of Education											
SOC code (for ISCO 245)	SOC Occupation name	Less than a High School Diploma	High School Diploma	Post-Secondary Certificate	Some College Courses	Associate's Degree	Bachelor's Degree	Post-Baccalaureate Certificate	Master's Degree	Post-Master's Certificate	First Professional Degree	Doctoral Degree	Post-Doctoral Training
27-1011	Art Directors	0%	0%	0%	11%	66%	24%	0%	0%	0%	0%	0%	0%
27-1012	Craft Artists	15%	36%	9%	9%	12%	18%	0%	0%	0%	0%	0%	0%
27-1013	Fine Artists, Including Painters, Sculptors, and Illustrators	16%	22%	5%	15%	9%	22%	3%	3%	0%	5%	0%	0%
27-2011	Actors	52%	8%	0%	28%	0%	9%	1%	0%	0%	2%	0%	0%
27-2012	Producers and Directors	2%	9%	6%	21%	7%	45%	5%	1%	0%	4%	0%	0%
27-2031	Dancers	47%	35%	0%	0%	3%	14%	1%	1%	0%	0%	0%	0%
27-2032	Choreographers	8%	32%	4%	12%	4%	28%	0%	8%	0%	4%	0%	0%
27-2041	Music Directors and Composers	8%	4%	1%	15%	12%	39%	4%	6%	6%	0%	6%	0%
27-2042	Musicians and Singers	22%	31%	0%	17%	0%	11%	0%	19%	0%	0%	0%	0%
27-3021	Broadcast News Analysts	0%	7%	0%	1%	14%	75%	1%	2%	0%	0%	0%	0%
27-3022	Reporters and Correspondents	1%	1%	0%	9%	2%	64%	7%	16%	0%	0%	0%	0%
27-3041	Editors	0%	2%	0%	7%	7%	73%	1%	3%	0%	6%	0%	0%
27-3042	Technical Writers	0%	2%	0%	1%	4%	92%	1%	0%	0%	0%	0%	0%
27-3043	Writers and Authors	8%	16%	0%	13%	5%	52%	2%	3%	0%	0%	0%	2%

Source: EPC

As all the three problems – of aggregation, transposition and disaggregation – are intertwined, it is necessary to explain in detail how to:

- link together the international and US classifications of sectors/industries (NACE, used by the Eurostat for European countries, and NAIRIC, used in the USA),
- similarly link classifications for occupations (ISCO and SOC),
- use their linkage for comparing European and US projections of employment in individual sectors, occupational groups and jobs.

3.2 Transposition of US data to European classifications

Table 3.5 illustrates the first stage of the process. US data have been transposed by using two correspondence tables, NACE to NAIRIC, and ISCO to SOC. The twin-table shows, first, the employment in the US economy in 2006 for all SOC occupations which map into ISCO 245, and at the same time are under those NAIRIC individual industries which are aggregated to NACE 22. Reading the table horizontally, total employment (taken from the US data) is indicated for each occupation, followed by the number of jobs in the respective NAIRIC individual industry, while the last column to the right (that is the sum of the previous four columns) indicates the result transposed to the international classification – the sector NACE 22. The same process is applied vertically: again, the first row indicates total employment, further sixteen rows indicate the position of respective occupations; the last row, the sum of all jobs in respective SOC occupations and NAIRIC individual industries, is already transposed to the occupational group ISCO 245, while the final total sum (the last column to the right) is transposed both to ISCO 245 and to NACE 22. The second part of the twin table repeats the exercise for the projection for 2020.

Table 3.5 illustrates a very uneven distribution of individual occupations in different sectors. Those employed in occupations more or less akin to art and literature represent more than 70 % of all jobs in the occupational group ISCO 245 across sectors, in the whole economy, whereas *Reporters and Correspondents* and *Editors* represent less than 18 % of jobs in this occupational group. The latter, on the contrary, represent in the sector *Publishing, printing & reproduction of recorded media* (NACE 22) more than 80 % of jobs in the whole occupational group ISCO 245, whereas the former represent less than 15 % (mostly *Writers and Authors*).

An uneven distribution of occupations persists in the ten-year projection. According to it, for example, the total employment in US economy will increase by more than 14 % in the period 2010-2020 but the employment in the sector NACE 22 will decrease by almost 9 %. Most occupations in the occupational group ISCO 245 will grow taken across sectors, in the whole economy, but fall in the sector NACE 22. This is also why the number of jobs in occupations such as *Writers, Technical Writers, Authors, Music Directors and Composers* is expected to increase rapidly, while the number of jobs in occupations *Reporters and Correspondents* and *Editors* will stagnate.

Table 3.5 Transposition of US data to European classifications

Jobs / Employment in US Economy 2010 by industries and by occupation for sector NACE 22 and group of occupations ISCO 245 *(Employment Projection 2010-2020. US BLS 2012)*		Total employment, all workers	Printing and related support activities	Manufacturing and reproducing magnetic and optical media	Newspaper, periodical, book, and directory publishers	Motion picture, video, and sound recording industries	Publishing, printing & reproduction of recorded media
SOC code:	**2010 NAIRIC code:**	**Total**	3231	3346	5111	5120	**NACE 22**
00-0000	**Total, all occupations, USA 2010**	**143 068 200**	**486 900**	**24 900**	**501 300**	**372 000**	**1 385 100**
27-1011	Art Directors	66 500	700		1 300	100	2 100
27-1012	Craft Artists	3 500					*<50*
27-1013	Fine Artists, Including Painters, Sculptors, and Illus	6 900			200		200
27-1014	Multimedia Artists and Animators	17 300	100	100	400		600
27-1019	Artists and Related Workers, All Other	6 300					*<50*
27-2011	Actors	31 500					*<50*
27-2012	Producers and Directors	87 200			200	600	800
27-2031	Dancers	5 500					*<50*
27-2032	Choreographers	12 400					*<50*
27-2041	Music Directors and Composers	49 900				200	200
27-2042	Musicians and Singers	88 000					*<50*
27-3021	Broadcast News Analysts	6 300			100		100
27-3022	Reporters and Correspondents	40 700			26 900		26 900
27-3041	Editors	55 500	300	100	23 500	100	24 000
27-3042	Technical Writers	36 300		100	200		300
27-3043	Writers and Authors	30 800			3 100	100	3 200
27-3099	Media and Communication Workers, All Other	16 000			300	100	400
ISCO 245	Writers and creative or performing artists	**560 600**	**1 100**	**300**	**56 200**	**1 200**	**58 800**

Jobs / Employment in US Economy 2010 by industries and by occupation for sector NACE 22 and group of occupations ISCO 245 *(Employment Projection 2010-2020. US BLS 2012)*		Total employment, all workers	Printing and related support activities	Manufacturing and reproducing magnetic and optical media	Newspaper, periodical, book, and directory publishers	Motion picture, video, and sound recording industries	Publishing, printing & reproduction of recorded media
SOC code:	**2020 NAIRIC code:**	**Total**	3231	3346	5111	5120	**NACE 22**
00-0000	**Total, all occupations, USA 2020**	**163 537 100**	**454 700**	**21 900**	**439 700**	**347 000**	**1 263 300**
27-1011	Art Directors	72 200	700		1 000		1 700
27-1012	Craft Artists	4 100					*<50*
27-1013	Fine Artists, Including Painters, Sculptors, and Illus	8 300			200		200
27-1014	Multimedia Artists and Animators	21 900	100	100	300		500
27-1019	Artists and Related Workers, All Other	5 900					*<50*
27-2011	Actors	34 700					*<50*
27-2012	Producers and Directors	98 900			100	200	300
27-2031	Dancers	5 900					*<50*
27-2032	Choreographers	15 300					*<50*
27-2041	Music Directors and Composers	52 200				100	100
27-2042	Musicians and Singers	92 100					*<50*
27-3021	Broadcast News Analysts	6 900			100		100
27-3022	Reporters and Correspondents	36 700			21 100		21 100
27-3041	Editors	53 600	300	100	16 600		17 000
27-3042	Technical Writers	43 200		100	100		200
27-3043	Writers and Authors	34 700			2 400		2 400
27-3099	Media and Communication Workers, All Other	18 400			200		200
ISCO 245	Writers and creative or performing artists	**605 000**	**1 100**	**300**	**42 100**	**300**	**43 800**

Source: EPC

Note 1: For statistical reasons (by the US rules) the table does not contain data for cells containing fewer than 50 cases.

Note 2: Five occupations have no or very low employment (less than 50) in the sector NACE 22 (although they are quite numerous in other sectors) and are not included in the employment of the sector NACE 22. Respective cells are coloured in grey.

The table is, in fact, only part of a large matrix based on US data and containing 352 industries defined at the 4th NAIRIC level by 826 individual occupations defined by SOC (out of more than 290 thousand cells of the matrix many will be empty, of course). The large matrix is then transposed into international classifications (used by EUROSTAT) and, at the same time, aggregated into a smaller matrix containing 38 NACE sectors used in European projections at this moment and 110 occupational groups at the ISCO 3-digit level, which can always find its counterpart in several SOC individual occupations.

To sum up the approach in different words, a qualification profile for any ISCO 3-digit occupational group represented in a given NACE sector is prepared by using knowledge about how individual occupations (classified by the SOC and described by the O*NET) are represented in those NAIRIC individual industries which correspond to a given NACE sector.

To appreciate the added value of the approach developed in this study, it must be considered that without the estimates obtained on the basis of the correspondence matrices provided between the USA and Europe data sources the table above would have only limited to four overall values indicated in the four corners of the table. On the other side, this approach is limited to a strictly specified objective, that is to determine sector-specific Occupational Skills Profiles, and it is not possible to transfer the inner - US based - contents of the table neither to various countries nor over time.

3.3 Constructing a sector-specific profile

Finally, Table 3.6 shows the second stage of the process: how a sector-specific Occupational Skills Profile has been arrived at. As already stated, a relatively narrow occupational group ISCO 245 and the sector NACE 22 serve as an example. Moreover, the table also illustrates how different results have been obtained for the seven dimensions of Occupational Skills Profiles.

To begin with, let us compare the Occupational Skills Profile of the occupational group ISCO 24 *Other Professional* with those of ISCO 245 *Writers and creative or performing artists* (which is a part of ISCO 24) and of concrete SOC occupations included in ISCO 245 (the table indicates four examples of them). It is quite understandable that their respective Occupational Skills Profiles differ a lot, as ISCO 245 jobs represent only about 15 % of all ISCO 24 jobs. Due to other large groups (for instance ISCO 241 *Business professionals*, ISCO 242 *Legal professionals* or ISCO 244 *Social science and related professionals*), the whole occupational group ISCO 24 requires a higher level of formal qualification, with a strong role for economics and law, which is quite different from ISCO 245.

Similar marked differences also exist between the occupational group ISCO 245 and individual occupations contained in it. Some occupations are quite demanding in terms of qualification requirements (*Reporters and Correspondents*), some only moderately (*Actors*). Some occupations require education in art (*Actors*), some in humanities or social sciences (*Producers and directors*). At higher levels of aggregation, however, the values are closer to the average or tilted towards predominant occupational groups. Any marked individual differences at the detailed occupational level get suppressed.

Moreover, the representation of individual occupations across sectors differs a lot as well. For instance, *Reporters and Correspondents (*and the corresponding ISCO occupation *Journalists)* represent only about 6 % of ISCO 245 jobs taken across all sectors, but one third of all jobs of the sector NACE 22 *Publishing, printing and reproduction of recorded media*, as two third of journalists work within this sector. On the contrary, *Actors* representing almost 8 % of ISCO 245 jobs (taken across all sectors) are almost non-existent in the sector NACE 22. Whereas the impact of *Reporters and Correspondents* on the ISCO 245 profile is significant, the one of actors is nil.

The occupation *Reporters and Correspondents* has a rather different Occupational Skills Profile compared to other occupations of the ISCO 245 occupational group in the sector NACE 22. From the point-of-view of the level of qualification requirements, the 7th level of qualification requirements (that of a master's degree) prevails, while it is the 6th level (that of

a bachelor's degree) that prevails otherwise across the occupational group. Similar differences can be observed as regards fields of education/training. Whereas in the occupation *Reporters and Correspondents* mostly graduates in social, media and cultural studies are sought-after, in the occupational group ISCO 245 it is the graduates in art studies that are required. Similarly, it is possible to find great differences when comparing other dimensions of Occupational Skills Profiles.

As for the first proposition, the table shows that the results concerning dimensions of an Occupational Skills Profile depend largely on the level of detail at which they have been determined. Three levels have been considered: besides the ISCO 2-digit and the ISCO 3-digit levels (with 27 and 110 occupations respectively) also the more detailed level of individual occupations. In the left part of the table very different outcomes are indicated: for the occupational group ISCO 24, for the occupational group ISCO 245, and finally for four individual occupations which all would come under the occupational group 245 – *Actors, Art directors, Producers and directors, Reporters* and *Correspondents* (these four occupations have been selected out of the 16 SOC occupations which come under ISCO 245 according to the correspondence table).

As for the second proposition, the sector-specific way of aggregation is illustrated using the example of the sector NACE 22 *Publishing, printing and reproduction of recorded media* (which was the first one that the EPC analysed). The difference in results is clearly shown by comparing the columns headed ISCO 24 and ISCO 245 (those on the left are based on results for all sectors added together, whereas those on the right are sector-specific, based on the observed jobs weights for NACE 22, reflecting actual jobs shares as classified by the US SOC and transposed to the ISCO 3-digit by using the EPC correspondence table).

Table 3.6 An example of a sector-specific profile

Occupational Skills Profile - OSP			Group of occupation		Individual occupation (SOC & ISCO 245)				NACE 22 specific	
OSP dimensions		OSP characteristics	ISCO 24	ISCO 245	Actors	Art directors	Producers & Directors	Reporters & Corresp.	ISCO 245	ISCO 24
Level of Qualification Requirements		Low	0%	1%	4%	0%	0%	0%	0%	0%
		Meduim	21%	19%	55%	54%	24%	3%	9%	9%
		High	79%	80%	41%	46%	76%	97%	91%	90%
		Average Years of Education	**15.1**	**15.2**	**13.5**	**13.8**	**15.0**	**15.9**	**15.6**	**15.6**
Field of Education / Training		General/ no specific field	3%	8%	5%	6%	10%	11%	9%	9%
		Art, fine/ applied	7%	36%	78%	48%	23%	4%	16%	13%
		Humanities	9%	14%	5%	2%	10%	21%	24%	20%
		Technical and engineering	6%	9%	1%	28%	13%	4%	7%	8%
		Agriculture/ forestry	1%	1%	0%	0%	0%	5%	1%	2%
		Teacher training/ education	3%	4%	1%	3%	3%	4%	5%	4%
		Science/ mathematics/ computing etc	2%	1%	0%	0%	1%	2%	2%	2%
		Medical/ health services/ nursing etc	2%	2%	0%	0%	0%	2%	2%	2%
		Economics/ business/ administration	29%	5%	0%	6%	14%	6%	5%	14%
		Social studies/ media/ culture	22%	17%	10%	6%	22%	36%	24%	22%
		Law and legal services	15%	1%	0%	0%	1%	2%	2%	2%
		Personal care services	1%	1%	0%	2%	2%	1%	1%	1%
		Public order and safety	0%	0%	0%	0%	0%	1%	1%	1%
		Transport and telecommunications	0%	1%	0%	0%	1%	1%	1%	1%
Knowledge	Level	Education and Training	19%	51%	37%	61%	44%	44%	46%	46%
		Arts and Humanities	19%	53%	55%	53%	45%	49%	52%	48%
		Social sciences, Economy and Law	21%	35%	35%	22%	34%	35%	33%	34%
		Sciences, Mathematics and Computers	21%	25%	12%	20%	24%	27%	27%	28%
		Engineering, Technology, Production an	35%	28%	13%	42%	33%	23%	26%	27%
		Helath services	32%	15%	16%	9%	8%	12%	12%	12%
		Services	46%	34%	17%	33%	42%	36%	34%	34%
		Bussiness and Management	47%	44%	24%	44%	49%	39%	41%	43%
	Importance	Education and Training	44%	46%	34%	43%	37%	36%	42%	41%
		Arts and Humanities	48%	59%	60%	56%	51%	57%	59%	55%
		Social sciences, Economy and Law	31%	34%	42%	21%	34%	32%	30%	32%
		Sciences, Mathematics and Computers	30%	21%	9%	16%	22%	22%	22%	23%
		Engineering, Technology, Production an	45%	29%	15%	42%	35%	22%	27%	28%
		Helath services	42%	13%	10%	7%	6%	11%	11%	11%
		Services	17%	37%	22%	36%	47%	38%	36%	36%
		Bussiness and Management	19%	43%	24%	50%	53%	37%	38%	41%
Skills	Level	Cognitive skills	19%	60%	45%	54%	57%	54%	56%	56%
		Communication in the mother language	36%	40%	23%	38%	46%	35%	35%	35%
		Comunication in foreign languages	34%	70%	52%	49%	54%	59%	55%	54%
		Numeracy & basic SMT concepts	12%	16%	9%	8%	15%	11%	18%	17%
		ICT/digital	11%	32%	6%	39%	37%	27%	32%	34%
		Learning to learn	49%	9%	1%	3%	20%	10%	7%	9%
		Practical skills	45%	64%	63%	61%	59%	52%	54%	53%
	Importance	Cognitive skills	68%	68%	53%	65%	69%	64%	64%	65%
		Communication in the mother language	58%	47%	29%	46%	54%	44%	44%	44%
		Comunication in foreign languages	28%	82%	73%	76%	81%	86%	80%	79%
		Numeracy & basic SMT concepts	24%	17%	8%	10%	17%	11%	17%	17%
		ICT/digital	75%	30%	5%	41%	37%	25%	30%	33%
		Learning to learn	60%	11%	1%	4%	19%	10%	10%	11%
		Practical skills	18%	63%	70%	61%	56%	46%	49%	49%
Competence		Personal abilities	75%	77%	80%	77%	80%	76%	76%	75%
		Social abilities	54%	59%	64%	65%	65%	57%	56%	56%
		Methodological abilities	58%	56%	49%	61%	71%	53%	56%	56%
Occupational Interests		Realistic	40%	17%	28%	33%	18%	11%	10%	11%
		Investigative	57%	23%	6%	6%	9%	50%	29%	30%
		Artistic	69%	89%	95%	100%	70%	89%	90%	76%
		Social	42%	25%	33%	22%	31%	28%	21%	22%
		Enterprising	13%	69%	61%	89%	98%	56%	73%	73%
		Conventional	44%	32%	11%	33%	48%	33%	42%	49%
Work Values		Achievement	72%	74%	78%	83%	76%	78%	74%	73%
		Working Conditions	70%	59%	53%	81%	69%	58%	58%	59%
		Recognition	64%	63%	61%	67%	77%	72%	67%	66%
		Relationships	67%	57%	83%	45%	69%	39%	48%	52%
		Support	53%	37%	17%	39%	42%	39%	45%	47%
		Independence	66%	70%	61%	89%	81%	67%	77%	75%

Source: EPC

Note 1: The characteristics of the first two dimensions – *Level of Qualification Requirements and Field of Education/Training* – indicate a relative, percentage distribution of jobs (the sum of the respective column – for all 8 EQF levels or for all 14 fields of education – makes 100 %). The characteristics of the remaining five dimensions – *Knowledge, Skills, Competence, Occupational Interests, and Work Values* – indicate the required level of the characteristics in question. Although in the O*NET data set the characteristics were expressed by different scales (e.g. 0-6, 0-5, 1-7 etc.), all they have been converted to percentage values 0 % - 100 % for their presentation, to make them more understandable and, in particular, comparable.

Note 2: The columns *Group of occupation* and *Individual occupation (SOC & ISCO 245)* covers all sectors. As for the column *Individual occupation (SOC & ISCO 245)*, we have to remember that O*NET defines characteristics for individual occupations regardless of the sector.

3.4 The substantiation of using US data for calculating OSPs in Europe

After reading the methodology most users of OSPs will be perhaps asking whether it is appropriate to use US data, such as the O*NET and the Occupational Projection and Training Data, for calculating OSPs for European countries. Are not occupational structures within sectors in the United States and European countries too different? Are O*NET questions perceived in the same way in Europe as in the US? Are data obtained for the O*NET database in the US similar to those that would be obtained in similar surveys in Europe?

Similar questions have been answered, of course, by the authors of this publication. They have been particularly related to dimensions 3 through 7, because the first two dimensions have been based either solely (as the second dimension - Fields of Education) or predominantly (as the first dimension - Qualification Requirements) on European data. On the other hand, for the calculation of dimensions 3 through 7 only O*NET data have been used.

In recent years two surveys based on O*NET questionnaires have been concluded in EU countries, *Indagine sulle professioni* in Italy and *Kvalifikace 2008* in the Czech Republic.

The results of both surveys can be compared with O*NET data at the ISCO 2 digit level as well as at the ISCO 3 digit level. Correlation analysis was used for testing the degree of similarity between both European surveys and the O*NET.

Table 3.7 Correlation with the O*NET data

			ISCO 3D		ISCO 2D	
			Italy	Czech	Italy	Czech
Knowledge	01 Education and Training	Importance	0.812	0.771	0.848	0.919
		Level	0.814	0.743	0.823	0.817
	02 Arts and Humanities	Importance	0.845	0.87	0.921	0.995
		Level	0.870	0.893	0.925	0.845
	03 Social sciences, Economy and Law	Importance	0.855	0.771	0.930	0.923
		Level	0.872	0.925	0.938	0.993
	04 Sciences, Mathematics and Computers	Importance	0.817	0.804	0.811	0.836
		Level	0.821	0.82	0.818	0.87
	05 Engineering, Technology, Production	Importance	0.752	0.693	0.742	0.759
		Level	0.732	0.792	0.703	0.734
	06 Helath services	Importance	0.884	0.855	0.927	0.906
		Level	0.882	0.914	0.890	0.853
	07 Services	Importance	0.731	0.774	0.618	0.665
		Level	0.773	0.697	0.691	0.611
	08 Bussiness and Management	Importance	0.683	0.687	0.878	0.853
		Level	0.757	0.797	0.899	0.876
Skills	01 Cognitive skills	Importance	0.743	0.715	0.892	0.962
		Level	0.774	0.683	0.900	0.915
	02 Practical skills	Importance	0.766	0.67	0.814	0.859
		Level	0.763	0.711	0.795	0.735
	03 Communication in the mother language	Importance	0.886	0.836	0.950	0.953
		Level	0.834	0.841	0.926	0.978
	04 Comunication in foreign languages	Importance	0.338	0.291	0.428	0.491
		Level	0.489	0.536	0.596	0.602
	05 Numeracy + basic SMT concepts	Importance	0.474	0.507	0.512	0.484
		Level	0.528	0.461	0.640	0.697
	06 ICT/digital	Importance	0.835	0.895	0.818	0.756
		Level	0.856	0.929	0.825	0.875
	07 Learning to learn	Importance	0.787	0.703	0.851	0.815
		Level	0.797	0.714	0.917	0.958
Competence	01 Personal abilities	Importance	0.714	0.782	0.897	0.924
		Level	0.220	0.281	0.448	0.36
	02 Social abilities	Importance	0.830	0.861	0.923	0.912
		Level	0.848	0.763	0.922	0.964
	03 Methodical abilities	Importance	0.662	0.75	0.871	0.855
		Level	0.758	0.673	0.904	0.999
		min	0.220	0.281	0.428	0.360
		max	0.886	0.929	0.950	0.999
		avg	0.745	0.734	0.811	0.821

Source: EPC

As can be seen, correlations are quite or very high, mostly around 0.8, with two exceptions: for the level of *Personal abilities*, and for the level and importance of *Communication in foreign languages*.

The difference in the required level and importance of *Communication in foreign languages* is to be expected, of course, the knowledge of foreign languages is required of US residents substantially less (firstly, the US economy represents a huge and relatively self-sufficient market, and secondly, American will use English outside it) than of Italians and even more so of Czechs (firstly, the Czech economy represents a very small and very open market, and secondly, Czech is hardly ever used outside the country).

Personal abilities cover various kinds of competence as thinking creatively, leadership, originality, initiative, cooperation and so on. The fact that the linear correlation of European and US data across occupations in this dimension is different points to a different perception of this type of competence in the United States and Europe, which refers to other issues that are, however, outside the scope of our methodology.

On the whole, correlations are so high that we feel fully justified to use US data for constructing OSPs for European countries. Still, both exemptions mentioned have to be kept in mind.

4. Examples of results obtained

Examples illustrating the use of Occupational Skills Profiles have been taken from the project *Forecasting of skill supply and demand in Europe to 2020*, where the new approach has been applied.

OSPs have been calculated for each of 33 European countries (EU27 countries and Croatia, FYROM, Iceland, Norway, Switzerland and Turkey) as well as for the EU27 as a whole, for each of 38 sectors and 37 occupations, and for three years – 2000, 2010 and 2020.

Just a few data should be mentioned in order to illustrate the magnitude of the exercise. For each country the results were presented in two tables – for sectors and for occupations: both tables have 66 columns (corresponding to the detailed structuring of dimensions as described in Chapter 2), the sector table has 114 rows (37 occupations plus the economy as a whole for three years, that is 38 x 3), the occupation table has 117 rows (38 sectors plus economy as a whole for three years, that is 39 x 3), which makes a total of more than 15 thousand cells for each country.

To indicate the range and contribution of results obtained three examples have been chosen, each covering a different area and comparing different type of data at different levels. The first example summarises the development of all seven dimensions during the period 2000-2020 for the whole EU27 (4.1). The second example looks into the different development of the Level of Qualification Requirements (Dimension 1) by sector and by occupation (4.2). The third example analyses and examines why Qualification Requirements and occupational structures of three selected sectors (Agriculture, Motor vehicles, Health and social work) differ so much across EU27 countries (4.3).

4.1 Change of OSP dimensions in time at EU level

This example illustrates the change in all seven dimensions of an Occupational Skills Profile aggregated at the highest possible level, that of the whole economy of the EU27, in the period 2000-2010-2020. Detailed tables are introduced by Box 4.1 summing up extreme changes in each dimension between the years 2010-2020.

Box 1 Extreme changes in OSP dimensions

1 **Level of Qualifications Requirements**: A limited increase (0.12 years) is expected for the Average Years of Education required for jobs in the EU27 in 2010-2020.

2 **Fields of Study**: In the EU27 is the highest growth expected for jobs where the required Field of Study is *Economics, commerce, business and administration*. On the other hand, jobs where the required Field of Study is *Agriculture/forestry* should decline the most.

3 **Knowledge**: The highest increase in Knowledge is expected in *Engineering, Technology, Production and Processing* and *Health Services*.

4 **Skills**: The importance and level of *Numeracy & basic SMT concepts* and *ICT/digital* will increase the most.

5 **Competences**: The importance and level of *Methodological abilities* will increase the most.

6 **Occupational Interests**: The importance of the personality type *Enterprising* will increase the most.

7 **Working Values**: The importance of *Recognition* and *Achievement* will be the most growing dimensions.

The detailed results for each dimension are condensed in the following tables. They have an identical structure, indicating for all categories (listed vertically as rows) of the respective dimension their relative proportion (for Dimensions 1 and 2 also absolute numbers) and the change between years 2000, 2010, and 2020 (horizontally as columns).

Dimensions 1 and 2 – Coordinating characteristics:

Table 4.1 - Level of Qualification Requirements

EU 27		Number of jobs (in thousand)			% of total			Change 2000-2020		Change 2000-2010		Change 2010-2020	
		2000	2010	2020	2000	2010	2020	Number	Share of Total	Number	Share of Total	Number	Share of Total
Required Education Level	Low	54 535	52 353	52 135	25.71%	23.45%	22.58%	-2 400	-3.13	-2 182	-2.26	-219	-0.87
	Medium	103 864	106 307	107 013	48.96%	47.62%	46.36%	3 149	-2.61	2 442	-1.34	706	-1.27
	High	53 721	64 558	71 698	25.33%	28.92%	31.06%	17 976	5.73	10 836	3.60	7 140	2.14
	Total	212 121	223 218	230 845	11.98	12.22	12.34	18 724	0.35	11 097	0.23	7 627	0.12
					Average years of education								

Source: EPC

Table 4.2 - Field of Study

EU 27		Number of jobs (in thousand)			% of total			Change 2000-2020		Change 2000-2010		Change 2010-2020	
		2000	2010	2020	2000	2010	2020	Number	Share of Total	Number	Share of Total	Number	Share of Total
Field of Education	General/no specific field	33 583	34 818	35 727	15.83%	15.60%	15.48%	2 144	-0.36	1 235	-0.23	909	-0.12
	Art, fine/applied	3 135	3 551	3 768	1.48%	1.59%	1.63%	633	0.15	416	0.11	217	0.04
	Humanities	3 290	3 700	3 864	1.55%	1.66%	1.67%	574	0.12	410	0.11	164	0.02
	Technical and engineering	63 107	62 795	63 327	29.75%	28.13%	27.43%	220	-2.32	-312	-1.62	531	-0.70
	Agriculture/forestry	10 017	8 881	8 730	4.72%	3.98%	3.78%	-1 287	-0.94	-1 136	-0.74	-151	-0.20
	Teacher training/ education	10 031	10 998	11 070	4.73%	4.93%	4.80%	1 039	0.07	967	0.20	72	-0.13
	Science/mathematics/ computing etc	5 290	6 006	6 479	2.49%	2.69%	2.81%	1 190	0.31	716	0.20	474	0.12
	Medical/health services/ nursing etc	13 398	16 115	16 896	6.32%	7.22%	7.32%	3 497	1.00	2 716	0.90	781	0.10
	Economics/commerce/business administration	39 041	41 745	44 029	18.40%	18.70%	19.07%	4 988	0.67	2 704	0.30	2 284	0.37
	Social studies/administration/media/culture	7 688	8 870	9 822	3.62%	3.97%	4.25%	2 134	0.63	1 181	0.35	952	0.28
	Law and legal services	2 123	2 635	2 878	1.00%	1.18%	1.25%	755	0.25	512	0.18	243	0.07
	Personal care services	12 544	13 986	14 617	5.91%	6.27%	6.33%	2 073	0.42	1 441	0.35	631	0.07
	Public order and safety	3 585	4 353	4 678	1.69%	1.95%	2.03%	1 093	0.34	768	0.26	325	0.08
	Transport and telecommunications	4 482	4 766	4 960	2.11%	2.14%	2.15%	478	0.04	284	0.02	194	0.01
	Total	212 121	223 218	230 845	99.62%	100.00%	100.00%	18 724		11 097		7 627	

Source: EPC

Dimensions 3 to 5 – Main characteristics:

Table 4.3 - Knowledge

EU 27			2000	2010	2020	2000-2020 (p. p.)	2000-2010 (p. p.)	2010-2020 (p. p.)
Knowledge	Importance	01 Education and Training	46.38%	42.56%	42.62%	-3.76	-3.83	0.06
		02 Arts and Humanities	47.91%	43.42%	43.62%	-4.29	-4.49	0.20
		03 Social sciences, Economy and Law	25.13%	23.93%	24.02%	-1.11	-1.20	0.10
		04 Sciences, Mathematics and Computers	23.70%	22.07%	22.17%	-1.53	-1.63	0.10
		05 Engineering, Technology, Production and Processing	31.36%	28.57%	28.86%	-2.49	-2.78	0.29
		06 Health services	29.61%	26.46%	26.74%	-2.87	-3.15	0.28
		07 Services	27.97%	23.06%	23.07%	-4.90	-4.91	0.01
		08 Business and Management	28.04%	22.82%	22.88%	-5.17	-5.22	0.05
	Level	01 Education and Training	26.48%	26.64%	26.56%	0.08	0.16	-0.09
		02 Arts and Humanities	26.01%	25.16%	25.08%	-0.93	-0.86	-0.08
		03 Social sciences, Economy and Law	24.90%	17.76%	17.92%	-6.98	-7.14	0.16
		04 Sciences, Mathematics and Computers	22.84%	16.39%	16.54%	-6.31	-6.45	0.14
		05 Engineering, Technology, Production and Processing	38.77%	38.48%	38.61%	-0.16	-0.28	0.12
		06 Health services	33.79%	32.56%	32.70%	-1.10	-1.23	0.14
		07 Services	38.49%	38.54%	38.74%	0.25	0.05	0.20
		08 Business and Management	37.47%	35.53%	35.80%	-1.67	-1.94	0.27

Source: EPC

Table 4.4 - Skills

EU 27			2000	2010	2020	2000-2020 (p. p.)	2000-2010 (p. p.)	2010-2020 (p. p.)
Skills	Importance	01 Cognitive skills	59.75%	56.42%	56.60%	-3.16	-3.33	0.17
		02 Practical skills	50.56%	46.73%	46.92%	-3.64	-3.83	0.19
		03 Communication in the mother language	35.16%	34.02%	33.81%	-1.35	-1.14	-0.21
		04 Communication in foreign languages	29.49%	27.84%	27.72%	-1.77	-1.64	-0.13
		05 Numeracy + basic SMT concepts	63.82%	60.46%	60.69%	-3.13	-3.37	0.24
		06 ICT/digital	51.32%	47.51%	47.74%	-3.58	-3.81	0.22
		07 Learning to learn	16.08%	15.14%	15.26%	-0.82	-0.94	0.12
	Level	01 Cognitive skills	14.62%	13.33%	13.46%	-1.16	-1.28	0.12
		02 Practical skills	35.83%	31.09%	31.22%	-4.60	-4.74	0.14
		03 Communication in the mother language	31.93%	27.71%	27.87%	-4.06	-4.22	0.16
		04 Communication in foreign languages	12.19%	9.72%	9.88%	-2.31	-2.47	0.16
		05 Numeracy + basic SMT concepts	11.05%	8.20%	8.38%	-2.67	-2.85	0.18
		06 ICT/digital	42.11%	39.13%	39.21%	-2.90	-2.98	0.08
		07 Learning to learn	40.03%	36.54%	36.68%	-3.35	-3.49	0.14

Source: EPC

Table 4.5 - Competences

EU 27		2000	2010	2020	2000-2020 (p. p.)	2000-2010 (p. p.)	2010-2020 (p. p.)
Competence	Importance	01 Personal abilities	68.41%	66.79%	66.92%	-1.49	-1.62	0.14
		02 Social abilities	46.89%	43.27%	43.44%	-3.45	-3.62	0.17
		03 Methodical abilities	53.06%	51.29%	51.54%	-1.52	-1.77	0.25
	Level	01 Personal abilities	45.07%	42.55%	42.79%	-2.28	-2.52	0.23
		02 Social abilities	51.29%	48.73%	48.88%	-2.41	-2.56	0.14
		03 Methodical abilities	40.10%	36.85%	37.09%	-3.01	-3.25	0.24

Source: EPC

Dimensions 6 and7 – Supplementary characteristics:

Table 4.6 - Occupational Interests

EU 27		2000	2010	2020	2000-2020 (p. p.)	2000-2010 (p. p.)	2010-2020 (p. p.)
Occupational Interests	Artistic	18.46%	15.42%	15.41%	-3.05	-3.04	-0.01
	Conventional	54.37%	58.87%	58.87%	4.49	4.49	0.00
	Enterprising	43.93%	47.19%	47.88%	3.95	3.25	0.69
	Investigative	38.66%	27.48%	27.78%	-10.89	-11.19	0.30
	Realistic	59.38%	59.51%	58.66%	-0.73	0.13	-0.85
	Social	36.75%	31.86%	32.16%	-4.59	-4.88	0.30

Source: EPC

Table 4.7 - Working Values

EU 27		2000	2010	2020	2000-2020 (p. p.)	2000-2010 (p. p.)	2010-2020 (p. p.)
Work Values	Achievement	51.58%	43.67%	44.17%	-7.41	-7.91	0.50
	Independence	56.20%	48.59%	48.89%	-7.31	-7.61	0.30
	Recognition	43.61%	36.20%	36.75%	-6.86	-7.40	0.55
	Relationships	60.41%	59.95%	60.17%	-0.24	-0.47	0.23
	Support	54.98%	55.84%	55.66%	0.68	0.86	-0.18
	Working Conditions	49.89%	43.92%	44.19%	-5.71	-5.98	0.27

Source: EPC

4.2 Differences in Qualification Requirements by sector and by occupation

To better show the full potential of the OSP approach, in this example differences across individual sectors, occupations and countries in the Level of Qualification Requirements (Dimension 1 of OSPs) are analysed and illustrated. In the first part of this sub-chapter differences in Dimension 1 by sector will be examined.

Dimension 1 of OSPs distinguishes eight levels of qualification requirements based on the EQF. The characteristics of the Level of Qualification Requirements indicate a percentage distribution of jobs for all the eight levels (their sum making 100 %). For a better measurability of differences across countries (or sectors or occupations), one aggregated index is constructed – the Total Level of Qualification Requirements (TQR). It is calculated as a scalar product of percentage distribution of jobs for all the eight levels of work complexity, corresponding to eight qualification levels (1-8).

The example below shows in detail how the TQR is calculated for two sectors (*01 Agriculture sector* and *02 Coal sector*) for the overall EU 27 data in the year 2010. TQR values for groups of occupations or for individual European countries are calculated in the same way.

Table 4.8 Total Level of Qualification Requirements (TQR)

EU27		Level of qualification requirements (EQF)								
		1	2	3	4	5	6	7	8	Total
2010	01 Agriculture	16.1%	24.3%	23.8%	15.9%	11.1%	4.4%	3.6%	0.8%	3.13
	02 Coal	8.1%	20.4%	24.8%	18.2%	14.1%	6.1%	6.7%	1.6%	3.63

TQR for Agriculture sector is equal to:

1*0.161+2*0.243+3*0.238+4*0.159+5*0.111+6*0.044+7*0.036+8*0.008 = **3.13**

TQR for Coal sector is equal to:

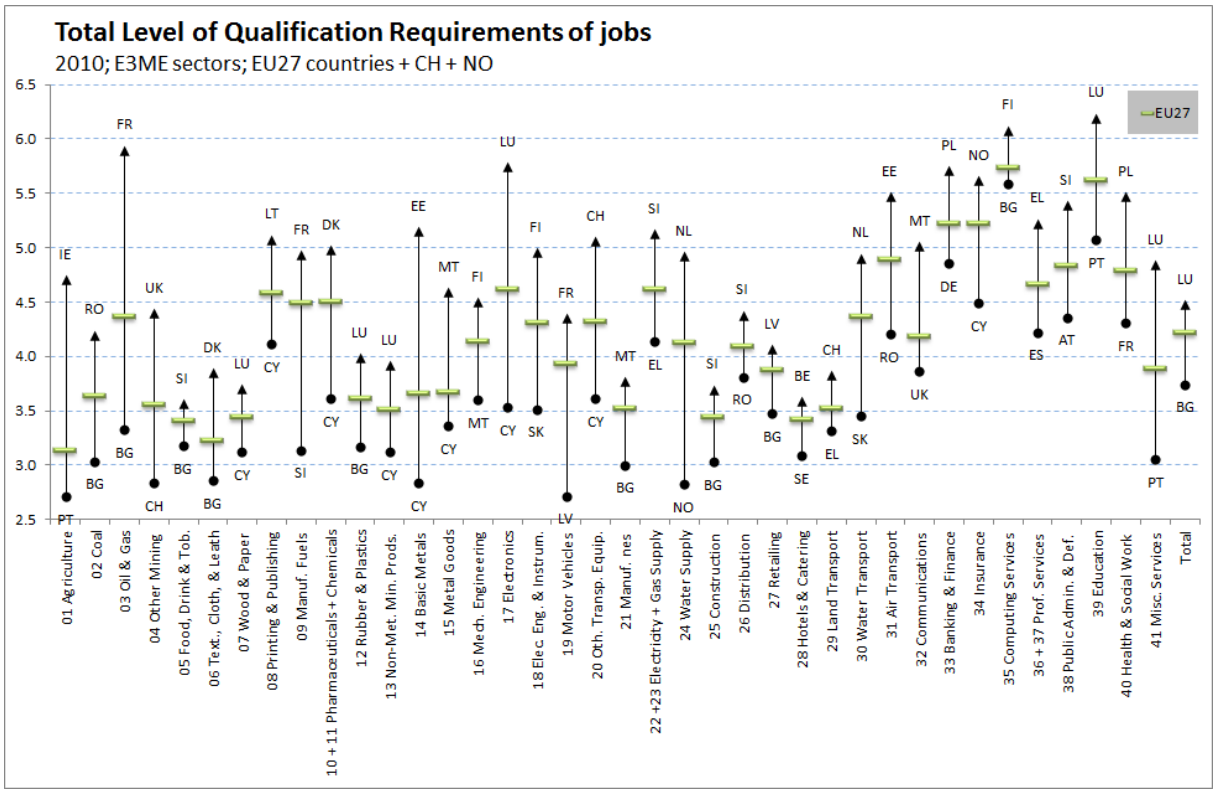
1*0.081+2*0.204+3*0.248+4*0.182+5*0.141+6*0.061+7*0.067+8*0.016 = **3.63**

Source: EPC

4.2.1 Analyses by sector

The TQR of jobs is calculated for each of the EU27 countries plus Switzerland and Norway and for the EU27 as a whole. Differences between countries relating to individual sectors are quite marked, as illustrated by Figure 5.1 indicating for each sector three values: the countries with maximum and the minimum levels of TQR and the EU27.

Figure 4.1 Total Level of Qualification Requirements of jobs by sectors



Source: EPC

It is apparent that there are high inter-country differences in each sector. Table 4.9 shows five sectors with the highest and five sectors with the lowest inter-country differences. They are measured as a difference between the highest and the lowest Total Level of Qualification Requirements of jobs (of countries) in a given sector.

Table 4.9 Maximal differences in Total Level of Qualification Requirements of jobs

	Sector	Difference
Sectors with the biggest inter-country differences	03 Oil & Gas	2.62
	14 Basic Metals	2.37
	17 Electronics	2.26
	24 Water Supply	2.15
	01 Agriculture	2.04
Sectors with the lowest inter-country differences	26 Distribution	0.62
	29 Land Transport	0.56
	28 Hotels & Catering	0.55
	35 Computing Services	0.54
	05 Food, Drink & Tob.	0.44
Average difference in all sectors		1.24

Source: EPC

However, comparison of sectors and countries only by the difference between maximum and minimum values of TQR may be misleading because little is known about the distribution of qualification requirement within countries. Therefore, it is also necessary to compare the standard deviation of the level of qualification requirements between all countries in a given sector (Table 4.10).

Table 4.10 Standard deviation of Total Level of Qualification Requirements of jobs

Sector	SD	Sector	SD
03 Oil & Gas	0.690	34 Insurance	0.256
17 Electronics	0.525	32 Communications	0.250
09 Manuf. Fuels	0.486	22 +23 Electricity + Gas Supply	0.238
41 Misc. Services	0.465	15 Metal Goods	0.231
24 Water Supply	0.438	16 Mech. Engineering	0.230
19 Motor Vehicles	0.409	33 Banking & Finance	0.228
14 Basic Metals	0.378	36 + 37 Prof. Services	0.221
01 Agriculture	0.378	Total	0.210
04 Other Mining	0.377	12 Rubber & Plastics	0.197
18 Elec. Eng. & Instrum.	0.376	21 Manuf. nes	0.184
20 Oth. Transp. Equip.	0.356	13 Non-Met. Min. Prods.	0.184
30 Water Transport	0.339	26 Distribution	0.171
10 + 11 Pharmaceuticals + Chemicals	0.336	25 Construction	0.166
02 Coal	0.329	07 Wood & Paper	0.159
38 Public Admin. & Def.	0.318	27 Retailing	0.143
31 Air Transport	0.280	29 Land Transport	0.132
40 Health & Social Work	0.269	35 Computing Services	0.129
39 Education	0.268	28 Hotels & Catering	0.116
08 Printing & Publishing	0.267	05 Food, Drink & Tob.	0.111
06 Text., Cloth, & Leath	0.259		

Source: EPC

It is interesting to note that, while sectors listed in Table 4.9 with the lowest inter-country differences are similarly sectors with the lowest standard deviation, sectors with the biggest inter-country differences do not necessarily show the highest standard deviation. For example, Basic Metals sector (14) which has the third highest inter-country differences is placed only 7th in Table 2. Similar differences are observed for Agriculture (01). It implies that in these sectors there is only a limited number of countries where qualification requirements differ significantly from other countries.

For instance, in Agriculture only two countries (Ireland and the Netherlands) show high TQR (see chapter 4.3.1). The 3rd highest level of TQR is in the Czech Republic (0.7 point lower than in the Netherlands and 1.3 points lower than in Ireland). For comparison, the difference of TQR in Agriculture between the Czech Republic and Portugal (that is country with the lowest TQR in this sector) is only less than 0.8. It means that in Agriculture there are two outlier countries, but all other countries are quite similar in this respect.

The next table (Table 4.11) shows sectors with the highest and lowest TQR for each country. Countries are sorted in ascending order by difference between sector with the highest and lowest TQR in a given country.

Table 4.11 Differences in Total Level of Qualification Requirements of jobs

Total Qualification requirements of jobs								
Country	Max		Whole economy	Min		Difference		
	TQR	Sector		TQR	Sector	Max-Tot	Tot-Min	Max-Min
IE	5.70	39 Education	4.35	3.26	25 Construction	1.35	1.09	2.44
DE	5.79	35 Computing Services	4.31	3.32	05 Food, Drink & Tob.	1.48	0.99	2.47
CZ	5.69	39 Education	4.24	3.21	06 Text., Cloth, & Leath	1.45	1.03	2.48
AT	5.75	39 Education	4.15	3.22	01 Agriculture	1.59	0.94	2.53
EU27	5.73	35 Computing Services	4.21	3.13	01 Agriculture	1.52	1.08	2.60
UK	5.86	35 Computing Services	4.38	3.25	01 Agriculture	1.48	1.12	2.61
RO	5.65	34 Insurance	3.75	3.01	06 Text., Cloth, & Leath	1.89	0.74	2.64
IT	5.60	35 Computing Services	4.12	2.96	01 Agriculture	1.48	1.16	2.64
PL	5.82	35 Computing Services	4.13	3.18	06 Text., Cloth, & Leath	1.69	0.95	2.64
DK	5.85	35 Computing Services	4.41	3.16	28 Hotels & Catering	1.44	1.25	2.69
BG	5.59	35 Computing Services	3.74	2.85	06 Text., Cloth, & Leath	1.85	0.88	2.73
BE	5.99	39 Education	4.50	3.25	01 Agriculture	1.49	1.25	2.74
FR	5.94	03 Oil & Gas	4.30	3.19	01 Agriculture	1.64	1.12	2.76
HU	5.76	35 Computing Services	4.15	3.00	04 Other Mining	1.61	1.15	2.76
NL	6.05	39 Education	4.51	3.27	28 Hotels & Catering	1.54	1.24	2.78
LT	5.83	35 Computing Services	4.27	3.03	01 Agriculture	1.56	1.24	2.80
EE	5.97	35 Computing Services	4.26	3.15	06 Text., Cloth, & Leath	1.71	1.11	2.82
SK	5.85	35 Computing Services	4.13	3.00	06 Text., Cloth, & Leath	1.72	1.13	2.85
FI	6.13	35 Computing Services	4.41	3.26	28 Hotels & Catering	1.71	1.16	2.87
SE	5.95	35 Computing Services	4.43	3.08	28 Hotels & Catering	1.52	1.35	2.87
CH	5.81	35 Computing Services	4.39	2.83	04 Other Mining	1.42	1.56	2.98
SI	5.91	39 Education	4.31	2.92	01 Agriculture	1.59	1.39	2.98
NO	5.83	35 Computing Services	4.40	2.82	24 Water Supply	1.43	1.58	3.01
CY	5.89	39 Education	3.94	2.83	14 Basic Metals	1.95	1.11	3.06
MT	5.99	35 Computing Services	4.21	2.90	19 Motor Vehicles	1.78	1.31	3.09
ES	5.94	39 Education	3.95	2.81	01 Agriculture	1.99	1.14	3.13
EL	6.13	39 Education	4.08	2.99	01 Agriculture	2.05	1.09	3.14
LV	5.86	35 Computing Services	4.16	2.72	19 Motor Vehicles	1.70	1.44	3.14
PT	5.87	35 Computing Services	3.81	2.71	01 Agriculture	2.06	1.10	3.16
LU	6.24	39 Education	4.52	2.86	04 Other Mining	1.72	1.66	3.38

Source: EPC

It is evident that in most (18) countries the highest Total Level of Qualification Requirements of jobs is in Computing Services, while in ten countries the sector with the highest level of TQR is Education. On the contrary Agriculture is the most often sector with the lowest TQR (11countries), while followed by Textiles, Wearing Apparel and Leather (6 countries), and Hotels and Catering (4 countries).

Table 4.12 shows the TQR in EU27 in 2010, while Table 4.13 shows TQR for whole economy for each country (data sorted in descending order).

Table 4.12 Total Level of Qualification Requirements of jobs by sectors

Sector	TQR	Sector	TQR
35 Computing Services	5.73	24 Water Supply	4.12
39 Education	5.62	26 Distribution	4.09
33 Banking & Finance	5.22	19 Motor Vehicles	3.93
34 Insurance	5.21	41 Misc. Services	3.89
31 Air Transport	4.88	27 Retailing	3.87
38 Public Admin. & Def.	4.83	15 Metal Goods	3.66
40 Health & Social Work	4.79	14 Basic Metals	3.65
36 + 37 Prof. Services	4.66	02 Coal	3.63
22 +23 Electricity + Gas Supply	4.62	12 Rubber & Plastics	3.61
17 Electronics	4.61	04 Other Mining	3.56
08 Printing & Publishing	4.58	29 Land Transport	3.52
10 + 11 Pharmaceuticals + Chemicals	4.50	21 Manuf. nes	3.52
09 Manuf. Fuels	4.48	13 Non-Met. Min. Prods.	3.50
03 Oil & Gas	4.36	25 Construction	3.44
30 Water Transport	4.36	07 Wood & Paper	3.43
20 Oth. Transp. Equip.	4.32	28 Hotels & Catering	3.41
18 Elec. Eng. & Instrum.	4.31	05 Food, Drink & Tob.	3.41
32 Communications	4.18	06 Text., Cloth, & Leath	3.22
16 Mech. Engineering	4.14	01 Agriculture	3.13

Source: EPC

Table 4.13 Total Level of Qualification Requirements of jobs by countries

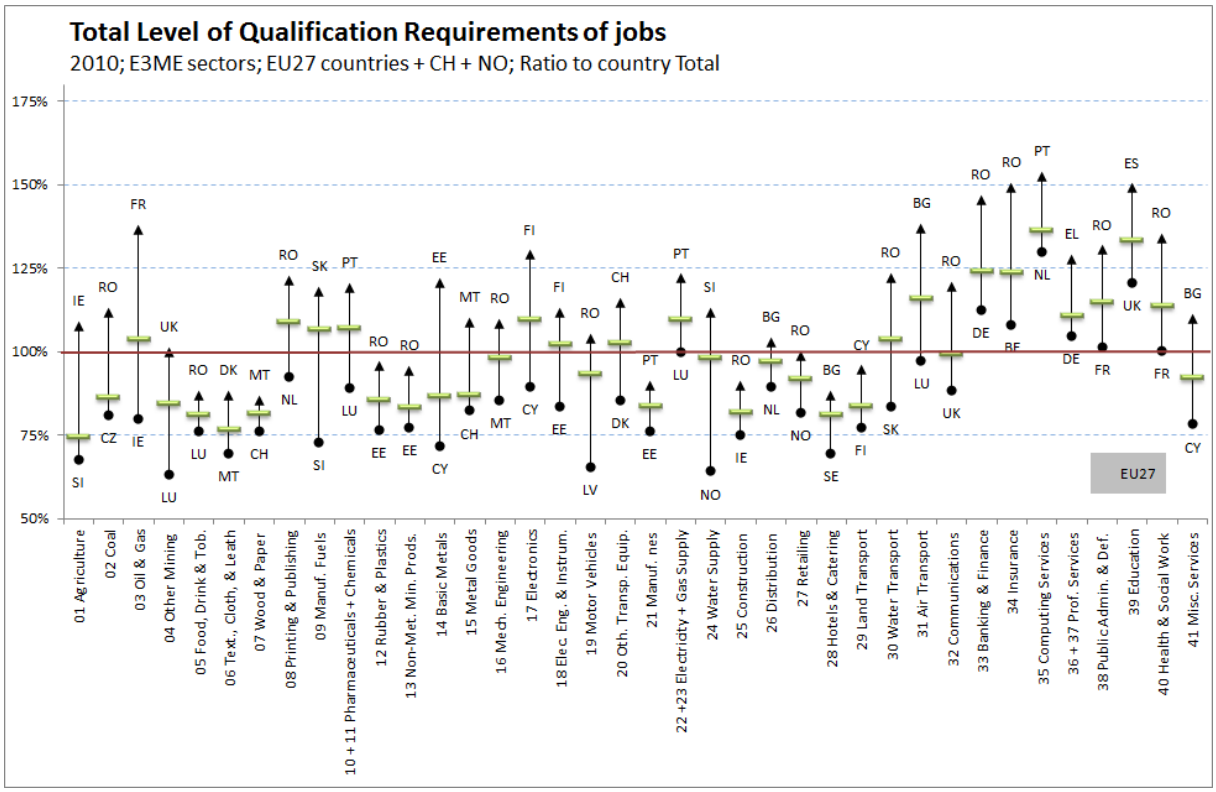
Country	TQR	Country	TQR
LU	4.52	CZ	4.24
NL	4.51	EU27	4.21
BE	4.50	MT	4.21
SE	4.43	LV	4.16
FI	4.41	AT	4.15
DK	4.41	HU	4.15
NO	4.40	PL	4.13
CH	4.39	SK	4.13
UK	4.38	IT	4.12
IE	4.35	EL	4.08
SI	4.31	ES	3.95
DE	4.31	CY	3.94
FR	4.30	PT	3.81
LT	4.27	RO	3.75
EE	4.26	BG	3.74

Source: EPC

It is clear that differences in the Total Level of Qualification Requirements of jobs are different in different countries. In countries where TQR is lower, there is most probably also lower level of QR in most sectors in comparison with country with higher TQR. That is why it is necessary to compare not only the absolute value of level of TQR size (Figure 4.1), but

also relative level of QR for given sector in given country in comparison with the overall TQR in a given country. This shows Figure 4.2.

Figure 4.2 Relative Total Level of Qualification Requirements of jobs by sectors



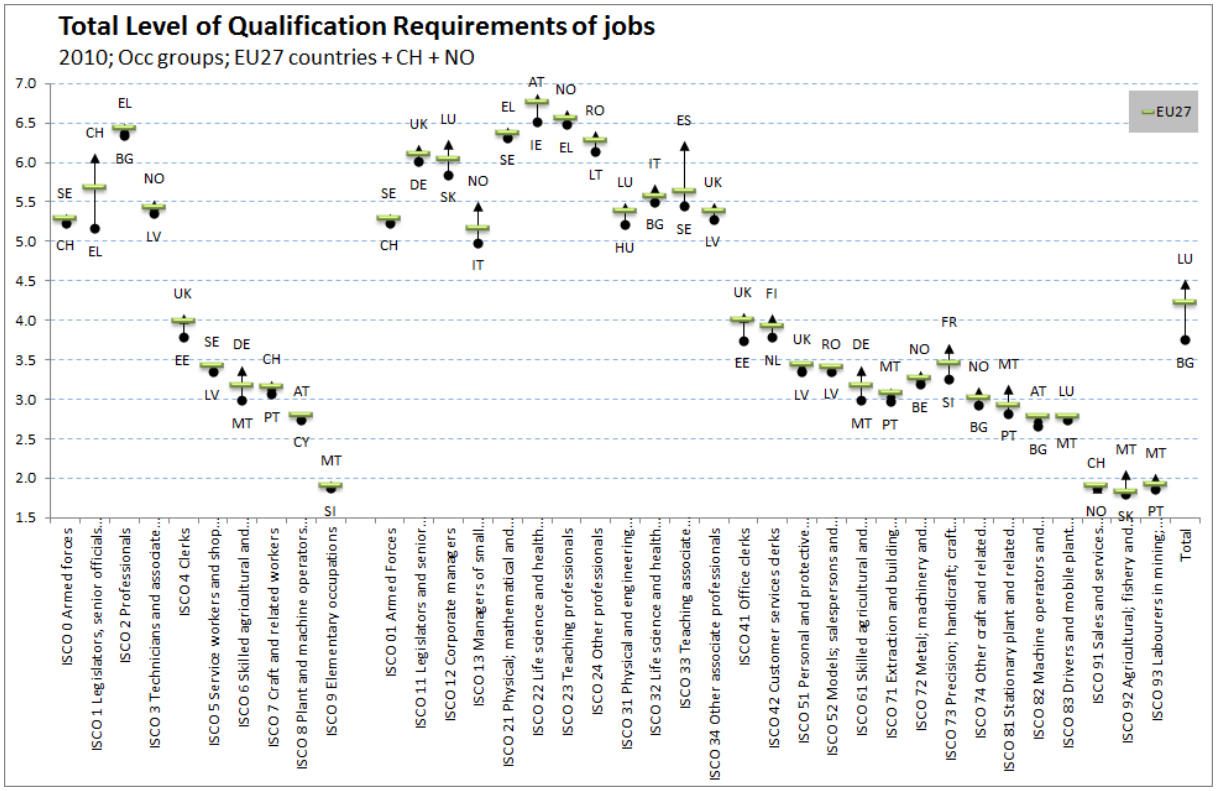
Source: EPC

Comparing values in Figure 4.1 and Figure 4.2 one very interesting thing can be found. In sector Distribution (26) there is Total Level of Qualification Requirements of jobs in Bulgaria equal to 3.90. This is the fourth lowest absolute value of all countries in this sector. On the other hand, this means that level of TQR is in this sector in Bulgaria at 104 % (see Figure 4.2) of total TQR in Bulgaria. It is the highest value of all countries in this sector. Thus, while in Figure 4.1 there is Bulgaria as the one of the lowest value indicated in sector Distribution in Figure 4.2 in the same sector Bulgaria generated the maximum value. When interpreting the results is therefore necessary to be very careful and it is always necessary exactly specify what the results described.

4.2.2 Analyses by occupation

In the second part of this sub-chapter differences in Dimension 1 by occupations will be examined. As in the previous case of sectors, also for the occupations TQR are calculated for each country of the EU-27 plus Switzerland and Norway and the EU27 as a whole. Figure 4.3 shows maximum (of countries) TQR, minimum (of countries) TQR and TQR for EU27 as a whole in a given occupational group and total economy (it is, of course, the same as for total economy in Figure 4.1).

Figure 4.3 Total Level of Qualification Requirements of jobs by occupations



Source: EPC

Occupations with the biggest and the lowest inter-country differences are in Table 4.14.

Table 4.14 Occupational inter-country differences

	Occupational group	Difference
Occupations with the biggest inter-country differences	ISCO 33 Teaching associate professionals	0.83
	ISCO 13 Managers of small enterprises	0.53
	ISCO 73 Precision; handicraft; craft printing and related trades workers	0.47
	ISCO 12 Corporate managers	0.45
	ISCO 61 Skilled agricultural and fishery workers	0.44
Occupations with the lowest inter-country differences	ISCO 21 Physical; mathematical and engineering science professionals	0.14
	ISCO 01 Armed Forces	0.12
	ISCO 83 Drivers and mobile plant operators	0.11
	ISCO 52 Models; salespersons and demonstrators	0.09
	ISCO 91 Sales and services elementary occupations	0.06
Average difference in all occupations		0.27

Source: EPC

Differences between countries are smaller for individual occupations than for sectors. The average difference is now 0.27 compared to 1.33 for sectors. In this context, it is not surprising that also standard deviations are much lower for occupations than for sectors.

Table 4.15 Standard deviation of Total Level of Qualification Requirements of jobs

Occupation	SD	Occupation	SD
ISCO 33 Teaching associate professionals	0.162	ISCO 92 Agricultural; fishery and related labour	0.053
ISCO 73 Precision; handicraft; craft printing and	0.116	ISCO 23 Teaching professionals	0.047
ISCO 13 Managers of small enterprises	0.116	ISCO 71 Extraction and building trades workers	0.045
ISCO 61 Skilled agricultural and fishery workers	0.112	ISCO 34 Other associate professionals	0.043
ISCO 22 Life science and health professionals	0.102	ISCO 82 Machine operators and assemblers	0.040
ISCO 12 Corporate managers	0.089	ISCO 72 Metal; machinery and related trades wc	0.040
ISCO 42 Customer services clerks	0.081	ISCO 51 Personal and protective services worke	0.039
ISCO 41 Office clerks	0.080	ISCO 93 Labourers in mining; construction; mar	0.034
ISCO 81 Stationary plant and related operators	0.079	ISCO 21 Physical; mathematical and engineering	0.028
ISCO 31 Physical and engineering science assoc	0.075	ISCO 83 Drivers and mobile plant operators	0.022
ISCO 32 Life science and health associate profe:	0.071	ISCO 01 Armed Forces	0.021
ISCO 24 Other professionals	0.063	ISCO 91 Sales and services elementary occupati	0.016
ISCO 74 Other craft and related trades workers	0.058	ISCO 52 Models; salespersons and demonstrat	0.016
ISCO 11 Legislators and senior officials	0.054		

Source: EPC

Table 4.16 shows occupations with the highest and lowest Total Level of Qualification Requirements of jobs for each country. In almost all countries the highest Total Level of Qualification Requirements of jobs is for occupational group ISCO 22 Life science and health professionals. Only in Belgium is the highest level of TQR in another occupational group Teaching professionals. On the contrary occupational group ISCO 92 Agricultural; fishery and related labourers has the lowest level of TQR in 28 countries out of 30.

Countries are sorted in descending order by difference between occupation with the highest and lowest TQR in a given country.

Table 4.16 Occupation with maximum and minimum Total Level of Qualification Requirements of jobs

Total Level of Qualification Requirements of jobs								
Country	Max		Whole economy	Min		Difference		
	TQR	Occupation		TQR	Occuption	Max-Tot	Tot-Min	Max-Min
IT	6.87	ISCO 22 Life science and	4.12	1.82	ISCO 92 Agricultural; fishe	2.74	2.30	5.05
AT	6.88	ISCO 22 Life science and	4.15	1.84	ISCO 92 Agricultural; fishe	2.73	2.32	5.05
UK	6.86	ISCO 22 Life science and	4.38	1.83	ISCO 92 Agricultural; fishe	2.49	2.55	5.03
CH	6.87	ISCO 22 Life science and	4.39	1.85	ISCO 92 Agricultural; fishe	2.48	2.55	5.03
EL	6.83	ISCO 22 Life science and	4.08	1.81	ISCO 92 Agricultural; fishe	2.75	2.27	5.02
SK	6.83	ISCO 22 Life science and	4.13	1.81	ISCO 92 Agricultural; fishe	2.70	2.32	5.02
DE	6.86	ISCO 22 Life science and	4.31	1.85	ISCO 92 Agricultural; fishe	2.55	2.46	5.01
RO	6.82	ISCO 22 Life science and	3.75	1.82	ISCO 92 Agricultural; fishe	3.07	1.94	5.00
EE	6.82	ISCO 22 Life science and	4.26	1.82	ISCO 92 Agricultural; fishe	2.55	2.45	5.00
CZ	6.81	ISCO 22 Life science and	4.24	1.81	ISCO 92 Agricultural; fishe	2.57	2.43	5.00
LV	6.81	ISCO 22 Life science and	4.17	1.82	ISCO 92 Agricultural; fishe	2.64	2.35	4.99
FR	6.87	ISCO 22 Life science and	4.30	1.89	ISCO 91 Sales and services	2.57	2.42	4.99
LT	6.80	ISCO 22 Life science and	4.28	1.81	ISCO 92 Agricultural; fishe	2.52	2.46	4.98
SI	6.77	ISCO 22 Life science and	4.31	1.81	ISCO 92 Agricultural; fishe	2.45	2.50	4.95
DK	6.81	ISCO 22 Life science and	4.41	1.86	ISCO 92 Agricultural; fishe	2.40	2.55	4.95
LU	6.79	ISCO 22 Life science and	4.52	1.84	ISCO 92 Agricultural; fishe	2.27	2.68	4.95
EU27	6.77	ISCO 22 Life science and	4.22	1.82	ISCO 92 Agricultural; fishe	2.55	2.39	4.94
BG	6.74	ISCO 22 Life science and	3.75	1.81	ISCO 92 Agricultural; fishe	2.99	1.94	4.93
HU	6.76	ISCO 22 Life science and	4.15	1.85	ISCO 92 Agricultural; fishe	2.61	2.30	4.91
FI	6.74	ISCO 22 Life science and	4.41	1.83	ISCO 92 Agricultural; fishe	2.32	2.58	4.90
NO	6.70	ISCO 22 Life science and	4.40	1.83	ISCO 92 Agricultural; fishe	2.30	2.58	4.87
SE	6.68	ISCO 22 Life science and	4.43	1.83	ISCO 92 Agricultural; fishe	2.25	2.60	4.85
NL	6.67	ISCO 22 Life science and	4.51	1.83	ISCO 92 Agricultural; fishe	2.16	2.68	4.84
ES	6.65	ISCO 22 Life science and	3.95	1.81	ISCO 92 Agricultural; fishe	2.70	2.14	4.84
CY	6.65	ISCO 22 Life science and	3.94	1.82	ISCO 92 Agricultural; fishe	2.70	2.12	4.83
PT	6.60	ISCO 22 Life science and	3.85	1.81	ISCO 92 Agricultural; fishe	2.76	2.03	4.79
PL	6.60	ISCO 22 Life science and	4.13	1.81	ISCO 92 Agricultural; fishe	2.47	2.32	4.79
MT	6.68	ISCO 22 Life science and	4.21	1.92	ISCO 91 Sales and services	2.47	2.30	4.77
BE	6.56	ISCO 23 Teaching profe	4.50	1.82	ISCO 92 Agricultural; fishe	2.06	2.68	4.74
IE	6.51	ISCO 22 Life science and	4.35	1.83	ISCO 92 Agricultural; fishe	2.16	2.52	4.68

Source: EPC

Table 4.17 shows Total Level of Qualification Requirements of jobs in EU27 in 2010. Occupations follow in the descending order.

Table 4.17 Total Level of Qualification Requirements of jobs in EU 27

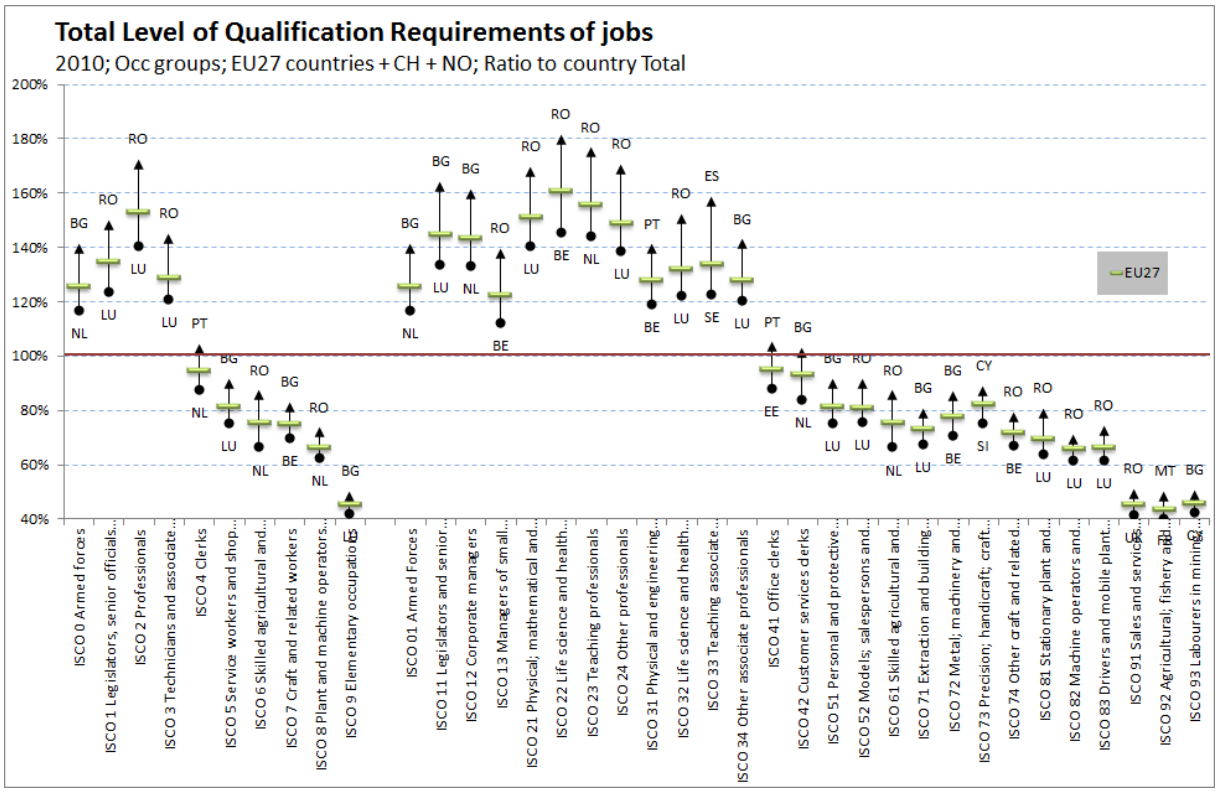
Occupation	TQR	Occupation	TQR
ISCO 22 Life science and health profe:	6.77	ISCO 73 Precision; handicraft; craft pr	3.46
ISCO 23 Teaching professionals	6.56	ISCO 51 Personal and protective servi	3.43
ISCO 21 Physical; mathematical and e:	6.37	ISCO 52 Models; salespersons and de	3.40
ISCO 24 Other professionals	6.28	ISCO 72 Metal; machinery and related	3.27
ISCO 11 Legislators and senior officia:	6.10	ISCO 61 Skilled agricultural and fisher	3.17
ISCO 12 Corporate managers	6.04	ISCO 71 Extraction and building trade:	3.07
ISCO 33 Teaching associate professio	5.63	ISCO 74 Other craft and related trades	3.02
ISCO 32 Life science and health assoc	5.56	ISCO 81 Stationary plant and related c	2.92
ISCO 31 Physical and engineering scie	5.38	ISCO 83 Drivers and mobile plant oper	2.79
ISCO 34 Other associate professionals	5.38	ISCO 82 Machine operators and asser	2.78
ISCO 01 Armed Forces	5.29	ISCO 93 Labourers in mining; constru	1.92
ISCO 13 Managers of small enterprise	5.16	ISCO 91 Sales and services elementary	1.90
ISCO 41 Office clerks	4.00	ISCO 92 Agricultural; fishery and relat	1.82
ISCO 42 Customer services clerks	3.92		

Source: EPC

The table which shows Total Level of Qualification Requirements of jobs for whole economy for each country is not displayed here, because it is the same regardless of whether it is based on sectors or occupations (see Table 4.13).

Figure 4.4 shows the TQR for a given occupational group in a given country compared with TQR for a given country.

Figure 4.4 Relative Total Level of Qualification Requirements of jobs by occupations



Source: EPC

The previous analysis shows a large difference between sectoral and occupational data. However, while occupational groups show quite small inter-country differences and quite high inter-occupation differences in a given occupation, for sectors it is the opposite. While in the EU27 is the difference between the highest and lowest Total Level of Qualification Requirements of jobs in sectors only 2.60 points (5.73 points in Computing Services minus 3.13 points in Agriculture), for occupational groups is this difference 4.94 points (6.77 points for Life science and health professionals minus 1.82 points for Agricultural, fishery and related labourers).

In a given sector, differences in the level of TQR across countries are mainly caused by different occupational structures within the sector.

4.3 Why occupational structures differ in different countries

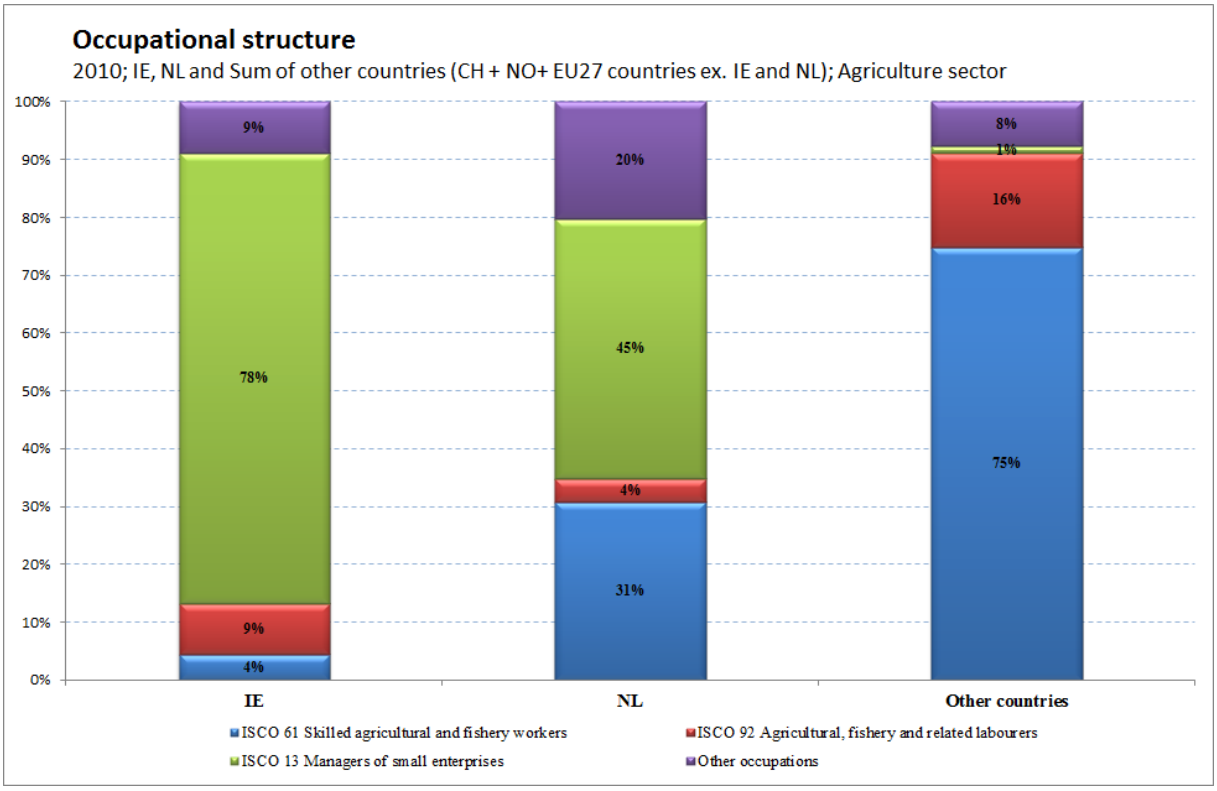
Three examples are used in order to explain why Qualification Requirements and occupational structures in a given sector can differ so much in different European countries. Two criteria have been used: each of the sectors selected represents a quite different area of the economy, and also the cause of the difference across countries is different in each case. The first example (*Agriculture*) illustrates the role that of methodological and statistical reasons can play in this. The second (*Motor Vehicles*) and the third (*Health and social work*) example illustrate that it may be caused by objective reasons, such as the overall orientation and technological level of the sector. Both reasons affect the resulting skill profiles of the sector in question, as illustrated by the example of Dimension I – Total Level of Qualification Requirements.

4.3.1 Agriculture

This is an example of sector with non-uniform perceptions of jobs classification in their inclusion to statistical groups in various European countries. This lack of homogeneity causes different occupational structure and subsequently different Total Level of Qualification Requirements of jobs in different countries.

Figure 4.5 shows occupational structure in Ireland, the Netherlands and sum of other countries.

Figure 4.5 Occupational structure of Agriculture sector



Source: EPC

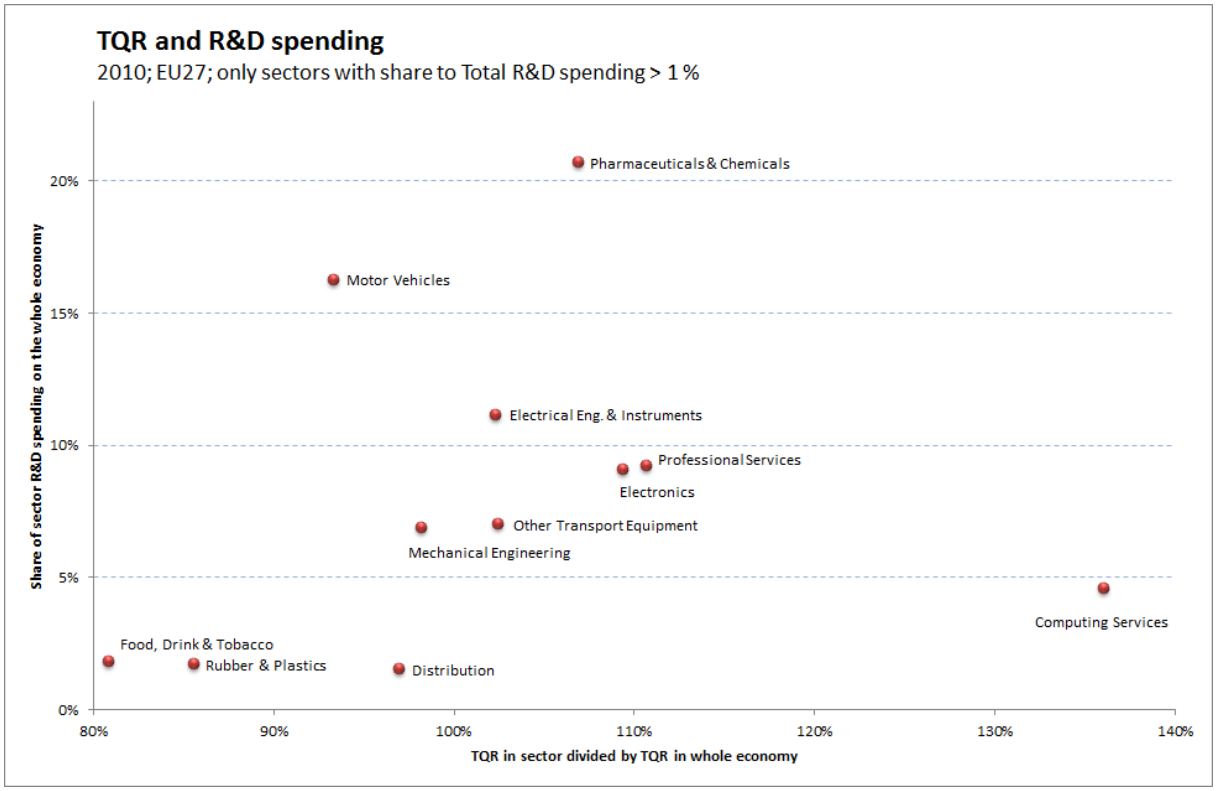
According to text presented below Table 4.10 Ireland and the Netherlands are two countries with high Total Level of Qualification Requirements of jobs in Agriculture. Figure 4.5 shows that the dominant reason for it is an absolutely different classification of occupations in both countries. Most of the employment classified in other countries as Agricultural and fishery related occupations, in Ireland and the Netherlands are classified as Managers of small enterprises (farms).

4.3.2 Motor Vehicles

This is an example of sector with different country's orientation in given sector – towards research, development and innovation on the one side or towards assembling and plain manufacturing on the other side. This causes different occupational structure and subsequently different Total Level of Qualification Requirements of jobs in different countries.

The Motor Vehicles sector is a R&D intensive sector absorbing more than 16 % of the total private R&D spending in EU27. Average R&D intensity (R&D spending per employment) in the Motor Vehicles sector in EU 27 in 2010 is about 12.5 thousands € (in constant prices 2000).

Figure 4.6 Total Level Qualification Requirements of jobs and R&D spending by sectors

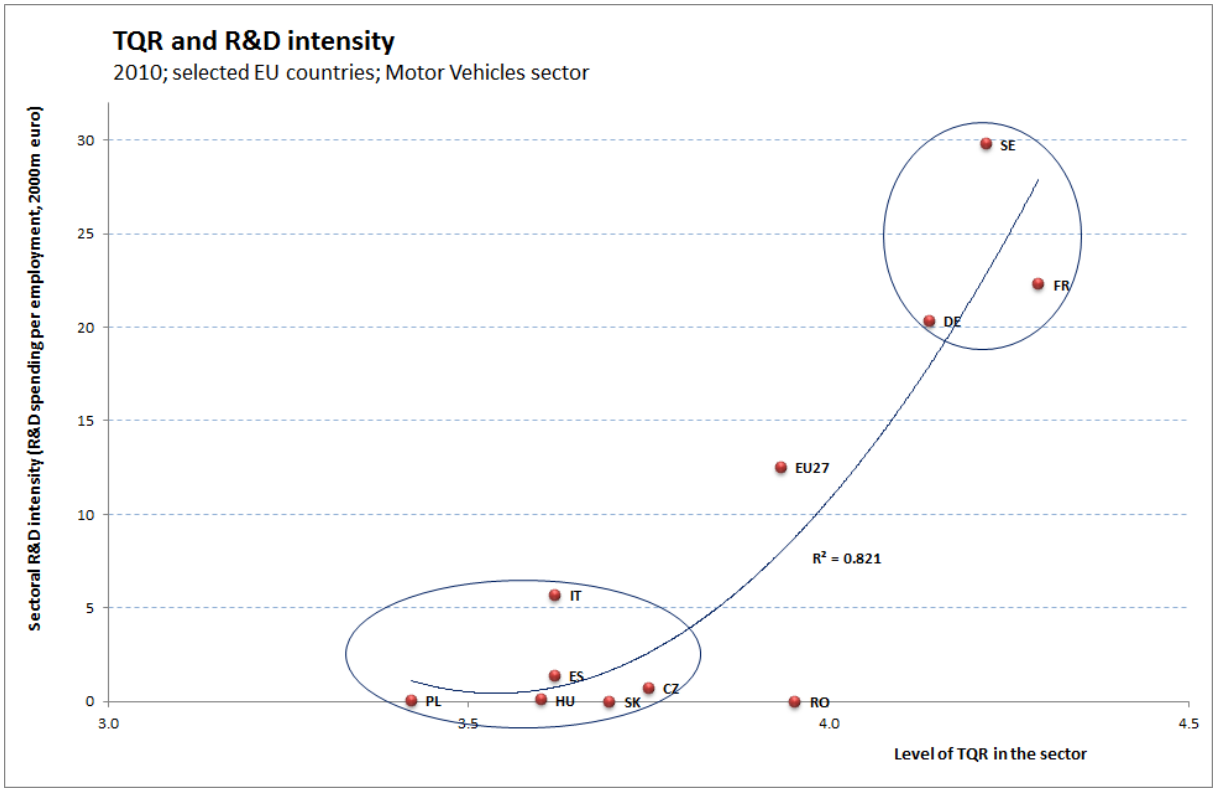


Source: EPC

To select countries for a specific analysis of the impact of R&D intensity in the Motor Vehicle sector on the average Total Level of Qualification Requirements in various European countries three criteria have been used: the rate of sectoral output in the whole national economy, the rate of sectoral employment in the whole national economy, and the rate of the country sectoral employment to the overall EU27 employment in the sector. The ten countries selected are above the average of the 27 EU concerning all the three criteria together (in the descending order): Germany (DE), the Czech Republic (CZ), Poland (PL), Spain (ES), France (FR), Hungary (HU), Slovakia (SK), Italy (IT), Sweden (SE), and Romania (RO). Figure 4.7 summarises the results of the analysis.

The results confirm that the relationship between the R&D intensity and the level of TQR is positive and really strong (with the exception of Romania whose data seem to be suspect). Further, European countries with an important Motor Vehicles sector can be divided into two groups. The first one is formed by Sweden, France and Germany. Their Motor Vehicles sector has a high level of the R&D intensity (20-30 thousand € per employment) and a corresponding high level of TQR (within the interval 4.1 – 4.3). The second group is formed by six countries – the Czech Republic, Poland, Spain, Hungary, Slovakia, and Italy. All of them have a markedly lower R&D intensity (the highest one in Italy is still more than several times lower than in the first group of countries), compared to the TQR (between 3.4 and 3.7).

Figure 4.7 Total Level of Qualification Requirements of jobs and R&D intensity by countries

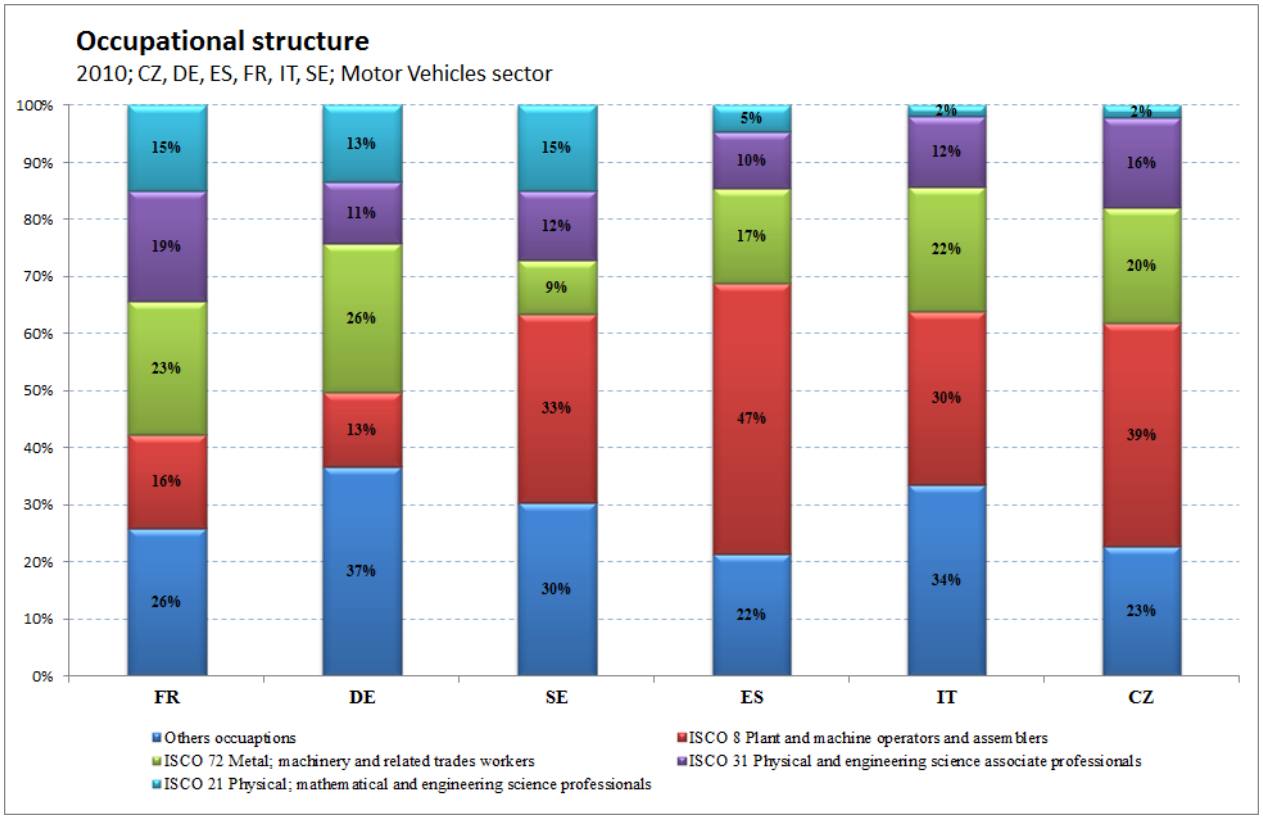


Source: EPC

In the example a different orientation of the sector (research v. assembling) determines a different occupational structure that in turn explains why the Total Level of Qualification Requirements of jobs is so different in this sector across different countries. For example in this sector, there are some countries where the occupational group Physical mathematical and engineering science professionals (ISCO 21) has a relatively high number of jobs. It indicates countries oriented to research and development. On the other hand in some other countries there are a lot of jobs for Plant and machine operators and assemblers (ISCO 8). It indicates countries oriented to assembling.

Figure 4.8 shows occupational structure of the sector in six European countries. It is evident that and why Germany, France and Sweden belong to the first group (as countries focused on research and development) while Spain, Italy and the Czech Republic (as an examples) belong to second one (as countries focused on assembling).

Figure 4.8 Occupational structure of Motor Vehicles sector



Source: EPC

4.3.3 Health and Social Work

Third example is a sector with different multiple sub-sectors whose proportions differ in individual countries. This causes that the whole sector has quite different occupational structures and subsequently different Total Levels of Qualification Requirements of jobs in different countries.

The Health and social work sector has three sub-sectors: Human health activities[14], Veterinary activities[15], and Social work activities[16].

The Veterinary activities sub-sector is the smallest one, its share in the number of employed in the sector being less than 2.5 % in almost all EU27 countries but for Bulgaria and Cyprus (about 3 %) and Romania (about 4 %). Hence main differences in the Total Level of Qualification Requirements of jobs are caused by a different proportion of other two sub-sectors – Human health activities and Social work activities.

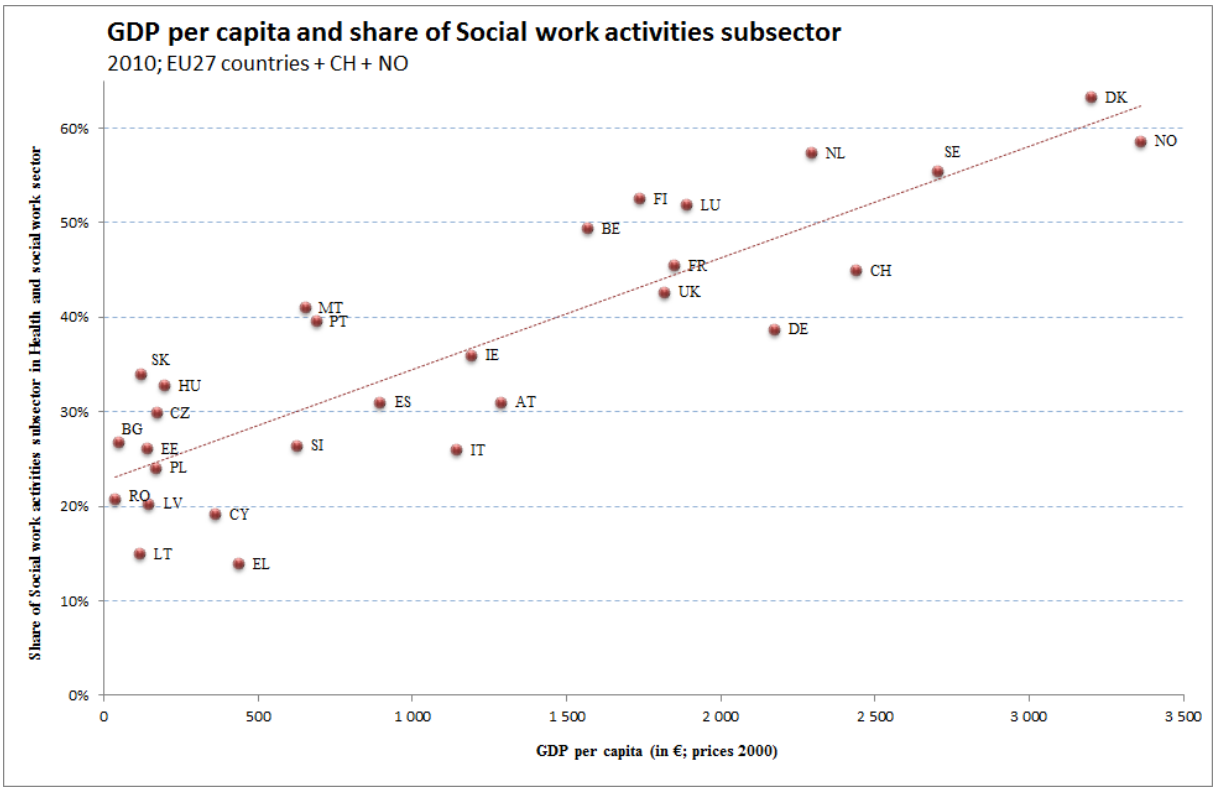
[14] This is defined as group 851 in NACE Rev.1 and as group 86 in NACE Rev. 2

[15] This is defined as group 852 in NACE Rev.1 and as group 75 in NACE Rev. 2

[16] This is defined as group 853 in NACE Rev.1 and as groups 87 and 88 in NACE Rev. 2

Figure 4.9 shows quite strong relationship between the level of development of economy (measured as GDP per capita) and the proportion of Social work activities in Health and social work sectors in a given country.

Figure 4.9 GDP per capita and share of Social work activities in the Health and social work sector by countries

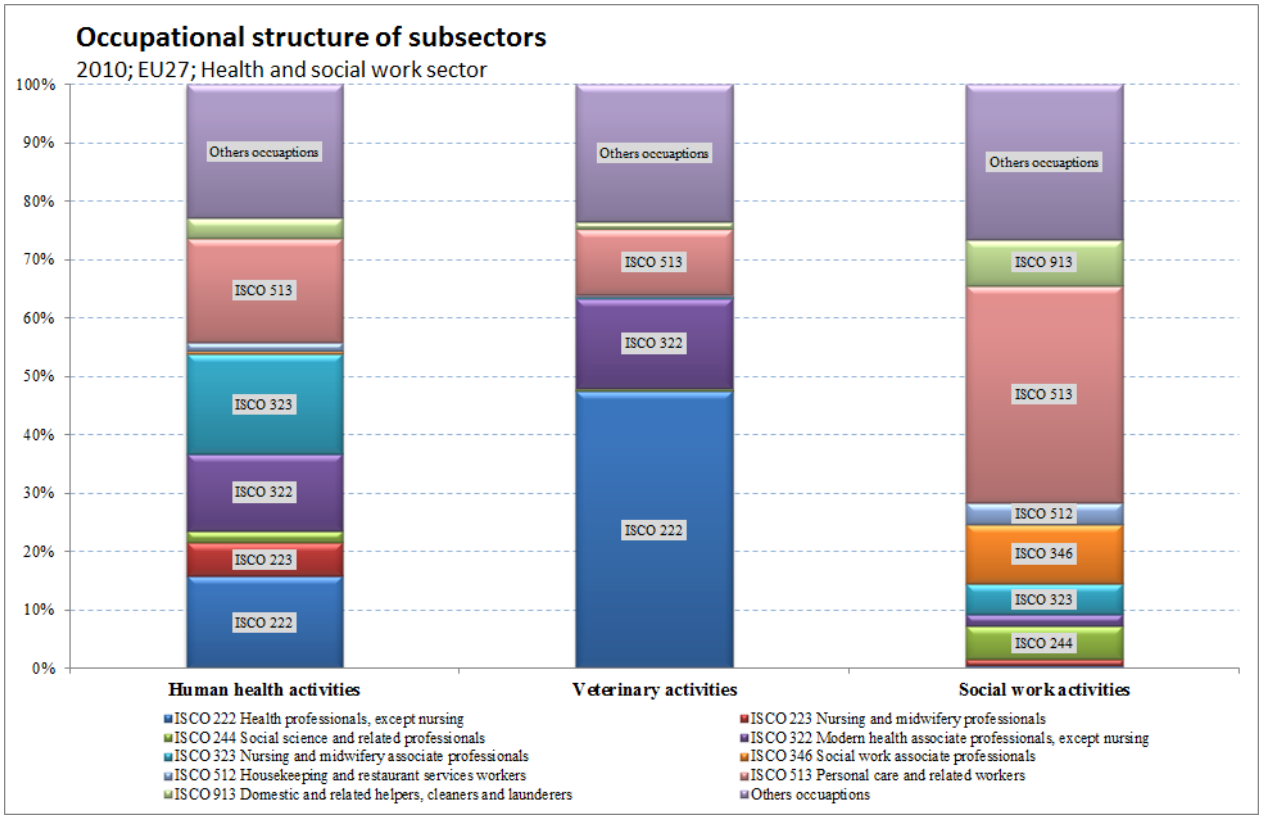


Source: EPC

There is a clear relationship between the two variables: the more developed the economy was in the year 2010, the higher the share of Social work activities (and the lower the share of Human health activities). A higher share of Social work activities means a higher orientation towards the care of older or otherwise socially disadvantaged people.

A different structure of work characteristics in sub-sectors leads, of course, toward a quite different occupational structure. Figure 4.10 shows how different main occupational groups are representing in each of sub-sectors.

Figure 4.10 Occupational structure of sub-sectors in Health and social work sector



Source: EPC

In Human health activities dominate four occupational groups – Health professionals, except nursing (ISCO 222), Modern health associate professionals, except nursing (ISCO 322), Nursing and midwifery associate professionals (ISCO 323), and Personal care and related workers (ISCO 513). In Veterinary activities dominate Health professionals, except nursing (ISCO 222) and in Social work activities Personal care and related workers (ISCO 513).

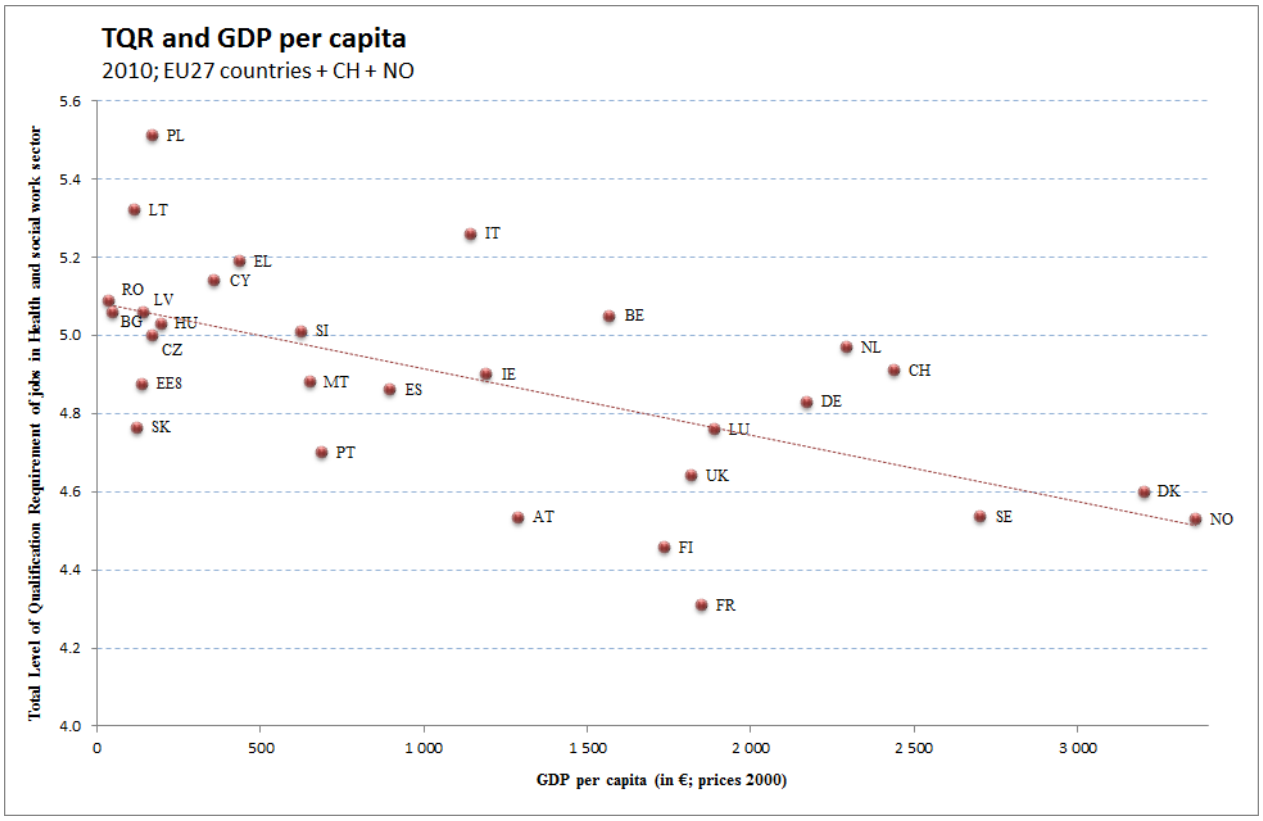
Different occupational structures of sub-sectors and different proportion of sub-sectors in a given country (and thus different occupational structures of the whole economy) cause different values of Total Level of Qualification Requirements of jobs in a given country in the whole sector. It is evident that jobs with a high proportion of employed from occupational groups ISCO 2 (Professionals) and ISCO 3 (Technicians and associate professionals) have a higher value of Total qualification requirements than jobs where employment from occupational groups ISCO 5 (Personal care, personal services and related workers) is needed.

It is therefore not surprising that the lowest Total Level of Qualification Requirements of jobs in the sector in EU27 are in Social work activities (TQR was 4.19 in 2010). Human health activities had TQR equal to 5.08 in 2010, and Veterinary activities equal to 6.00. The Total Level of Qualification Requirements of jobs for the Health and social work sector in the EU 27 were equal to 4.79 points in 2010.

Figure 4.11, showing Total Level of Qualification Requirements of jobs in the Health and social work sector in individual countries, suggests a rather unexpected, yet obvious and logical conclusion that the more developed countries (measured by GDP per capita) have a lower Total Level of Qualification Requirements of jobs for the whole sector Health and

social work, which is caused, as shown in Figure 4.9, by a higher share of Social work activities.

Figure 4.11 Total Level of Qualification Requirements of jobs in Health and social work sector and GDP per capita by countries



Source: EPC

The sector illustrates how a different proportion of sub-sectors in individual countries (caused by their macroeconomic situation and standard of living), and subsequently a different occupational structure, can explain differences in the Total Level of Qualification Requirements of jobs in a given sector and country.

5. Conclusion

This study has presented a new approach of Occupational Skills Profiles that have been developed in order to overcome fragmented and inconsistent information about occupational skill needs and limitations and lack of comparable statistical data. The final chapter sums up main features of the Occupational Skills Profiles approach, its advantages and potential benefits for labour market analysis and forecast, as well as problems, critical points and applicative limits.

Advantages of the approach

The basic advantage of OSPs – and also the justification of their use – is twofold: that job requirements are defined in a coherent, systematic and unified way across all occupations, focused on relevant generic (that is not job specific) information; and that job requirements are not only qualitatively described but also quantified, that is that they are measurable and regularly measured as well. Therefore they are comparable at the job level between sectors, countries and even in time.

Even more important is the fact that a way has been found how to aggregate OSPs of a single job at higher levels – that of an occupation, of an occupational group, of a sector and even of a whole economy, be it of a single country or the European Union – without losing their specificity, in other words to be sector-specific. Thus not only the range of their mutual comparability but also of their application has been substantially widened.

Occupational Skills Profiles have been developed for analysing and forecasting skill needs and determining skills matches/mismatches, comparing them between various occupations, sectors, and countries, taking also account of their development in time. As they are based on job requirements, they represent the demand side of the labour market, and can be easily compared to other projections traditionally based on surveys of job holders, that is on the supply side. However, they can be also used at an individual level when looking for a job or choosing education and training programmes.

Problems, critical points, limits

In order to guarantee all the advantages and uses envisaged, a series of stringent requirements has to be met. The most important of all is the necessity to define OSPs at such a level of occupational classification where the job structure and characteristics are sufficiently detailed, yet at the same time supported by empirical data. This rather limits the choice of data sources having to fulfil the four criteria of availability, usability, accessibility, and suitability.

Again, a way has been found how to meet these not easily reconcilable requirements by carefully supplementing a limited supply of European data at lower levels of classification with US surveys, once factor analyses of both European and US data sources have confirmed that it is possible, and that adequate conversion tables have been put into practice.

Possible future application and development

Analyses carried out so far have also shown that skill requirements may differ significantly not only in time, but also between individual countries analysed. In order to enable a more precise and usable international comparison of changing skills structures, it will be therefore necessary to modify the existing Occupational Skills Profiles so as to be country-specific as well.

This can be achieved by using data collected for the OECD project *Programme for the International Assessment of Adult Competencies* (PIAAC) whose results will be available in autumn 2013. PIAAC assesses the level and distribution of adult skills in a coherent and consistent way across 23 countries[17]. It focuses on the key cognitive and workplace skills that are needed for successful participation in the economy and society and required in a specific job (identified by industry and occupation). PIAAC also gathers a range of other information including the antecedents and outcomes of skills, as well as information on usage of information technology and literacy and numeracy practices generally. The size of the PIAAC database with more than 100 thousand respondents in employment is equally very important.

Another important element of the 'added value' of PIAAC compared with national surveys is its international comparative dimension. The PIAAC assessments and questionnaires are designed to maximise their cross-cultural, cross-national and cross-language validity. All participating countries must adhere to common technical standards when implementing the survey. PIAAC will thus provide a firm basis for comparative analysis of skill formation systems and their outcomes and for international benchmarking regarding adult skills.

Therefore the PIAAC data will considerably contribute to the further development of Occupational Skills Profiles, particularly to their quantification at the level of individual countries (for all sectors and occupations and for each country). It may also bring a deeper understanding of mismatches.

Even more important for the future development of OSPs is the fact that PIAAC will be conducted in the United States as well. Its data will also serve to verify further the suitability of US data sources (particularly the O*NET) for determining qualification requirements in European countries, thus making OSPs even more robust.

[17] Namely 16 EU countries: Austria, Belgium, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Ireland, Italy, the Netherlands, Poland, Slovakia, Spain, Sweden, the United Kingdom; and 7 non-EU countries: Australia, Canada, Japan, Korea, Norway, the Russian Federation and the United States.

6. Frequently Asked Questions

This chapter presents answers to some important and frequent questions that were raised about previous versions of this document by CEDEFOP and country experts personally during workshops and by e-mails. To similar questions regarding the same subject only one answer is provided.

We hope this chapter will help readers to better understand the OSPs methodology. We are very grateful for all the comments we have already received and will really welcome the new ones concerning this version so that we may respond to them in the final version of the methodology to be prepared in the course of 2012.

***Q**: One of the participants expressed concern whether occupational skills profiles consider the accumulation of skills during individual's lifetime. The EU population is ageing rapidly. The formal qualification acquired by individuals in the initial education and training system is not enough anymore. The knowledge, skills and competences of the people need to be continuously updated. Share of adults who participate in lifelong learning is constantly increasing in Europe. By the age of e.g. 50 individual considerably raises its qualification by adding new or improving existing knowledge, skills and competences. Thus real qualification of individual aged 50 is much higher than formal (initial) one. Question is whether occupational skills profiles developed within this project consider this difference between formal and real qualification levels of individuals, i.e. whether they incorporate adult learning dimension within occupational skills profiles? If not, this dimension should be duly considered in the module as it will become more and more important until 2020. Employer survey on skills needs in Europe developed by Cedefop could provide important additional evidence in this respect.*

***Q**: Another issue raised by participants regarding occupational skills profiles is situation that currently large share of youth has qualification required for a particular type of job, but does not have relevant skills that are needed to perform it. Participants were wondering whether this difference between formal qualification and current level of skills of an individual is considered in occupational skills profiles.*

A: By definition OSPs describe the characteristics of the job, not of the job holder (see Chapter 1.1). On the contrary, both questions concern job holders, and should be addressed instead to core projections which focus on job holders. Moreover, a different question should be posed: To what extent does the level of formal education attained indicate the real qualification?

***Q**: Are skills profiles at the most detailed level (ISCO 2 digits occupations x 38 industries) identical for all European countries? This seems to be the case for dimensions 3 through 7, which are based on an extra-European source, but is this also true for the first two dimensions, for which the ESS is the main input?*

A: Up to the present, all dimensions of OSPs at the level of ISCO 3 digits occupations (about 110-120 groups of occupations) x 38 industries are identical for all European countries**.** At the aggregated level used in the core project (ISCO 2 digits occupations x 38 industries) all dimensions are country specific, as all aggregations of jobs have been performed as country specific. During the year 2012, however, also OSPs at the level of ISCO 3 digits occupations

x 38 industries will be country specific for the 1st and 2nd dimensions as they will be prepared in a different way to be explained in the final version of the methodology.

***Q**: Have these industry x occupation profiles been calculated for one given base year (which?) or for different years? In other words, are the 2000 and 2010 overall industry profiles that are available in the country workbooks to be interpreted as separate observations or do they result from applying a different employment structure (industry x occupation) to once-and-for-all given profiles by industry x occupation?*

***Q**: Are the occupational skill profiles of groups stable and the trends are constructed only on the basis of changing occupational structure of employment?*

A: Yes, but only for dimensions 3 through 7. All industry x occupation profiles have been calculated for the last year available in the O*NET (version 16.0 from July 2011) for all groups of jobs at the level of ISCO 3 digits occupations (about 110-120 groups of occupations) x 38 industries. Profiles for years 2000 and 2020 have been obtained by re-weighting static base-year profiles (industry x occupation) by BLS and CEDEFOP projected employment structure. OSPs of groups are stable, their trends are constructed only on the basis of change in the occupational structure of employment.

The 1st and 2nd dimensions of OSPs for all groups of jobs at the level of ISCO 3 digits occupations (about 110-120 groups of occupations) x 38 industries are dynamic in time. The way how they are calculated is explained in Chapter 2.1.

***Q**: Overall, there seems to be relatively little variation in the industry as well as the aggregate profiles across countries at a given moment of time, and, even more surprisingly, across time for given countries or for Europe as a whole.*

A: Largest variations of OSPs occur understandably at the level of occupations. However, marked variations can be found between industries and countries. For example the same industry requires a high level of education and skills in one country, whereas a considerably lower level in another country. Our preliminary analyses have shown that it may be caused by the orientation and technological level of the country in question. In the automotive industry, for example, the occupational mix and skills requirements in Germany or Sweden are considerably higher than in Italy or the Czech Republic, as they, of course, closely correspond with very different levels of R&D expenditure in the industry. During 2012 more similar detailed analyses will be prepared.

Nevertheless, it is possible that relatively little variations in preceding versions were caused by the fact that intra-occupation changes were not covered. In this version of the methodology the outcomes of analysis/projection take into account the dynamisation of the 1st a 2nd dimensions. For dimensions 3 through 7 the problem is more complicated. The O*NET seems to be a good source for them but it will take much more time to analyse them in time series, as some problems still remain.

***Q**: With regard to the seven dimensions vis-à-vis the industry profile, can you kindly indicate how such individual percentages for each dimension was reached, in particular for each member state? Which were those factors that would create a different percentage scales (for a given dimension and industry) for different member states? Have these percentages been*

calculated for a given base year or for different years? Kindly indicate which were the year(s) under observation.

***Q**: Differences between countries represent different occupational mix in specific sectors (and industries in case of total country results)? The OSP for specific industry-occupation cell are common for all countries?*

A: We hope that both questions have been adequately answered and explained by our answers to the preceding questions.

***Q**: As stated, occupational skills profiles, which summarise essential characteristics for a given occupation, have been developed for, amongst other uses, analysing, projecting and forecasting skill needs, determining education mismatches and comparing differences between European countries. Using data from the USA, such as the occupational information network (O*NET) and data from the European Social Survey, which is based on a module carried out in one year only and does not cover all the member states gives rise to concerns about the reliability of the underlying data and the ensuing projections, especially in the case of small countries such as Cyprus.*

A: Obviously the scope and origin of data used for calculating OSPs affect their final form. The EPC try to use all available sources that are suitable, relevant and meet quite demanding conditions for including them into a common database. Beside US data (not only O*NET but also BLS) and ESS data we are using data from Germany, Italy and the Czech Republic. To obtain them is quite difficult and time-consuming (and sometimes you have to buy them), we have not succeeded in getting, for example, British Skill Survey data. I am afraid we have no better data sources available at this moment, and we would be very grateful for indicating us other possible sources.

We have to stress that a great advantage of US jobs skill requirements data is that they are updated regularly (O*NET annually, and BLS biannually). Moreover, the 5th round of the European Social Survey (ESS-5) in 2010-2011 has replicated the ESS-2 module (2004-2005) containing questions focused on education and work experience of respondents.

***Q**: In the Cedefop project, forecasts of employment by qualification level are provided. As already mentioned, there are strong reservations on the methodology of extrapolating past labour market data on the shares of employment by qualification level. The actual labour market data show the outcome of the interaction between the supply and demand of persons by qualification level. Therefore in the case of oversupply of persons with high qualifications they may, as a necessity, end up in occupations requiring medium or even low qualification levels. This is a phenomenon observed also in situations where countries have relatively large proportions of foreign workers, as these may accept working in lower level occupations despite their higher level qualifications in order to fulfil their basic needs. An extrapolation of such trends would result in forecasting need for persons with high qualifications to cover low level occupations.*

A: This question neatly re-formulates from a different angle of view the crucial problem of the distinction between qualification requirements of the job (which make the very contents of OSPs) and the qualification of job holders as indicated by formal education they have attained. The EPC share this view and separate both notions, working only with job characteristics as described by the seven dimensions of OSPs. The EPC don't make any forecasts themselves, but use forecasts of jobs defined by sector (38 industries) and

occupation (ISCO 2 digits) elaborated by the core project, and assign to forecasted jobs characteristics of their respective OSPs.

***Q**: Concerning required educational level and its link to the core projection – we have a demand side providing in principal the same information but very different numbers in the core project (e.g. CZ low educational level required based on OSP 1706 thousands. employed in 2000 and based on demand projection 315 thousands employed). How to deal with that in the interpretation?*

A: Again, the difference in numbers is explained by the distinction between job requirements as defined by OSPs and the actual qualification (education) of job holders. Both numbers relate to different notions: in the Czech Republic in 2000 there were 1706 thousand jobs where only a low level of education was required, however only 315 thousand of job holders had attained only the required low level of education, the rest was overqualified for the job. Such a big difference can be explained by the fact that the Czech Republic is one of few European countries with a very low proportion of adults who have not attained upper secondary education, and most of low skill jobs were held by people with a higher level of qualification (quite often with an upper secondary level vocational qualification).

***Q**: Required educational level – multiple sources have been used based on factor analysis (p. 17). Maybe the combination of these sources is not so good in this case. (Or more detailed results of the factor analysis will need to be published to fully understand the concept. Based on the documentation there was quite a big importance (weight) of CZ survey. But the Czech Republic has quite specific educational structure and it forms only a very little share of European total employment. Maybe simple selection of one source of data (probably ESS) will be a better solution here.*

In some countries the requirements can differ significantly from the EU average. It may be useful to measure these differences and if the differences are significant, than use for specific country its own results. Only in countries where the results are not available can then be used EU averages or results of country with similar economy and educational structure.

A: Because we have expanded the sources for constructing OSPs and their respective weights have changed, the weight of CZ surveys has been considerably reduced (see Chapter 1.3). The outcomes of factor analysis have tested and justified our approach but served only as a first clue for determining weights of various data sources.

The second part of the question proposes a theoretically sound approach but unfortunately impossible to be applied, as data sources required from individual countries are extremely insufficient. Moreover, with our experience of last several years we rather doubt that it is possible to use them consistently. The results differ considerably even within one country, depending on the design and methodology of data collection, the selection of respondents and on many other problems.

In the given context (the construction of OSPs for sector specific occupations) the ESS database can be used for identification of jobs only for the whole sample, not for individual countries, because their samples are too small.

However we are well aware of the need to construct country specific OSPs, because differences in perceiving qualification required between individual countries are quite marked. We have found how different they are not only by comparing the requirements in the

USA and in Europe, but also by comparing individual European countries. The EPC is preparing a new approach how to define country specific OSPs.

***Q**: The European Social Survey (ESS) is used for the provision of the first two characteristics of the occupational skills profiles, which are the level of education required and the field of education required. This analysis might have been useful provided the methodology of the ESS and the data collected were reliable. Unfortunately, the data required and finally used refers to only one particular module of the survey and does not cover all the member states. Furthermore, the extrapolation of the data into the future may provide unreliable forecasts as the requirements for levels and fields of education change over time. It must be noted that Cyprus was not included in the countries covered by the ESS module.*

***Q**: Regarding the methodology we have some doubts about the use of ESS and their representativeness. If we understand well, the ESS is used to construct the first two dimensions related to the level of education and training required and to the field of education and training required. The Spanish sample is enough big to gain representative results at this level of detail?*

A: We agree that the ESS in not representative enough for individual countries in the given context. We only use ESS-2 and ESS-5 data for the whole sample (see the previous answer as well).

***Q**: The outcome of the process is the provision of information for the five characteristics of knowledge, skills, competence, occupational interests and work values. As described in the paper, the main source of data is the occupational information network (O*NET) which is used by the US Department of Labor. There are strong reservations regarding the transposition of US data for estimating these five characteristics. The US perceptions about these characteristics may differ significantly from the EU perceptions, which in any case may vary between member states depending on the development stage of economic sectors and occupations and on other characteristics such as technological level, environmental issues, culture and tradition. This may be especially true in the case of small countries, such as Cyprus.*

A: Projects using the O*NET approach have been carried out in Italy and in the Czech Republic. Their results have been compared with those of the O*NET, and they seem to be similar enough. More details can be found in Chapter 1.4.

***Q**: The methodology for forecast is not described.*

A: The CEDEFOP employment forecast has been used for a number of jobs in the given sector (38 industries) and the given occupation (ISCO 2 digits).

***Q**: Fields of education: The strong concentration in Technical & engineering and Economics, etc makes one wish for more detail here. Is this available?*

A: Unfortunately not. We only have more detailed data for the field of education for some national sources (f.i. DE, CZ), but we do not think that their use for all European countries is appropriate.

***Q**: The level of skills and competencies etc. is published in %. What does hypothetical 100 % of a specific skill means?*

A: Please find Annex A.3 Level Scale Anchors for better understanding.

***Q**: How has self-employment been treated? Do all (or some of) the sources that have been used to establish the profiles cover self-employed?*

A: Self-employed people are covered by the ELFS database as well as by the BLS database. However the ECP does not use this characteristic.

References

Bundesagentur für Arbeit (2010) *Klassifikation der Berufe 2010. Systematischer und alphabetischer Teil mit Erläuterungen*. Bundesagentur für Arbeit, Nürnberg

Cedefop (2009) *The shift to learning outcomes,* Cedefop Reference series 72, Luxembourg

Coles M. (2007) Qualification frameworks in Europe: platforms for collaboration, integration and reform. A paper for the conference "*Making the European Learning Area a Reality*", Munich

ČSÚ (2010) *Klasifikace zaměstnání CZ-ISCO*. Český statistický úřad, Praha

Dawis R. V., Lofquist L. H. (1984) *A psychological theory of work adjustment.* University of Minnesota Press, Minneapolis

European Communities (2008b) *NACE Rev. 2. Statistical classification of economic activities in the European Community*

European Communities (2006) *Key Competences for Lifelong Learning*

European Communities (2008) *The European Qualifications Framework for Lifelong Learning*

Felstead A., Green F., Gallie D., Zhou Y. (2007) *Skills At Work, 1986 to 2006*. SKOPE, Oxford University

Franceschetti M. (2012) *Indagine campionaria sulle professioni Isfol-Istat*. Presentazione Isfol, Roma, 14 maggio 2012

Frontier Economics (2010) *Defining and measuring skill at the occupational and job level*. Report prepared for the Migration Advisory Committee (MAC)

Green F., Felstead A., Gallie D. (2002) *Work Skills in Britain 1986-2001*. Nottingham, DfES Publication

Handel M. (2007) *Measuring Job Content: Skills, Technology, and Management Practices*. Working paper, Northeastern University

Hilton M. (2008) *Research on Future Skill Demands*. National Research Council, Washington

Holland J. L. (1997). *Making Vocational Choices: A Theory of Vocational Personalities and Work Environments*. (3rd ed.). Odessa, FL: Psychological Assessment Resources, Inc.

ILO (2012) *International Standard Classification of Occupations 2008 (ISCO-08).* International Labour Office, Geneva

ILO and EC (2011) *Comparative Analysis of Methods of Identification of Skill Needs on the Labour Market in Transition to the Low Carbon Economy 2011*. International Labour Office, Geneva

Istat (2009) *L'indagine sulle professioni 2007: Contenuti, metodologia e organizzazione*. Istituto nazionale di statistica, Roma

Koucký J., Lepič M. (2009) *Sector studies: Overview of findings; Comparison of the EC sector studies and CEDEFOP's approach on skills*

Levy F. (2010) *How Technology Changes Demands for Human Skills*. OECD Publishing, Paris.

Machin S., Van Reenen J. (1998) "Technology and Changes in Skill Structure: Evidence From Seven OECD Countries", *Quarterly Journal of Economics* 113 (4): 1215-1244

McCloy Rod et al. (1999) *Determining the Occupational Reinforcer Patterns for O*NET Occupational Units.* Volume I: Report. National Center for O*NET Development

McKinsey (2011) *An economy that works: Job creation & America future*. McKinsey Global Institute Report

MPiPS (2010) *Klasyfikacja zawodów i specjalności na potrzeby rynku pracy - KZiS*. Ministerstwo Pracy i Polityki Spolecznej, Warszawa

Neumark D., Johnson H., and Cuellar Mejia M. (2011) *Future Skill Shortages in the U.S. Economy?* Presentation at the Conference „Catch the Train: Skills, Education and Jobs", Brussels, June 2011

Rounds J. B. (1981) *The comparative and combined utility of need and importance data in the prediction of job satisfaction*, Doctoral dissertation, University of Minnesota

Rychen D.S., Salganik L. H. (Eds.) 2001) *Defining and Selecting Key Competences*, Hogrefe&Huber

Smith T. J., Campbell C. (2006) The structure of O*NET occupational values, *Journal of Career Assessment*, 2006; 14; 437

Schneider S. L. (2009) *Confusing credentials: The Cross-nationally Comparable measurement of Educational attainment.* Dissertation, Nuffield College Oxford

Schröder H., Ganzeboom H. (2012) *Scaling the grades: a comparison of different methods to achieve cross-national comparability in the measurement of education level*. VU University Amsterdam

Steedman H., Murray A. (2001) Skill Profiles of France, Germany, the Netherlands, Portugal, Sweden and the UK, *European Journal for Vocational Training* 1, no. 22

Taylor P., Kan Shi, Borman W. (2008) The transportability of job information across countries, *Personnel Psychology*, Vol. 61: 69-111

Tippins N. T., Hilton M.L. (2009) *A Database for a Changing Economy: Review of the Occupational Information Network (O*NET)*. National Research Council, Washington

US Department of Labor (2009) *New and Emerging Occupations of the 21st Century*. U.S. Bureau of Labor Statistics, Washington

US Department of Labor (2010) *Standard Occupational Classification 2010*. U.S. Bureau of Labor Statistics, Washington

US Department of Labor (2012) *Employment Projection 2010-2020*. U.S. Bureau of Labor Statistics, Washington

US Department of Labor (2012) *The Guide to Occupational Exploration*. U.S. Bureau of Labor Statistics, Washington

Wilson R.A. (2010). *Medium-term forecast of skill supply in Europe: overview and synthesis*. Cedefop project on forecasting skill supply and demand in Europe

www.bls.gov

www.onetonline.org

Annex

A.1 How Occupational Skills Profiles have been generated

As described in Chapter 2, Occupational Skills Profiles are structured into seven Dimensions. The first two Dimensions – grouped together as *Coordinating Characteristics* – relate to the level of education and training required (and hence to the complexity of the occupation), and to the field of education and training required. Three further Dimensions – together referred to as *Main Characteristics* – contain what is required to do the job in terms of theoretical and factual knowledge, cross-functional skills, and personal, social and methodological abilities. The last two Dimensions – under the heading of *Supplementary Characteristics* – add information relating to the profile and orientation of work, such as occupational interests (preferences for work environment) and work values (important to job satisfaction).

The data sources for the seven OSP Dimensions are described in detail in Chapters 1 and 2. The way how they have been used in order to generate them differs according to their origin – European or US – and to the Dimension in question. Generating Dimensions 3-7 is similar and as it is more complicated, it will be discussed first.

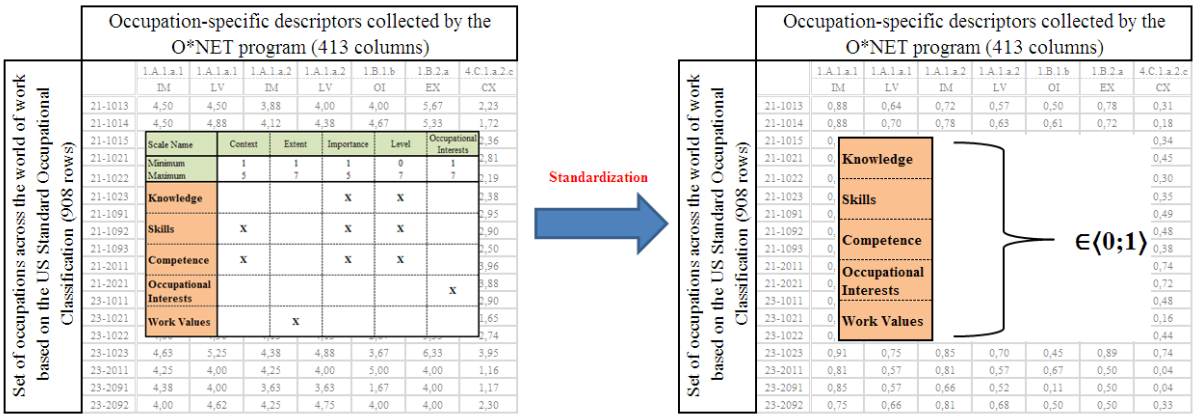
Computing dimensions 3 – 7

Step 1: <u>Standardise O*NET descriptors</u>

The matrix of O*NET descriptors is first converted (standardized) to the range 0 to 1.

<u>Input matrix</u>: The original O*NET database – US occupational groups (SOC) x Occupation-specific descriptors collected by the O*NET program (908 x 413 = 375 004 cells). These can take a variety of values depending on the particular descriptor chosen.

<u>Output matrix</u>: The standardized O*NET database – US occupational groups (SOC) x Standardized occupation-specific descriptors collected by the O*NET program (908 x 413 = 375 004 cells). Values of each descriptor are now standardised.



$\forall_{i=1,\ldots,908;\ d=1,\ldots,413}\quad a_{id} = \frac{x_{id} - min_s}{max_s - min_s}$, where

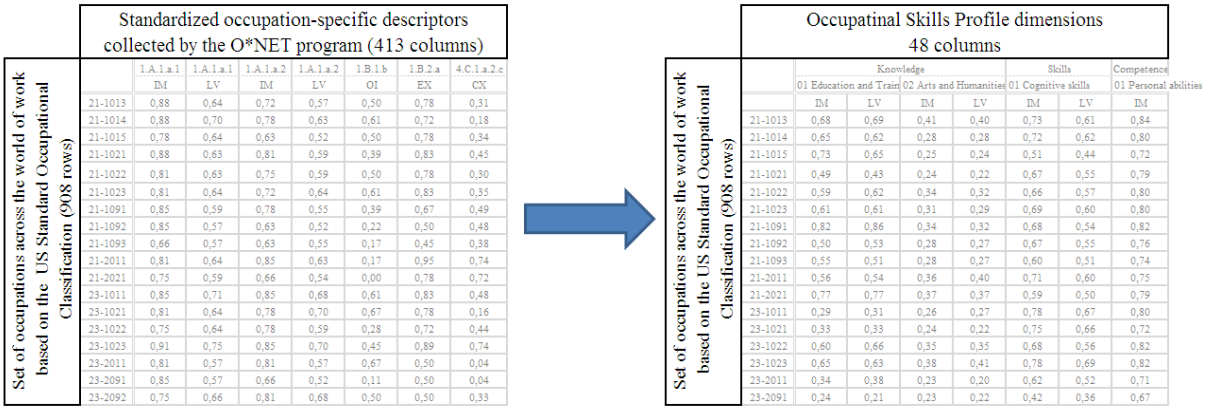
x_{id} … Elements of the input matrix
a_{id} … Elements of the output matrix
i … Occupational group
d … Occupation-specific descriptors collected by the O*NET program
s … Scale; s ∈{Context; Extent; Importance; Level; Occupational Interests}

Step 2: Transform <u>O*NET descriptors</u>

The matrix of standardized occupation-specific descriptors collected by the O*NET Program is transformed to the Occupational Skills Profile dimensions. The 413 O*NET descriptors are aggregated to 48 OSP "dimensions" (it is only 48 "dimensions", not 66 as set out above, because this part is only for dimension 3-7 and there is only 48 "dimensions". Other 18 "dimensions" covered to dimension 1 and 2). For detailed of assignation see Annex 2.

<u>Input matrix</u>: The standardized O*NET database – US occupational groups (SOC) x Standardized occupation-specific descriptors collected by the O*NET program (908 x 413 = 375 004 cells).

<u>Output matrix</u>: The matrix of OSP for US occupational groups (SOC) – US occupational groups (SOC) x OSP dimensions (908 x 48 = 43 584 cells).



Standardized occupation-specific descriptors collected by the O*NET program (413 columns)

Set of occupations across the world of work based on the US Standard Occupational Classification (908 rows)

	1.A.1.a.1 IM	1.A.1.a.1 LV	1.A.1.a.2 IM	1.A.1.a.2 LV	1.B.1.b OI	1.B.2.a EX	4.C.1.a.2.c CX
21-1013	0,88	0,64	0,72	0,57	0,50	0,78	0,31
21-1014	0,88	0,70	0,78	0,63	0,61	0,72	0,18
21-1015	0,78	0,64	0,63	0,52	0,50	0,78	0,34
21-1021	0,88	0,63	0,81	0,59	0,39	0,83	0,45
21-1022	0,81	0,63	0,75	0,59	0,50	0,78	0,30
21-1023	0,81	0,64	0,72	0,64	0,61	0,83	0,35
21-1091	0,85	0,59	0,78	0,55	0,39	0,67	0,49
21-1092	0,85	0,57	0,63	0,52	0,22	0,50	0,48
21-1093	0,66	0,57	0,63	0,55	0,17	0,45	0,38
21-2011	0,81	0,64	0,85	0,63	0,17	0,95	0,74
21-2021	0,75	0,59	0,66	0,54	0,00	0,78	0,72
23-1011	0,85	0,71	0,85	0,68	0,61	0,83	0,48
23-1021	0,81	0,64	0,78	0,70	0,67	0,78	0,16
23-1022	0,75	0,64	0,78	0,59	0,28	0,72	0,44
23-1023	0,91	0,75	0,85	0,70	0,45	0,89	0,74
23-2011	0,81	0,57	0,81	0,57	0,67	0,50	0,04
23-2091	0,85	0,57	0,66	0,52	0,11	0,50	0,04
23-2092	0,75	0,66	0,81	0,68	0,50	0,50	0,33

Occupatinal Skills Profile dimensions 48 columns

Set of occupations across the world of work based on the US Standard Occupational Classification (908 rows)

	Knowledge				Skills		Competence
	01 Education and Train		02 Arts and Humanities		01 Cognitive skills		01 Personal abilities
	IM	LV	IM	LV	IM	LV	IM
21-1013	0,68	0,69	0,41	0,40	0,73	0,61	0,84
21-1014	0,65	0,62	0,28	0,28	0,72	0,62	0,80
21-1015	0,73	0,65	0,25	0,24	0,51	0,44	0,72
21-1021	0,49	0,43	0,24	0,22	0,67	0,55	0,79
21-1022	0,59	0,62	0,34	0,32	0,66	0,57	0,80
21-1023	0,61	0,61	0,31	0,29	0,69	0,60	0,80
21-1091	0,82	0,86	0,34	0,32	0,68	0,54	0,82
21-1092	0,50	0,53	0,28	0,27	0,67	0,55	0,76
21-1093	0,55	0,51	0,28	0,27	0,60	0,51	0,74
21-2011	0,56	0,54	0,36	0,40	0,71	0,60	0,75
21-2021	0,77	0,77	0,37	0,37	0,59	0,50	0,79
23-1011	0,29	0,31	0,26	0,27	0,78	0,67	0,80
23-1021	0,33	0,33	0,24	0,22	0,75	0,66	0,72
23-1022	0,60	0,66	0,35	0,35	0,68	0,56	0,82
23-1023	0,65	0,63	0,38	0,41	0,78	0,69	0,82
23-2011	0,34	0,38	0,23	0,20	0,62	0,52	0,71
23-2091	0,24	0,21	0,23	0,22	0,42	0,36	0,67

$$\forall_{i=1,\dots,908;d=1,\dots,48} \quad a_{id} = \frac{\sum_{j=1}^{N_d} x_{ij}}{N_d}$$, where

x_{ij} … Elements of input matrix
a_{id} … Elements of output matrix
i … Occupational group
d … OSP dimension
N_d … Number of Occupation-specific descriptors collected by the O*NET program covered by the OSP dimension d

Step 3: Generating a Mapping from US NAICS to NACE categories

The industry categories used in the latest US National Employment Matrix (for last version it is Matrix with 2008 data) are converted to the NACE classification used in the main CEDEFOP projections.

Input matrix: The latest US National Employment Matrix, industry employment by occupation – US occupation groups (SOC) x US industrial groups (NAICS) (567 x 130 = 73 710 cells).

Output matrix: The modified US National Employment Matrix (it is employment in the USA in combination of US SOC and European NACE categories); industry employment by occupation – US occupation groups (SOC) x CEDEFOP sectoral groups[18] (567 x 38 = 21 546 cells).

Employment in thousands	Sectoral structure based on the North American Industry Classification Systém (130 columns)							
Occupational structure based on the US Standard Occupational Classification (567 rows)		1111	1133	2111	2121	2122	2123	2130
	11-1011	6,2		0,7	0,2		0,3	0,7
	11-1021	4,9	0,9	6,8	0,9	0,3	2,1	8,4
	11-1031							
	11-2011							
	11-2021	0,6		0,2				0,1
	11-2022	1,1		0,1			0,1	0,4
	11-2031							
	11-3011			0,6		0,1		0,7
	11-3021			0,3				0,1
	11-3031	0,3		1,9	0,1	0,1	0,2	0,8
	11-3040	0,9		0,2				0,2
	11-3051	2,0		1,7	0,4	0,1	0,7	0,3
	11-3061	0,5		0,1	0,1			
	11-3071			0,1				0,1
	11-9011	246,5						
	11-9021			0,2	0,1		0,2	0,8
	11-9030	0,1						
	11-9041			0,9	0,2	0,1	0,1	0,5

Employment in thousands	Sectoral structure based on the CEDEFOP sectoral classification (38 columns)							
Occupational structure based on the US Standard Occupational Classification (567 rows)		01 Agricult	02 Coal	03 Oil & G	04 Other M	05 Food, D	06 Text., C	07 Wood & Paper
	11-1011	6,2	0,2	1,4	0,3	3,1	1,4	2,1
	11-1021	5,8	0,9	15,2	2,4	16,8	7,4	11,4
	11-1031							
	11-2011							
	11-2021	0,6		0,3		1,0	0,5	0,2
	11-2022	1,1		0,5	0,1	4,8	1,0	2,4
	11-2031							
	11-3011			1,3	0,1	0,6	0,3	0,8
	11-3021			0,4		0,8	0,3	0,3
	11-3031	0,3	0,1	2,7	0,3	4,0	0,9	2,3
	11-3040	0,9		0,4		1,3	0,1	0,6
	11-3051	2,0	0,4	2,0	0,8	11,9	3,9	8,8
	11-3061	0,5	0,1	0,1		1,4	0,4	1,1
	11-3071			0,2		3,3		0,8
	11-9011	246,5				0,1		
	11-9021		0,1	1,0	0,2			
	11-9030	0,1						
	11-9041		0,2	1,4	0,2	0,5	0,4	1,2

$$\forall_{i=1,\ldots,567;\ d=1,\ldots,38} \quad a_{id} = \sum_{j=1}^{N_d} x_{ij}$$, where

x_{ij} … Number employed in occupation *i* in the sectoral group *j* (elements of the input matrix)
a_{id} … Number employed in occupation *i* in the sectoral group *d* (elements of the output matrix)
i … Occupational group (SOC classification)
j … Sectoral group (NAICS classification)
d … Sectoral group (CEDEFOP classification)
N_d … Number of sectoral groups defined by the NAICS covered by the CEDEFOP sectoral group *d*

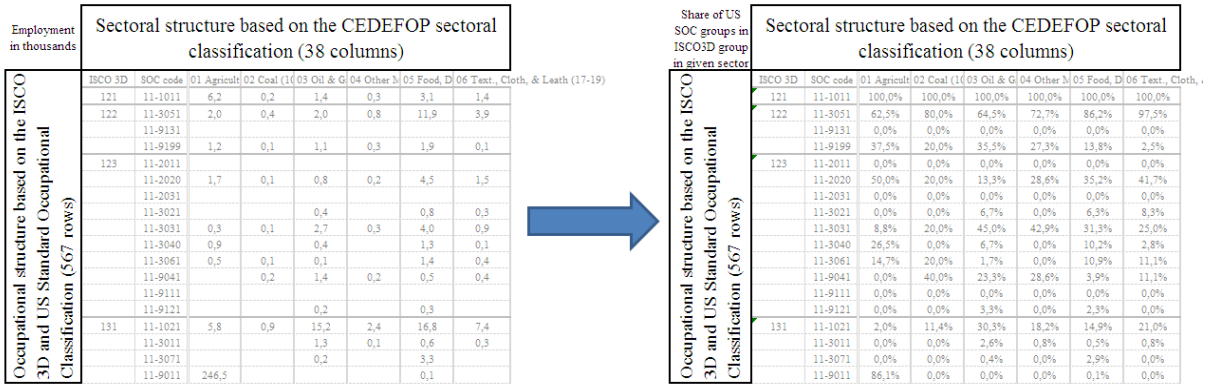
[18] In the main CEDEFOP project Cambridge Econometrics use the E3ME model, in which the structure of sectors is based on the NACE Rev.1.1 classification. The number of sectors has been reduced in E3ME by aggregation to 41. EPC use basically the same classification here. However the number of sectors has been further reduced to just 38, as three pairs of sectors had to be combined due to data limitations. The first combined sector unites Pharmaceuticals (10) and Chemicals (11), the second one Electricity (22) and Gas Supply (23), and the third one Professional Services (36) and Other Business Services (37).

Step 4: <u>Development of sector-specific weights</u>

In this step sector specific weights are developed (for the aggregated CEDEFOP 38 sectors, Ind 38) for computing OSPs for occupational groups based on ISCO 3 digit categories (ISCO 3D).

<u>Input matrix</u>: The modified Employment Matrix from Step 3, which is industry employment by occupation – US occupational groups (SOC) and ISCO 3D groups (103) x CEDEFOP sectoral groups (567 x 38 = 21 546 cells).

<u>Output matrix</u>: The matrix of weights for the occupational group *i* (SOC classification) in the occupational group *j* (ISCO 3D classification) in the sectoral group *d* (CEDEFOP sectoral classification).



Employment in thousands

Occupational structure based on the ISCO 3D and US Standard Occupational Classification (567 rows)	Sectoral structure based on the CEDEFOP sectoral classification (38 columns)							
ISCO 3D	SOC code	01 Agricult	02 Coal (1(	03 Oil & G	04 Other N	05 Food, D	06 Text., Cloth, & Leath (17-19)	
121	11-1011	6,2	0,2	1,4	0,3	3,1	1,4	
122	11-3051	2,0	0,4	2,0	0,8	11,9	3,9	
	11-9131							
	11-9199	1,2	0,1	1,1	0,3	1,9	0,1	
123	11-2011							
	11-2020	1,7	0,1	0,8	0,2	4,5	1,5	
	11-2031							
	11-3021			0,4		0,8	0,3	
	11-3031	0,3	0,1	2,7	0,3	4,0	0,9	
	11-3040	0,9		0,4		1,3	0,1	
	11-3061	0,5	0,1	0,1		1,4	0,4	
	11-9041		0,2	1,4	0,2	0,5	0,4	
	11-9111							
	11-9121			0,2		0,3		
131	11-1021	5,8	0,9	15,2	2,4	16,8	7,4	
	11-3011			1,3	0,1	0,6	0,3	
	11-3071			0,2		3,3		
	11-9011	246,5				0,1		

Share of US SOC groups in ISCO3D group in given sector

Occupational structure based on the ISCO 3D and US Standard Occupational Classification (567 rows)	Sectoral structure based on the CEDEFOP sectoral classification (38 columns)							
ISCO 3D	SOC code	01 Agricult	02 Coal (1(	03 Oil & G	04 Other N	05 Food, D	06 Text., Cloth,	
121	11-1011	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	
122	11-3051	62,5%	80,0%	64,5%	72,7%	86,2%	97,5%	
	11-9131	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	
	11-9199	37,5%	20,0%	35,5%	27,3%	13,8%	2,5%	
123	11-2011	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	
	11-2020	50,0%	20,0%	13,3%	28,6%	35,2%	41,7%	
	11-2031	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	
	11-3021	0,0%	0,0%	6,7%	0,0%	6,3%	8,3%	
	11-3031	8,8%	20,0%	45,0%	42,9%	31,3%	25,0%	
	11-3040	26,5%	0,0%	6,7%	0,0%	10,2%	2,8%	
	11-3061	14,7%	20,0%	1,7%	0,0%	10,9%	11,1%	
	11-9041	0,0%	40,0%	23,3%	28,6%	3,9%	11,1%	
	11-9111	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	
	11-9121	0,0%	0,0%	3,3%	0,0%	2,3%	0,0%	
131	11-1021	2,0%	11,4%	30,3%	18,2%	14,9%	21,0%	
	11-3011	0,0%	0,0%	2,6%	0,8%	0,5%	0,8%	
	11-3071	0,0%	0,0%	0,4%	0,0%	2,9%	0,0%	
	11-9011	86,1%	0,0%	0,0%	0,0%	0,1%	0,0%	

$$\forall_{j=1,\dots,103;\ d=1,\dots,38} \quad w_{ijd} = \frac{a_{id}}{\sum_{i=1}^{567} k_{ij}.a_{id}}$$, where

w_{ijd} …Weight (or share) of the occupational group *i* in occupational group *j* in sectoral group *d* (elements of the output matrix)

a_{id} …Number employed in the US SOC occupational group *i* in sectoral group *d* (elements of the input matrix)

i … Occupational group (SOC classification)

j … Occupational group (ISCO 3D classification)

d … Sectoral group (CEDEFOP classification)

$$k_{ij} = \begin{cases} 0 \dots \text{occupation group } i \text{ (SOC classification) is not a part of occupational group } j \text{ (ISCO 3D classification)} \\ 1 \dots \text{occupation group } i \text{ (SOC classification) is a part of occupational group } j \text{ (ISCO 3D classification)} \end{cases}$$

Mapping the US SOC occupational group to ISCO 3D groups is based on correspondence table created by EPC.

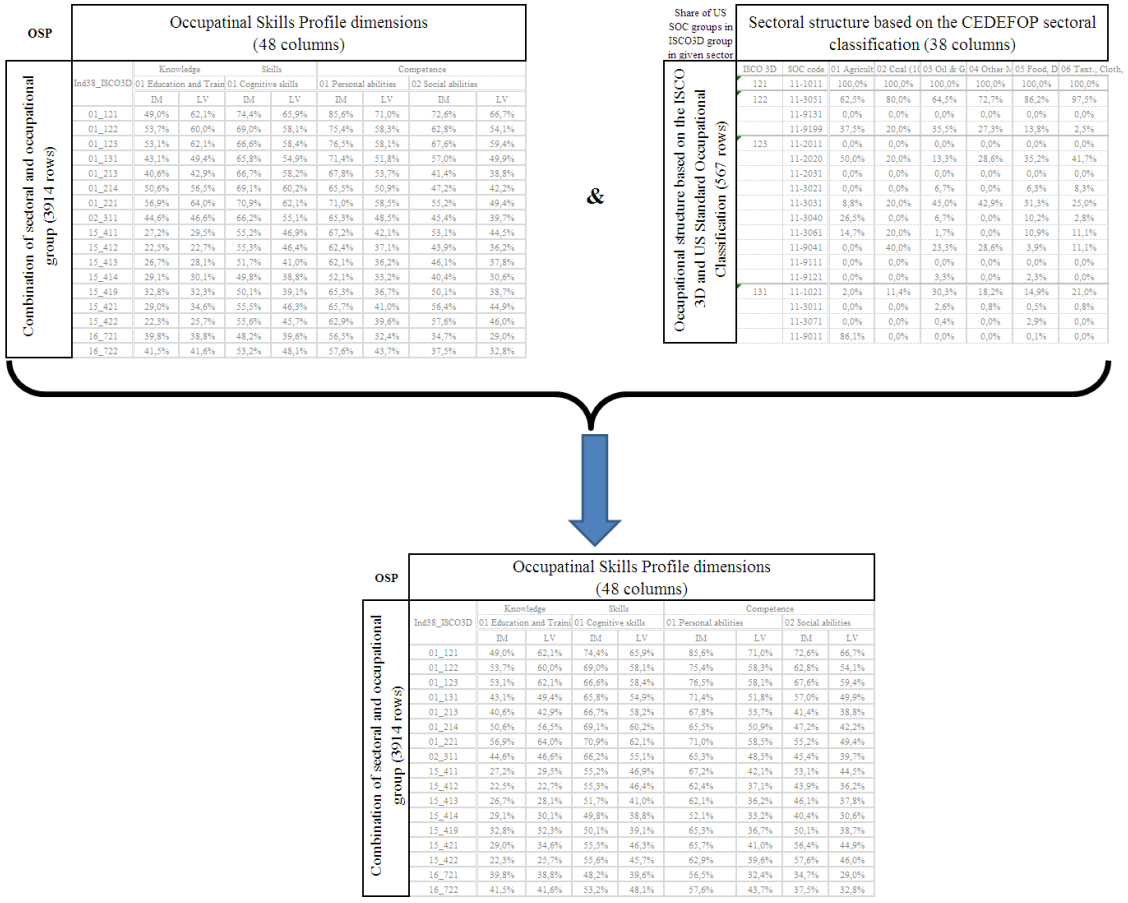
Step 5: <u>Development of sector-specific OSPs</u>

In this Step sector specific Occupational Skills Profiles are computed. They are computed for each combination of occupations (ISCO 3D) and sectors (38 sectoral groups).

<u>Input matrixes</u>:

- The matrix of OSP for US occupational groups (SOC) – US occupational groups (SOC) x OSP dimensions (908 x 48 = 43 584 cells), from Step 2, and
- The matrix of weights for the occupational group *i* (SOC classification) in the occupational group *j* (ISCO 3D classification) in the sectoral group *d* (CEDEFOP sectoral classification) (567 x 38 = 21 546 cells), from Step 4.

<u>Output matrix</u>: The matrix of OSP for each combination Occupation (ISCO 3D or ISCO 2D) x Sector (Ind 38)

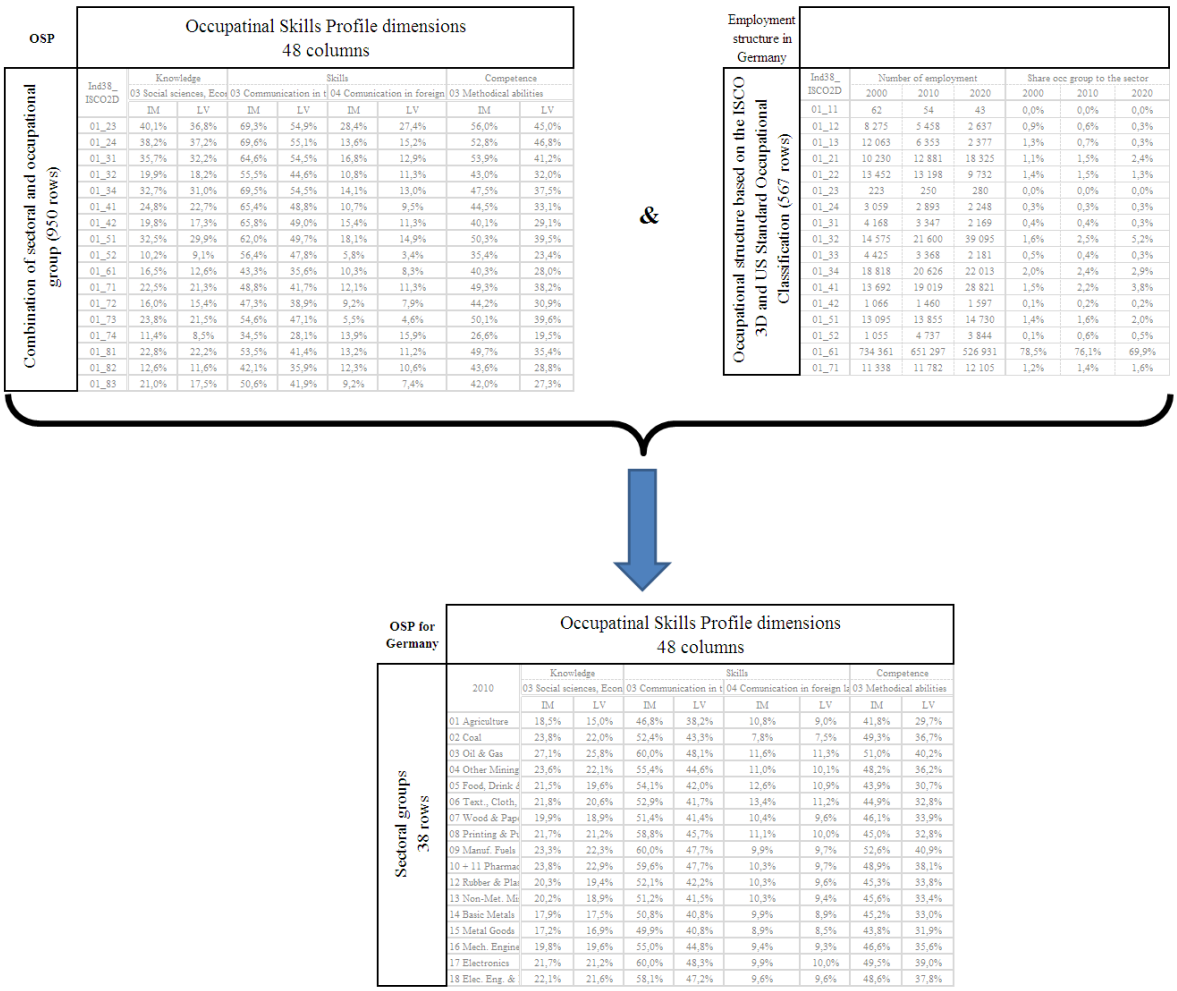


As in the Core project the ISCO 2D classification is used, the OSP matrix computed in this step (ISCO 3D x Ind 38) is transformed to the matrix ISCO2D x Ind 38. As a weight, the employment structure of the EU19[19] is used.

[19] The EU19 covers EU15 countries + Czech Republic + Hungary + Poland +Slovakia; Only EU19 is used because authors have no data for ISCO 3D for all European countries.

Step 6: <u>Generate OSPs for all industries</u>

In the last step OSPs are computed for each country. They are based on its particular employment structure (occupation x sectors).



OSP

Occupatinal Skills Profile dimensions
48 columns

Combination of sectoral and occupational group (950 rows)

Ind38_ ISCO2D	Knowledge		Skills				Competence	
	03 Social sciences, Ecor		03 Communication in t		04 Comunication in foreign		03 Methodical abilities	
	IM	LV	IM	LV	IM	LV	IM	LV
01_23	40,1%	36,8%	69,3%	54,9%	28,4%	27,4%	56,0%	45,0%
01_24	38,2%	37,2%	69,6%	55,1%	13,6%	15,2%	52,8%	46,8%
01_31	35,7%	32,2%	64,6%	54,5%	16,8%	12,9%	53,9%	41,2%
01_32	19,9%	18,2%	55,5%	44,6%	10,8%	11,3%	43,0%	32,0%
01_34	32,7%	31,0%	69,5%	54,5%	14,1%	13,0%	47,5%	37,5%
01_41	24,8%	22,7%	65,4%	48,8%	10,7%	9,5%	44,5%	33,1%
01_42	19,8%	17,3%	65,8%	49,0%	15,4%	11,3%	40,1%	29,1%
01_51	32,5%	29,9%	62,0%	49,7%	18,1%	14,9%	50,3%	39,5%
01_52	10,2%	9,1%	56,4%	47,8%	5,8%	3,4%	35,4%	23,4%
01_61	16,5%	12,6%	43,3%	35,6%	10,3%	8,3%	40,3%	28,0%
01_71	22,5%	21,3%	48,8%	41,7%	12,1%	11,3%	49,3%	38,2%
01_72	16,0%	15,4%	47,3%	38,9%	9,2%	7,9%	44,2%	30,9%
01_73	23,8%	21,5%	54,6%	47,1%	5,5%	4,6%	50,1%	39,6%
01_74	11,4%	8,5%	34,5%	28,1%	13,9%	15,9%	26,6%	19,5%
01_81	22,8%	22,2%	53,5%	41,4%	13,2%	11,2%	49,7%	35,4%
01_82	12,6%	11,6%	42,1%	35,9%	12,3%	10,6%	43,6%	28,8%
01_83	21,0%	17,5%	50,6%	41,9%	9,2%	7,4%	42,0%	27,3%

&

Employment structure in Germany

Occupational structure based on the ISCO 3D and US Standard Occupational Classification (567 rows)

Ind38_ ISCO2D	Number of employment			Share occ group to the sector		
	2000	2010	2020	2000	2010	2020
01_11	62	54	43	0,0%	0,0%	0,0%
01_12	8 275	5 458	2 637	0,9%	0,6%	0,3%
01_13	12 063	6 353	2 377	1,3%	0,7%	0,3%
01_21	10 230	12 881	18 325	1,1%	1,5%	2,4%
01_22	13 452	13 198	9 732	1,4%	1,5%	1,3%
01_23	223	250	280	0,0%	0,0%	0,0%
01_24	3 059	2 893	2 248	0,3%	0,3%	0,3%
01_31	4 168	3 347	2 169	0,4%	0,4%	0,3%
01_32	14 575	21 600	39 095	1,6%	2,5%	5,2%
01_33	4 425	3 368	2 181	0,5%	0,4%	0,3%
01_34	18 818	20 626	22 013	2,0%	2,4%	2,9%
01_41	13 692	19 019	28 821	1,5%	2,2%	3,8%
01_42	1 066	1 460	1 597	0,1%	0,2%	0,2%
01_51	13 095	13 855	14 730	1,4%	1,6%	2,0%
01_52	1 055	4 737	3 844	0,1%	0,6%	0,5%
01_61	734 361	651 297	526 931	78,5%	76,1%	69,9%
01_71	11 338	11 782	12 105	1,2%	1,4%	1,6%

OSP for Germany

Occupatinal Skills Profile dimensions
48 columns

Sectoral groups 38 rows

2010	Knowledge		Skills				Competence	
	03 Social sciences, Econ		03 Communication in t		04 Comunication in foreign la		03 Methodical abilities	
	IM	LV	IM	LV	IM	LV	IM	LV
01 Agriculture	18,5%	15,0%	46,8%	38,2%	10,8%	9,0%	41,8%	29,7%
02 Coal	23,8%	22,0%	52,4%	43,3%	7,8%	7,5%	49,3%	36,7%
03 Oil & Gas	27,1%	25,8%	60,0%	48,1%	11,6%	11,3%	51,0%	40,2%
04 Other Mining	23,6%	22,1%	55,4%	44,6%	11,0%	10,1%	48,2%	36,2%
05 Food, Drink &	21,5%	19,6%	54,1%	42,0%	12,6%	10,9%	43,9%	30,7%
06 Text., Cloth,	21,8%	20,6%	52,9%	41,7%	13,4%	11,2%	44,9%	32,8%
07 Wood & Pape	19,9%	18,9%	51,4%	41,4%	10,4%	9,6%	46,1%	33,9%
08 Printing & Pu	21,7%	21,2%	58,8%	45,7%	11,1%	10,0%	45,0%	32,8%
09 Manuf. Fuels	23,3%	22,3%	60,0%	47,7%	9,9%	9,7%	52,6%	40,9%
10 - 11 Pharmac	23,8%	22,9%	59,6%	47,7%	10,3%	9,7%	48,9%	38,1%
12 Rubber & Plas	20,3%	19,4%	52,1%	42,2%	10,3%	9,6%	45,3%	33,8%
13 Non-Met. Mi	20,2%	18,9%	51,2%	41,5%	10,3%	9,4%	45,6%	33,4%
14 Basic Metals	17,9%	17,5%	50,8%	40,8%	9,9%	8,9%	45,2%	33,0%
15 Metal Goods	17,2%	16,9%	49,9%	40,8%	8,9%	8,5%	43,8%	31,9%
16 Mech. Engine	19,8%	19,6%	55,0%	44,8%	9,4%	9,3%	46,6%	35,6%
17 Electronics	21,7%	21,2%	60,0%	48,3%	9,9%	10,0%	49,5%	39,0%
18 Elec. Eng. &	22,1%	21,6%	58,1%	47,2%	9,6%	9,6%	48,6%	37,8%

Computing Dimensions 1 and 2

The approach is not so complicated here. European sources (such as ESS or BIBB) use the ISCO x NACE classifications. It is straightforward to find the value of Dimension 1 and 2 in OSPs for each necessary combination of the ISCO 2 digit (ISCO 2D) and NACE industry category (in particular the 38 categories used here (Ind 38).

For the US data the procedure required is the same as described in Steps 4 to 6 in the previous section.

*A.2 Assigning variables from O*NET*

Dimension III – Knowledge

Main dimension	Detail dimension	O*NET code	O*NET name
Knowledge	01 Education and Training	2.C.6	Education and Training
	02 Arts and Humanities	2.C.3.c	Design
		2.C.7.a	Mother Language
		2.C.7.c	Fine Arts
		2.C.7.d	History and Archeology
		2.C.7.e	Philosophy and Theology
		2.C.9.b	Communications and Media
	03 Social sciences, Economy and Law	2.C.1.c	Economics and Accounting
		2.C.4.e	Psychology
		2.C.4.f	Sociology and Anthropology
		2.C.8.b	Law and Government
	04 Sciences, Mathematics and Computers	2.C.4.a	Mathematics
		2.C.4.b	Physics
		2.C.4.c	Chemistry
		2.C.4.d	Biology
		2.C.4.g	Geography
	05 Engineering, Technology, Production and Processing	2.C.2.a	Production and Processing
		2.C.2.b	Food Production
		2.C.3.a	Computers and Electronics
		2.C.3.b	Engineering and Technology
		2.C.3.d	Building and Construction
		2.C.3.e	Mechanical
	06 Helath services	2.C.5.a	Medicine and Dentistry
		2.C.5.b	Therapy and Counseling
	07 Services	2.C.1.e	Customer and Personal Service
		2.C.10	Transportation
		2.C.8.a	Public Safety and Security
		2.C.9.a	Telecommunications
	08 Bussiness and Management	2.C.1.a	Administration and Management
		2.C.1.b	Clerical
		2.C.1.d	Sales and Marketing
		2.C.1.f	Personnel and Human Resources

Dimension IV – Skills

Main dimension	Detail dimension	O*NET code	O*NET name
Skills	01 Cognitive skills	1.A.1.b.4	Deductive Reasoning
		1.A.1.b.5	Inductive Reasoning
		1.A.1.b.6	Information Ordering
		1.A.1.b.7	Category Flexibility
		1.C.7.b	Analytical Thinking
		2.A.2.a	Critical Thinking
		2.A.2.b	Active Learning
		2.B.2.i	Complex Problem Solving
		4.A.2.a.1	Judging the Qualities of Things, Services, or People
		4.A.2.a.2	Processing Information
		4.A.2.a.3	Evaluating Information to Determine Compliance with Standards
		4.A.2.a.4	Analyzing Data or Information
		4.A.2.b.1	Making Decisions and Solving Problems
		4.A.2.b.3	Updating and Using Relevant Knowledge
	02 Practical skills	2.B.3.a	Operations Analysis
		2.B.3.b	Technology Design
		2.B.3.c	Equipment Selection
		2.B.3.d	Installation
		2.B.3.g	Operation Monitoring
		2.B.3.h	Operation and Control
		2.B.3.j	Equipment Maintenance
		2.B.3.k	Troubleshooting
		2.B.3.l	Repairing
		2.B.3.m	Quality Control Analysis
		4.A.1.a.1	Getting Information
		4.A.1.a.2	Monitor Processes, Materials, or Surroundings
		4.A.1.b.1	Identifying Objects, Actions, and Events
		4.A.1.b.2	Inspecting Equipment, Structures, or Material
		4.A.1.b.3	Estimating the Quantifiable Characteristics of Products, Events, or Information
		4.A.3.b.1	Interacting With Computers
		4.A.3.b.2	Drafting, Laying Out, and Specifying Technical Devices, Parts, and Equipment
		4.A.3.b.4	Repairing and Maintaining Mechanical Equipment
		4.A.3.b.5	Repairing and Maintaining Electronic Equipment
		4.A.3.b.6	Documenting/Recording Information
	03 Communication in the mother language	1.A.1.a.1	Oral Comprehension
		1.A.1.a.2	Written Comprehension
		1.A.1.a.3	Oral Expression
		1.A.1.a.4	Written Expression
		2.A.1.a	Reading Comprehension
		2.A.1.b	Active Listening
		2.A.1.c	Writing
		2.A.1.d	Speaking
		4.A.4.a.1	Interpreting the Meaning of Information for Others
		4.A.4.a.2	Communicating with Supervisors, Peers, or Subordinates
		4.A.4.a.3	Communicating with Persons Outside Organization
		4.A.4.a.8	Performing for or Working Directly with the Public
		4.C.1.a.2.c	Public Speaking
		4.C.1.a.2.f	Telephone
		4.C.1.a.2.h	Electronic Mail
		4.C.1.a.2.j	Letters and Memos
		4.C.1.a.2.l	Face-to-Face Discussions
		4.C.1.a.4	Contact With Others
	04 Comunication in foreign languages	2.C.7.b	Foreign Language
	05 Numeracy + basic SMT concepts	1.A.1.c.1	Mathematical Reasoning
		1.A.1.c.2	Number Facility
		2.A.1.e	Mathematics
		2.A.1.f	Science
	06 ICT/digital	2.B.3.e	Programming
	07 Learning to learn	2.A.2.c	Learning Strategies

Dimension V – Competence

Main dimension	Detail dimension	O*NET code	O*NET name
Competence	01 Personal abilities	1.A.1.b.1	Fluency of Ideas
		1.A.1.b.2	Originality
		1.A.1.b.3	Problem Sensitivity
		1.C.1.a	Achievement/Effort
		1.C.1.b	Persistence
		1.C.1.c	Initiative
		1.C.2.b	Leadership
		1.C.3.a	Cooperation
		1.C.3.b	Concern for Others
		1.C.4.a	Self Control
		1.C.4.b	Stress Tolerance
		1.C.4.c	Adaptability/Flexibility
		1.C.5.a	Dependability
		1.C.5.c	Integrity
		1.C.6	Independence
		1.C.7.a	Innovation
		2.A.2.d	Monitoring
		4.A.2.b.2	Thinking Creatively
	02 Social abilities	2.B.1.a	Social Perceptiveness
		2.B.1.b	Coordination
		2.B.1.c	Persuasion
		2.B.1.d	Negotiation
		2.B.1.e	Instructing
		2.B.1.f	Service Orientation
		4.A.4.a.4	Establishing and Maintaining Interpersonal Relationships
		4.A.4.a.5	Assisting and Caring for Others
		4.A.4.a.6	Selling or Influencing Others
		4.A.4.a.7	Resolving Conflicts and Negotiating with Others
		4.C.1.b.1.e	Work With Work Group or Team
	03 Methodical abilities	2.B.4.e	Judgment and Decision Making
		2.B.4.g	Systems Analysis
		2.B.4.h	Systems Evaluation
		2.B.5.a	Time Management
		2.B.5.b	Management of Financial Resources
		2.B.5.c	Management of Material Resources
		2.B.5.d	Management of Personnel Resources
		4.A.2.b.4	Developing Objectives and Strategies
		4.A.2.b.5	Scheduling Work and Activities
		4.A.2.b.6	Organizing, Planning, and Prioritizing Work
		4.A.4.b.1	Coordinating the Work and Activities of Others
		4.A.4.b.2	Developing and Building Teams
		4.A.4.b.3	Training and Teaching Others
		4.A.4.b.4	Guiding, Directing, and Motivating Subordinates
		4.A.4.b.5	Coaching and Developing Others
		4.A.4.b.6	Provide Consultation and Advice to Others
		4.A.4.c.2	Staffing Organizational Units
		4.A.4.c.3	Monitoring and Controlling Resources
		4.C.1.b.1.g	Coordinate or Lead Others
		4.C.1.c.2	Responsibility for Outcomes and Results
		4.C.3.a.1	Consequence of Error
		4.C.3.a.2.a	Impact of Decisions on Co-workers or Company Results
		4.C.3.a.2.b	Frequency of Decision Making
		4.C.3.a.4	Freedom to Make Decisions
		4.C.3.b.8	Structured versus Unstructured Work
		4.C.3.d.1	Time Pressure

Dimension VI – Occupational Interests

Main dimension	Detail dimension	O*NET code	O*NET name
Occupational Interests	Artistic	1.B.1.c	Artistic
	Conventional	1.B.1.f	Conventional
	Enterprising	1.B.1.e	Enterprising
	Investigative	1.B.1.b	Investigative
	Realistic	1.B.1.a	Realistic
	Social	1.B.1.d	Social

Dimension VII – Work Values

Main dimension	Detail dimension	O*NET code	O*NET name
Work Values	Achievement	1.B.2.a	Achievement
	Independence	1.B.2.f	Independence
	Recognition	1.B.2.c	Recognition
	Relationships	1.B.2.d	Relationships
	Support	1.B.2.e	Support
	Working Conditions	1.B.2.b	Working Conditions

A.3 Level Scale Anchors

Element ID	Element Name	OSP group / OSP subgroup	Anchor %	Anchor Description
1.A.1.a.1	Oral Comprehension	Skills / 03 Communication in the mother language	29%	Understand a television commercial
			57%	Understand a coach's oral instructions for a sport
			86%	Understand a lecture on advanced physics
1.A.1.a.2	Written Comprehension	Skills / 03 Communication in the mother language	29%	Understand signs on the highway
			57%	Understand an apartment lease
			86%	Understand an instruction book on repairing missile guidance systems
1.A.1.a.3	Oral Expression	Skills / 03 Communication in the mother language	29%	Cancel newspaper delivery by phone
			57%	Give instructions to a lost motorist
			86%	Explain advanced principles of genetics to college freshmen
1.A.1.a.4	Written Expression	Skills / 03 Communication in the mother language	14%	Write a note to remind someone to take food out of the freezer
			57%	Write a job recommendation for a subordinate
			86%	Write an advanced economics textbook
1.A.1.b.1	Fluency of Ideas	Competence / 01 Personal abilities	29%	Name four different uses for a screwdriver
			57%	Think of as many ideas as possible for the name of a new company
			86%	Name all the possible strategies for a military battle
1.A.1.b.2	Originality	Competence / 01 Personal abilities	29%	Use a credit card to open a locked door
			57%	Redesign job tasks to be interesting for employees
			86%	Invent a new type of man-made fiber
1.A.1.b.3	Problem Sensitivity	Competence / 01 Personal abilities	29%	Recognize that an unplugged lamp won't work
			57%	Recognize from the mood of prisoners that a prison riot is likely to occur
			86%	Recognize an illness at an early stage of a disease when there are only a few symptoms
1.A.1.b.4	Deductive Reasoning	Skills / 01 Cognitive skills	29%	Know that a stalled car can coast downhill
			71%	Decide what factors to consider in selecting stocks
			86%	Design an aircraft wing using principles of aerodynamics
1.A.1.b.5	Inductive Reasoning	Skills / 01 Cognitive skills	29%	Decide what to wear based on the weather report
			57%	Determine the prime suspect based on crime scene evidence
			86%	Diagnose a disease using results of many different lab tests
1.A.1.b.6	Information Ordering	Skills / 01 Cognitive skills	14%	Put things in numerical order
			29%	Follow the correct steps to make change
			86%	Assemble a nuclear warhead
1.A.1.b.7	Category Flexibility	Skills / 01 Cognitive skills	29%	Sort nails in a toolbox on the basis of length
			43%	Classify flowers according to size, color, and smell
			86%	Classify man-made fibers in terms of their strength, cost, flexibility, melting points, etc.
1.A.1.c.1	Mathematical Reasoning	Skills / 05 Numeracy + basic SMT concepts	14%	Determine how much 10 oranges will cost when they are priced at 2 for 20 cents
			57%	Decide how to calculate profits to determine the amounts of yearly bonuses
			86%	Determine the mathematics required to simulate a space craft landing on the moon
1.A.1.c.2	Number Facility	Skills / 05 Numeracy + basic SMT concepts	14%	Add 2 and 7
			43%	Balance a checkbook
			71%	Compute the interest payment that should be generated from an investment
2.A.1.a	Reading Comprehension	Skills / 03 Communication in the mother language	29%	Read step-by-step instructions for completing a form
			57%	Read a memo from management describing new personnel policies
			86%	Read a scientific journal article describing surgical procedures
2.A.1.b	Active Listening	Skills / 03 Communication in the mother language	29%	Take a customer's order
			57%	Answer inquiries regarding credit references
			86%	Preside as judge in a complex legal disagreement
2.A.1.c	Writing	Skills / 03 Communication in the mother language	29%	Take a telephone message
			57%	Write a memo to staff outlining new directives
			86%	Write a novel for publication
2.A.1.d	Speaking	Skills / 03 Communication in the mother language	29%	Greet tourists and explain tourist attractions
			57%	Interview applicants to obtain personal and work history
			86%	Argue a legal case before the Supreme Court
2.A.1.e	Mathematics	Skills / 05 Numeracy + basic SMT concepts	29%	Count the amount of change to be given to a customer
			57%	Calculate the square footage of a new home under construction
			86%	Develop a mathematical model to simulate and resolve an engineering problem
2.A.1.f	Science	Skills / 05 Numeracy + basic SMT concepts	29%	Conduct standard tests to determine soil quality
			57%	Conduct product tests to ensure safety standards are met, following written instructions
			86%	Conduct analyses of aerodynamic systems to determine the practicality of an aircraft design

Element ID	Element Name	OSP group / OSP subgroup	Anchor %	Anchor Description
2.A.2.a	Critical Thinking	Skills	29%	Determine whether a subordinate has a good excuse for being late
		01 Cognitive skills	57%	Evaluate customer complaints and determine appropriate responses
			86%	Write legal brief challenging a federal law
2.A.2.b	Active Learning	Skills	29%	Think about the implications of a newspaper article for job opportunities
		01 Cognitive skills	57%	Determine the impact of new menu changes on a restaurant's purchasing requirements
			86%	Identify the implications of a new scientific theory for product design
2.A.2.c	Learning Strategies	Skills	29%	Learn a different method of completing a task from a coworker
		07 Learning to learn	57%	Identify an alternative approach that might help trainees who are having difficulties
			86%	Apply principles of educational psychology to develop new teaching methods
2.A.2.d	Monitoring	Competence	29%	Proofread and correct a letter
		01 Personal abilities	57%	Monitor a meeting's progress and revise the agenda to ensure that important topics are discussed
			86%	Review corporate productivity and develop a plan to increase productivity
2.B.1.a	Social Perceptiveness	Competence	29%	Notice that customers are angry because they have been waiting too long
		02 Social abilities	57%	Be aware of how a coworker's promotion will affect a work group
			86%	Counsel depressive patients during a crisis period
2.B.1.b	Coordination	Competence	29%	Schedule appointments for a medical clinic
		02 Social abilities	57%	Work with others to put a new roof on a house
			86%	Work as director of a consulting project calling for interaction with multiple subcontractors
2.B.1.c	Persuasion	Competence	29%	Solicit donations for a charity
		02 Social abilities	57%	Convince a supervisor to purchase a new copy machine
			86%	Change the opinion of the jury in a complex legal case
2.B.1.d	Negotiation	Competence	29%	Present justification to a manager for altering work schedule
		02 Social abilities	57%	Contract with a wholesaler to sell items at a given cost
			86%	Work as an ambassador in negotiating a new treaty
2.B.1.e	Instructing	Competence	29%	Instruct a new employee in the use of a time clock
		02 Social abilities	57%	Instruct a coworker in how to operate a software program
			86%	Demonstrate surgical procedure to interns in a teaching hospital
2.B.1.f	Service Orientation	Competence	29%	Ask customers if they would like cups of coffee
		02 Social abilities	57%	Make flight reservations for customers, using airline reservation system
			86%	Direct relief agency operations in a disaster area
2.B.2.i	Complex Problem Solving	Skills	29%	Lay out tools to complete a job
		01 Cognitive skills	57%	Redesign a floor layout to take advantage of new manufacturing techniques
			86%	Develop and implement a plan to provide emergency relief for a major metropolitan area
2.B.3.a	Operations Analysis	Skills	29%	Select a photocopy machine for an office
		02 Practical skills	57%	Suggest changes in software to make a system more user friendly
			86%	Identify the control system needed for a new process production plant
2.B.3.b	Technology Design	Skills	29%	Adjust exercise equipment for use by a customer
		02 Practical skills	57%	Redesign the handle on a hand tool for easier gripping
			86%	Create new technology for producing industrial diamonds
2.B.3.c	Equipment Selection	Skills	29%	Select a screwdriver to use in adjusting a vehicle's carburetor
		02 Practical skills	57%	Choose a software application to use to complete a work assignment
			86%	Identify the equipment needed to produce a new product line
2.B.3.d	Installation	Skills	29%	Install a new air filter in an air conditioner
		02 Practical skills	57%	Install new switches for a telephone exchange
			86%	Install a "one of a kind" process production molding machine
2.B.3.e	Programming	Skills	29%	Write a program in BASIC to sort objects in a database
		06 ICT/digital	57%	Write a statistical analysis program to analyze demographic data
			86%	Write expert system programs to analyze ground radar geological data for probable existence of mineral deposits
2.B.3.g	Operation Monitoring	Skills	29%	Monitor completion times while running a computer program
		02 Practical skills	57%	Monitor machine functions on an automated production line
			86%	Monitor and integrate control feedback in a petrochemical processing facility to maintain production flow
2.B.3.h	Operation and Control	Skills	29%	Adjust the settings on a copy machine to make reduced size photocopies
		02 Practical skills	57%	Adjust the speed of assembly line equipment based on the type of product being assembled
			86%	Control aircraft approach and landing at a large airport during a busy period
2.B.3.j	Equipment Maintenance	Skills	29%	Add oil to an engine as indicated by a gauge or warning light
		02 Practical skills	57%	Clean moving parts in production machinery
			86%	Conduct maintenance checks on an experimental aircraft
2.B.3.k	Troubleshooting	Skills	29%	Identify the source of a leak by looking under a machine
		02 Practical skills	57%	Identify the circuit causing an electrical system to fail
			86%	Direct the debugging of control code for a new operating system
2.B.3.l	Repairing	Skills	29%	Tighten a screw to get a door to close properly
		02 Practical skills	57%	Replace a faulty hydraulic valve
			86%	Repair structural damage after an earthquake
2.B.3.m	Quality Control Analysis	Skills	29%	Inspect a draft memorandum for clerical errors
		02 Practical skills	57%	Measure new part requisitions for tolerance to specifications
			86%	Develop procedures to test a prototype of a new computer system

Element ID	Element Name	OSP group / OSP subgroup	Anchor %	Anchor Description
2.B.4.e	Judgment and Decision Making	Competence	29%	Decide how scheduling a break will affect work flow
		03 Methodical abilities	57%	Evaluate a loan application for degree of risk
			86%	Decide whether a manufacturing company should invest in new robotics technology
2.B.4.g	Systems Analysis	Competence	29%	Determine how loss of a team member will affect the completion of a job
		03 Methodical abilities	57%	Determine how the introduction of a new piece of equipment will affect production rates
			86%	Identify how changes in tax laws are likely to affect preferred sites for manufacturing operations in different industries
2.B.4.h	Systems Evaluation	Competence	29%	Determine why a co-worker has been overly optimistic about how long it would take to complete a task
		03 Methodical abilities	57%	Identify the major reasons why a client might be unhappy with a product
			86%	Evaluate the long-term performance problem of a new computer system
2.B.5.a	Time Management	Competence	29%	Keep a monthly calendar of appointments
		03 Methodical abilities	57%	Allocate the time of subordinates to projects for the coming week
			86%	Allocate the time of scientists to multiple research projects
2.B.5.b	Management of Financial Resources	Competence	29%	Take money from petty cash to buy office supplies and record the amount of the expenditure
		03 Methodical abilities	57%	Prepare and manage a budget for a short-term project
			86%	Develop and approve yearly budgets for a large corporation and obtain financing as necessary
2.B.5.c	Management of Material Resources	Competence	29%	Rent a meeting room for a management meeting
		03 Methodical abilities	57%	Evaluate an annual uniform service contract for delivery drivers
			86%	Determine the computer system needs of a large corporation and monitor use of the equipment
2.B.5.d	Management of Personnel Resources	Competence	29%	Encourage a coworker who is having difficulty finishing a piece of work
		03 Methodical abilities	57%	Direct the activities of a road repair crew with minimal disruption of traffic flow
			86%	Plan, implement, and manage recruitment, training, and incentive programs for a high performance company
2.C.1.a	Administration and Management	Knowledge	29%	Sign a pay voucher
		08 Bussiness and Management	57%	Monitor progress of a project to ensure timely completion
			86%	Manage a $10 million company
2.C.1.b	Clerical	Knowledge	29%	File letters alphabetically
		08 Bussiness and Management	43%	Type 30 words per minute
			71%	Organize a storage system for company forms
2.C.1.c	Economics and Accounting	Knowledge	29%	Answer billing questions from credit card customers
		03 Social sciences, Economy and Law	57%	Develop financial investment programs for individual clients
			86%	Keep a major corporation's financial records
2.C.1.d	Sales and Marketing	Knowledge	29%	Sell cakes at a bake sale
		08 Bussiness and Management	57%	Call a list of clients to introduce them to a new product line
			86%	Develop a marketing plan for a nationwide telephone system
2.C.1.e	Customer and Personal Service	Knowledge	29%	Process customer dry-cleaning drop off
		07 Services	57%	Work as a day care aide supervising 10 children
			86%	Respond to a citizen's request for assistance after a major disaster
2.C.1.f	Personnel and Human Resources	Knowledge	29%	Fill out a medical claim form
		08 Bussiness and Management	43%	Interview applicants for a secretarial position
			86%	Design a new personnel selection and promotion system for the Army
2.C.10	Transportation	Knowledge	29%	Ride a train to work
		07 Services	71%	Steer a large freighter through a busy harbor
			86%	Control air traffic at a busy airport
2.C.2.a	Production and Processing	Knowledge	29%	Put a computer back into its packing materials
		05 Engineering, Technology, Production and Processing	57%	Supervise an appliance assembly line
			86%	Manage an international shipping company distribution center
2.C.2.b	Food Production	Knowledge	29%	Keep an herb box in the kitchen
		05 Engineering, Technology, Production and Processing	71%	Operate a commercial fishing boat
			86%	Run a 100,000-acre farm
2.C.3.a	Computers and Electronics	Knowledge	14%	Operate a VCR to watch a pre-recorded training tape
		05 Engineering, Technology, Production and Processing	43%	Use a word processor
			86%	Create a program to scan computer disks for viruses
2.C.3.b	Engineering and Technology	Knowledge	29%	Install a door lock
		05 Engineering, Technology, Production and Processing	57%	Design a more stable grocery cart
			86%	Plan for the impact of weather in designing a bridge
2.C.3.c	Design	Knowledge	29%	Draw a straight line 4 3/16 inches long
		02 Arts and Humanities	57%	Draw plans for remodeling a kitchen
			86%	Develop detailed plans for a high-rise office building
2.C.3.d	Building and Construction	Knowledge	29%	Choose the proper type of wood for adding a deck onto a house
		05 Engineering, Technology, Production and Processing	57%	Fix a plumbing leak in the ceiling
			86%	Build a high-rise office tower
2.C.3.e	Mechanical	Knowledge	29%	Replace the filters in a furnace
		05 Engineering, Technology, Production and Processing	57%	Replace a valve on a steam pipe
			100%	Overhaul an airplane jet engine
2.C.4.a	Mathematics	Knowledge	14%	Add two numbers
		04 Sciences, Mathematics and Computers	57%	Analyze data to determine areas with the highest sales
			86%	Derive a complex mathematical equation
2.C.4.b	Physics	Knowledge	14%	Use a crowbar to pry open a box
		04 Sciences, Mathematics and Computers	57%	Calculate water pressure through a pipe
			86%	Design a cleaner burning gasoline engine

Element ID	Element Name	OSP group / OSP subgroup	Anchor %	Anchor Description
2.C.4.c	Chemistry	Knowledge	29%	Use a common household bug spray
		04 Sciences, Mathematics and Computers	57%	Use the proper concentration of chlorine to purify a water source
			86%	Develop a safe commercial cleaner
2.C.4.d	Biology	Knowledge	14%	Feed domestic animals
		04 Sciences, Mathematics and Computers	71%	Investigate the effects of pollution on marine plants and animals
			100%	Isolate and identify a new virus
2.C.4.e	Psychology	Knowledge	29%	Monitor several children on a playground
		03 Social sciences, Economy and Law	57%	Understand the impact of alcohol on human responses
			86%	Treat a person with severe mental illness
2.C.4.f	Sociology and Anthropology	Knowledge	29%	Identify two cultures in a story as being different
		03 Social sciences, Economy and Law	71%	Write a pamphlet about cultural differences
			100%	Create a new theory about the development of civilizations
2.C.4.g	Geography	Knowledge	29%	Know the capital of the United States
		04 Sciences, Mathematics and Computers	57%	Identify Turkey on a world map
			86%	Develop a map of the world showing mountains, deserts, and rivers
2.C.5.a	Medicine and Dentistry	Knowledge	14%	Use a band-aid
		06 Helath services	71%	Fill a tooth cavity
			100%	Perform open heart surgery
2.C.5.b	Therapy and Counseling	Knowledge	29%	Put ice on a sprained ankle
		06 Helath services	57%	Provide job counseling to the unemployed
			86%	Counsel an abused child
2.C.6	Education and Training	Knowledge	29%	Show someone how to bowl
		01 Education and Training	57%	Lead a quality improvement seminar
			86%	Design a training program for new employees
2.C.7.a	English Language	Knowledge	29%	Write a thank you note
		02 Arts and Humanities	57%	Edit a feature article in a local newspaper
			86%	Teach a college English class
2.C.7.b	Foreign Language	Skills	14%	Say "please" and "thank you" in a foreign language
		04 Comunication in foreign languages	43%	Ask directions in a foreign city
			71%	Write an English language review of a book written in a foreign language
2.C.7.c	Fine Arts	Knowledge	14%	Attend a popular music concert
		02 Arts and Humanities	43%	Play a minor part in a local theater play
			71%	Design an artistic display for a major trade show
2.C.7.d	History and Archeology	Knowledge	43%	Take a class in US history
		02 Arts and Humanities	57%	Teach local history to school children
			86%	Determine the age of bones for placing them in fossil history
2.C.7.e	Philosophy and Theology	Knowledge	29%	Watch a TV program on family values
		02 Arts and Humanities	57%	Understand another culture's religious practices
			86%	Compare the teachings of major philosophers
2.C.8.a	Public Safety and Security	Knowledge	14%	Use a seatbelt
		07 Services	57%	Inspect a building site for safety violations
			86%	Command a military operation
2.C.8.b	Law and Government	Knowledge	29%	Register to vote in a national election
		03 Social sciences, Economy and Law	57%	Prepare documents and title papers for the purchase of a new house
			86%	Serve as a judge in a federal court
2.C.9.a	Telecommunications	Knowledge	14%	Dial a phone
		07 Services	29%	Install a satellite TV dish
			100%	Develop a new, world-wide telecommunications network
2.C.9.b	Communications and Media	Knowledge	29%	Write a thank you note
		02 Arts and Humanities	57%	Be a radio disk jockey
			71%	Write a novel
4.A.1.a.1	Getting Information	Skills	29%	Follow a standard blueprint
		02 Practical skills	57%	Review a budget
			86%	Study international tax laws
4.A.1.a.2	Monitor Processes, Materials, or Surroundings	Skills	29%	Check to see if baking bread is done
		02 Practical skills	57%	Test electrical circuits
			86%	Check the status of a patient in critical medical care
4.A.1.b.1	Identifying Objects, Actions, and Events	Skills	29%	Test an automobile transmission
		02 Practical skills	57%	Judge the acceptability of food products
			86%	Determine the reaction of a virus to a new drug
4.A.1.b.2	Inspecting Equipment, Structures, or Material	Skills	14%	Check that doors to building are locked
		02 Practical skills	57%	Inspect equipment in a chemical processing plant
			86%	Inspect a nuclear reactor
4.A.1.b.3	Estimating the Quantifiable Characteristics of	Skills	29%	Estimate the size of household furnishings to be crated
		02 Practical skills	57%	Estimate the time required to evacuate a city in the event of a major disaster
			86%	Estimate the amount of natural resources that lie beneath the world's oceans

Element ID	Element Name	OSP group / OSP subgroup	Anchor %	Anchor Description
4.A.2.a.1	Judging the Qualities of Things, Services, or People	Skills / 01 Cognitive skills	29%	Determine whether to remove a tree that has been damaged
			57%	Determine the value of property lost in a fire
			86%	Establish the value of a recently discovered ancient art work
4.A.2.a.2	Processing Information	Skills / 01 Cognitive skills	29%	Tabulate the costs of parcel deliveries
			57%	Calculate the adjustments for insurance claims
			86%	Compile data for a complex scientific report
4.A.2.a.3	Evaluating Information to Determine Compliance	Skills / 01 Cognitive skills	14%	Review forms for completeness
			57%	Evaluate a complicated insurance claim for compliance with policy terms
			86%	Make a ruling in court on a complicated motion
4.A.2.a.4	Analyzing Data or Information	Skills / 01 Cognitive skills	14%	Determine the location of a lost order
			57%	Determine the interest cost to finance a new building
			86%	Analyze the cost of medical care services for all hospitals in the country
4.A.2.b.1	Making Decisions and Solving Problems	Skills / 01 Cognitive skills	29%	Determine the meal selection for a cafeteria
			57%	Select the location for a major department store
			86%	Make the final decision about a company's 5-year plan
4.A.2.b.2	Thinking Creatively	Competence / 01 Personal abilities	14%	Change the spacing on a printed report
			57%	Adapt popular music for a high school marching band
			86%	Create new computer software
4.A.2.b.3	Updating and Using Relevant Knowledge	Skills / 01 Cognitive skills	29%	Keep up with price changes in a small retail store
			57%	Keep current on changes in maintenance procedures for repairing sports cars
			86%	Learn information related to a complex and rapidly changing technology
4.A.2.b.4	Developing Objectives and Strategies	Competence / 03 Methodical abilities	29%	Plan the holiday schedule for an airline workforce
			57%	Develop the plan to complete the merger of two organizations over a 3-year period
			86%	Develop a 10-year business plan for an organization
4.A.2.b.5	Scheduling Work and Activities	Competence / 03 Methodical abilities	29%	Make appointments for patients using a predetermined schedule
			57%	Prepare the work schedule for salesclerks in a large retail store
			86%	Schedule a complex conference program with multiple, parallel sessions
4.A.2.b.6	Organizing, Planning, and Prioritizing Work	Competence / 03 Methodical abilities	29%	Organize a work schedule that is repetitive and easy to plan
			57%	Plan and organize your own activities that often change
			86%	Prioritize and plan multiple tasks several months ahead
4.A.3.b.1	Interacting With Computers	Skills / 02 Practical skills	29%	Enter employee information into a computer database
			57%	Write software for keeping track of parts in inventory
			86%	Set up a new computer system for a large multinational company
4.A.3.b.2	Drafting, Laying Out, and Specifying Technical Devices,	Skills / 02 Practical skills	29%	Specify the lighting for a work area
			57%	Specify the furnishings for a new school
			86%	Draw the electronic circuitry for a high-speed scientific computer
4.A.3.b.4	Repairing and Maintaining Mechanical	Skills / 02 Practical skills	29%	Make simple, external adjustments to a door hinge with ordinary hand tools
			57%	Adjust a grandfather clock
			86%	Overhaul a power plant turbine
4.A.3.b.5	Repairing and Maintaining Electronic Equipment	Skills / 02 Practical skills	14%	Use knobs to adjust a television picture
			57%	Make repairs by removing and replacing circuit boards
			86%	Use complex test equipment to calibrate electronic equipment
4.A.3.b.6	Documenting/Recording Information	Skills / 02 Practical skills	29%	Record the weights of trucks that use the highways
			57%	Document the results of a crime scene investigation
			86%	Maintain information about the use of orbiting satellites for private industry communications
4.A.4.a.1	Interpreting the Meaning of Information for Others	Skills / 03 Communication in the mother language	14%	Interpret a blood pressure reading
			57%	Interpret how foreign tax laws apply to U.S. exports
			86%	Interpret a complex experiment in physics for general audiences
4.A.4.a.2	Communicating with Supervisors, Peers, or Subordinates	Skills / 03 Communication in the mother language	14%	Write brief notes to others
			57%	Report the results of a sales meeting to a supervisor
			86%	Create a videotaped presentation of a company's internal policies
4.A.4.a.3	Communicating with Persons Outside Organization	Skills / 03 Communication in the mother language	14%	Have little contact with people outside the organization
			57%	Make standard presentations about available services
			86%	Prepare or deliver press releases
4.A.4.a.4	Establishing and Maintaining Interpersonal Relationships	Competence / 02 Social abilities	14%	Exchange greetings with a coworker
			57%	Maintain good working relationships with almost all coworkers and clients
			100%	Gain cooperation from a culturally diverse group of executives hostile to your company
4.A.4.a.5	Assisting and Caring for Others	Competence / 02 Social abilities	29%	Help a coworker complete an assignment
			57%	Assist a stranded traveler in finding lodging
			86%	Care for seriously injured persons in an emergency room
4.A.4.a.6	Selling or Influencing Others	Competence / 02 Social abilities	14%	Convince a coworker to assist with an assignment
			57%	Deliver standard arguments or sales pitches to convince others to buy popular products
			86%	Deliver major sales campaign in a new market
4.A.4.a.7	Resolving Conflicts and Negotiating with Others	Competence / 02 Social abilities	29%	Apologize to a customer who complains about waiting too long
			57%	Get two subordinates to agree about vacation schedules
			100%	Negotiate a major labor-management contract
4.A.4.a.8	Performing for or Working Directly with the Public	Skills / 03 Communication in the mother language	14%	Tend a highway toll booth
			57%	Sell shoes in a popular shoe store
			86%	Perform a monologue on national TV

Element ID	Element Name	OSP group / OSP subgroup	Anchor %	Anchor Description
4.A.4.b.1	Coordinating the Work and Activities of Others	Competence	29%	Exchange information during a shift change
		03 Methodical abilities	57%	Organize the cleanup crew after a major sporting event
			100%	Act as general contractor for building a large industrial complex
4.A.4.b.2	Developing and Building Teams	Competence	14%	Encourage two coworkers to stick with a tough assignment
		03 Methodical abilities	57%	Lead an assembly team in an automobile plant
			86%	Lead a large team to design and build a new aircraft
4.A.4.b.3	Training and Teaching Others	Competence	29%	Give coworkers brief instructions on a simple procedural change
		03 Methodical abilities	57%	Teach a social sciences course to high school students
			86%	Develop and conduct training programs for a medical school
4.A.4.b.4	Guiding, Directing, and Motivating Subordinates	Competence	29%	Work occasionally as a backup supervisor
		03 Methodical abilities	57%	Supervise a small number of subordinates in a well-paid industry
			100%	Manage a severely downsized unit
4.A.4.b.5	Coaching and Developing Others	Competence	29%	Show a coworker how to operate a piece of equipment
		03 Methodical abilities	57%	Provide on-the-job training for clerical workers
			86%	Coach a college athletic team
4.A.4.b.6	Provide Consultation and Advice to Others	Competence	14%	Work in a position that requires little advising of others
		03 Methodical abilities	57%	Recommend a new software package to increase operational efficiency
			100%	Provide ideas for changing an organization to increase profitability
4.A.4.c.2	Staffing Organizational Units	Competence	14%	Work in a position that has minimal staffing requirements
		03 Methodical abilities	57%	Interview candidates for a sales position and make hiring recommendations
			100%	Direct a large recruiting and employment program for a large international manufacturing organization
4.A.4.c.3	Monitoring and Controlling Resources	Competence	29%	Work as a housekeeper responsible for keeping track of linens
		03 Methodical abilities	57%	Work as a chef responsible for ordering food for the menu
			86%	Serve as a financial executive in charge of a large company's budget