Reviewing the measurement and comparison of occupations across Europe

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Reviewing the measurement and comparison of occupations across Europe

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Deliverable D21.1 of InGRID Workpackage 21
'Innovative tools and protocols for working conditions'

WP 149

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Abstract

This paper was written for the InGRID - Inclusive Growth Infrastructure Diffusion – project, which has received funding from the 7th Framework Program of the European Commission (2013-17). It is a deliverable of Workpackage 21 'Innovative tools and protocols for working conditions & vulnerability research.' Section 2 provides a review of the measurement of occupations in surveys in Europe. Section 3 specifies how occupations are measured in web surveys. Section 4 outlines the methodology currently used to test the comparability of the job content and skill requirements in occupational titles. Section 5 details the results of the validation efforts, including the design of a project to measure occupations on a global scale.

Occupation is a key variable in socio-economic research, used in a wide variety of studies. Where such studies use quantitative approaches, they usually rely on survey data. In this paper an inventory of 33 surveys is analysed with respect to the phrasing of the question. The vast majority uses an open text format for the occupation question, but the phrasing of the question is different across almost all surveys. In an additional question, half of the surveys ask for a job description, and again the phrasing varies largely across the surveys. Coding of the open format question is usually (semi-) automatic, survey agencies applying dictionary approaches for automatic occupational coding. In web surveys closed survey questions can be asked using text string matching and search trees for navigating. Recently, machine learning algorithms appear to be a promising development, requiring a substantial amount of manually coded occupations to be used as training data for the automatic classification. a huge training set is required for an auto-coder to apply machine learning algorithms. This paper details a design to develop such a training set in a multi-country approach.

1 Introduction

This paper was written for the InGRID - Inclusive Growth Infrastructure Diffusion – project, which has received funding from the 7th Framework Program of the European Commission (2013-17). This paper is a deliverable of InGRID's Workpackage WP 21 'Innovative tools and protocols for working conditions & vulnerability research.' This WP aims among others to provide the research community and stakeholders with classification and analytical tools for working conditions and occupational safety and health analysis, and to develop new methods and tools to generate comparative data of relevance for the EU New skills new jobs strategy.[1] Within WP 21 this paper addresses Task 21.1 'New skills new jobs: tools for harmonising the measurement of occupations'. See Appendix 1 for an overview of the remaining sub-tasks in this task in WP 21.

The outline of this paper is as follows. Section 2 provides a review of the measurement of occupations in surveys in Europe. Section 3 specifies how occupations are measured in web surveys. Section 4 outlines the methodology currently used to test the comparability of the job content and skill requirements in occupational titles. Section 5 details the results of the validation efforts, including the design of a project to measure occupations on a global scale.

1 See Page 54-55 of Annex I - "Description of Work" for Project InGRID Inclusive Growth Research Infrastructure Diffusion, funded from EU's Framework Programme 7, INFRA-2012-1.1.1. Research infrastructures for the study of poverty, working life and living conditions, Grant agreement no: 312691.

2 Review of the measurement of occupations in surveys in Europe

2.1 Introduction

Occupation is a key variable in socio-economic research, used in a wide variety of studies, among others for school-to-work transitions, manpower forecasting, the gender pay gap, skill obsolescence, occupational health and safety, processes of professionalization, and social stratification (see for the latter Lambert and Bihagen, 2014). Where such studies use quantitative approaches, they usually rely on survey data. This section reviews how occupations are measured in surveys, more specifically how survey questions and answers are phrased in various survey modes, and which coding practices and coding classifications are used. The section is based on an inventory of survey questions and answers in 33 surveys and on a review of coding practices and classifications.

2.2 Survey questions and answers for the measurement of occupations

In many surveys the occupation variable is collected via questions such as "What is your occupation?", "What kind of work do you do?" or similar (Hoffmann et al., 1995). Yet, to the best of my knowledge, no overview of survey questions for the measurement of occupations is available. Therefore an own inventory of the occupation question in surveys was drafted. Questionnaires were selected that were firstly free available at the Internet and secondly in a language understood by the author (English, German, French, Dutch). The inventory includes 33 surveys, held in Europe and the United States (see Annex 2). The 33 surveys fall apart in international surveys such as the European Social Survey (ESS) or the European Working Conditions Survey (EWCS), national Labour Force Surveys held by National Statistical Offices, and other national surveys such as the German Socio-Economic Panel (SOEP). For the international surveys and the Labour Force Surveys, the English language versions were taken, resulting in 28 English surveys. In total 23 of the 33 surveys were designed for face-to-face interviews, some of them computer-assisted. The remainders aimed at postal/paper surveys or web surveys, or the survey mode was unknown. 21 surveys were held in the period 2007 – 2014, the remainders were held in the early 2000's and two were held in the late 1990's.

Table 1 shows the survey questions about job title or occupation asked in these 33 surveys.

Table 1 Survey questions about job title or occupation (duplicates not included)

Survey_ID	Survey questions - OPEN FORMAT
ISSP_2008	And in your current job, what is your main occupation? If you are not working now, please tell us about your last job.
WVS_2005/06	In which profession/occupation are you doing most of your work?
WVS_1999-2002	In which profession/occupation do you or did you work? If more than one job, the main job? What is/was your job there?
CPS_US_2013	Kind of Work (Occupation)
VIONA_BE_2000	Kunt u de naam en een bondige omschrijving geven van uw huidige functie?
WVS_2010/12	NO Q ABOUT OCCUPATION, ONLY ABOUT EMPLOYMENT STATUS
EWCS_1995	Now, we would like to obtain some information about your work, more specifically your main paid job. What is your main paid job? Please give me your job title?
EFT_BE_2013	Quelle est votre profession ou votre fonction dans votre activité principale ?
NEA_NL_2013	Uw beroep: Wat is uw beroep of functie?
SOEP_DE_2013	Welche berufliche Tätigkeit haben Sie damals, in Ihrer ersten Stelle, ausgeübt?
EBB_NL_2014	Welk beroep of welke functie oefent ($A: u $B: hij $C: zij) uit?
WERS_UK_2011	What is the full title of your main job?
SCPR_UK_1997	What is the name or title of your job?
EWCS_2010_2005	What is the title of your main paid job? By main paid job, we mean the one where you spend most hours.
AKU_DK_2011	What is you occupation more precisely (your title)?
HEGESCO_2008	What is your current occupation or job title?
PIAAC_2010	What is your job title?
EWCS_2000	What is your main paid job ? Please give me your job title in full.
ECHP_2001	What is your present occupation?
ESS_2012/13_2002	What is/was the name or title of your main job?
ISSP_2010	What kind of work (do you/did you) normally do? That is, what (is/was) your job called?
ACS_US_2014	What kind of work was this person doing?
BHPS_UK_2013	What was your (main) job last week? Please tell me the exact job title and describe fully the sort of work you do.
Survey_ID	**Survey questions - CLOSED FORMAT**
WORLD HEALTH SURVEY_2002	During the last 12 months, what has been your main occupation?
SHARE_2013_2010	Please look at card {SHOWCARD_ID}. What best describes this job?
EUROCADRES_2005	Profession ou position dans l'entreprise ou l'administration
EQLS_2011/12_2007_2003	What is your current occupation?
EPICURUS_2004	Which description fits best your main job?

Source: Inventory of survey questions about occupations (Appendix 2)

Our review leads to the following conclusions:

- 25 of the 33 surveys use an open text format for the occupation question;
- the phrasing of the open format question is different across almost all 25 surveys;
- the words 'job title' and 'occupation' are used both, in some instances even within one question; from the view point of interview time efficiency, PIAAC's question "What is your job title?" seems to be the most optimal;

- almost all face-to-face surveys with an open text question include interviewer instructions, such as 'Avoid vague occupational titles such as manager, clerk, or farmer' or 'Write in full details';
- almost all postal/paper or web surveys with an open text question include an instruction for the respondent, such as 'Describe fully, using two words or more (do not use initials or abbreviations)' or 'e.g. Primary School Teacher, State Registered Nurse, Car Mechanic, Benefits Assistant. If you are a civil servant or local government officer, please give your job title, not your grade or pay band';
- 6 of the 8 surveys with a closed format question provide a show card with the categories of the first level of the International Standard Classification of Occupations ISCO (10 entries), which is in some surveys extended with example occupations within each category; the remaining 2 surveys provide a show card with a mixture of employment status, occupational titles, skill level, and supervisory position.

In the open response format questions, respondents report their job titles as they like, eliciting response at various levels of aggregation. In face-to-face or telephone interviews, the interviewer can control this response by asking details if needed. In self-administered surveys the response cannot be controlled. According to Ganzeboom (2010), the answers are most often detailed job titles, but responses may also be crude, highly aggregated or unidentifiable. Respondents tend to report a detailed job title, as they know it from their employment contract, job classification scheme, collective bargaining agreement, job advertisement, or just from a common understanding in the workplace. In some cases this leads to highly disaggregated occupational titles such as Lithographic stone grinder or to very firm-specific job titles such as Appls Prog I, which are difficult to code. In contrast, some respondents tend to report highly aggregated categories, such as Clerk or Teacher, or they may be not specific at all, e.g. Employee of department X, Senior supervisor, or Dogsbody.

Survey holders usually have manuals to guide interviewers for this survey question. The manual for the US Current Population Survey for example details how interviewers should deal with inadequate descriptions, because these result in difficult to code occupations (US Census Bureau, 2013). Interviewers are instructed that one word responses to the question on occupation (for example, clerk, engineer, manager, nurse, teacher) are usually far too general to be coded accurately. Whenever very brief responses are given to this question, interviewers should probe to obtain a more specific response. Many of the 33 reviewed

surveys therefore ask in an additional question for a job description (see Table 2). The conclusions are as follows:

- in the 25 open format surveys, 14 ask for a job description; again the phrasing varies largely across the surveys;
- the face-to-face, postal/paper surveys or web surveys use the job description question alike;
- in 1 survey the open format occupation question is not followed by a job description question, but by a question asking respondents to identify their occupation in a list of 45 occupational titles, clustered in 11 categories.

Table 2 Survey questions about job descriptions (duplicates not included)

SURVEY_ID	Survey questions - OPEN FORMAT
EWCS_2010_2005	Q3 What do you mainly do in your job?
ESS_2012/13_2002	F34 In your main job, what kind of work do/did you do most of the time?
ISSP_2010	MAINSLF B. IF NOT ALREADY ANSWERED, ASK: What (do/did) you actually do in that job? Tell me what (are/were) some of your main duties?
ISSP_2008	Q19a. [[STANDARD BACKGROUND: WRKTYPE: ABCD]] In your current job, for whom do you work? If you are not working now, please tell us about your most recent job.
HEGESCO_2008	F2 Please describe your current main tasks or activities
PIAAC_2010	D_Q01b (OECD) (A) What are your most important responsibilities? Please give a full description.
ECHP_2001	Please describe the principal activity you perform
AKU_DK_2011	B2STILA 9. Continued occupational description (description of specific tasks)
EFT_BE_2013	9d. Décrivez en termes précis votre profession ou fonction.
VIONA_BE_2000	Bondige omschrijving:
SCPR_UK_1997	B3b What kind of work do you do most of the time? What materials/equipment do you use? Text : Maximum 120 characters
WERS_UK_2011	E9 Describe what you do in your main job. Please describe as fully as possible.
BHPS_UK_2013	DESCRIBE FULLY WORK DONE:

Source: Inventory of survey questions about occupations (Appendix 2)

In the closed response format questions, a tick list offers respondents a choice of occupational titles or occupational categories. This self-identification method can be used in all survey modes, but the size of the choice-set varies widely across the modes. Telephone surveys allow for asking at most 5 highly aggregated occupational categories, otherwise respondents will not memorize. Paper-based or face-to-face surveys allow for a choice of at most 50 categories when using show-cards, showing mostly a mixture of aggregated and disaggregated occupations. A limited choice-set may result in lower data quality, because it is difficult to assure consistency in how respondents fit their own job titles into the highly aggregated categories, thereby introducing aggregation bias (De Vries and Ganzeboom 2008). Web surveys allow for very large choice-sets, thereby solving the problem of aggregation bias. See further details in Section 4.

2.3 Occupational classifications

Before turning to the occupational coding practices, this section briefly details a few occupational classifications. Given the unlimited number of job titles, the responses need to be coded into a limited set of aggregated occupational titles, using occupational classification systems. For this purpose, the statistical agencies of 150 countries associated in the International Labour Organization (ILO), a United Nations affiliate, have adopted the International Standard Classification of Occupations (ISCO) to harmonize the measurement of occupations, dating back to 1958.[2] Revisions were made in 1968, and 1988. Recently the fourth version - ISCO-08 - has been released (Hunter, 2009). The hierarchical ISCO-08 classification distinguishes nine major groups at the highest level of aggregation, stepwise breaking these groups down into 433 occupational units at the classification's lowest 4-digit level. In this paper, we refer to occupations in greater detail, notably at 5-digt level, based on the ISCO-08 classification.

ISCO-08, as was the case for its predecessors, defines a job as a set of work tasks and duties performed by one person. Jobs with the same set of main tasks and duties are aggregated into the 4-digit occupation units. On the basis of similarity in the tasks and duties performed, the units are grouped into 3- and 2-digit groups, which in turn on the basis of the skill level are grouped into 1-digit groups (Hunter, 2014).

According to Tomaskovic-Devey (1995), the concept of occupation is especially relevant in comparative research, since studying only jobs limits generalisations to the work organisation context and hampers national or international comparisons. Note that the number of job titles may easily run into tens of thousands, and these jobs may have hundreds of thousands of tasks. The concept of occupation is also relevant for vocational training, targeting at occupations rather than jobs. Hence, occupations are job titles, which are aggregated beyond the organisational context. Table 3 depicts the number of units included in each level of the ISCO-08 hierarchical classification.

Table 3 Stylized details, logic and number of occupations for ISCO-08

Detail	Logic	Numbers of occupations (est)
ISCO-08 1-digit	Skill level	10
ISCO-08 2-digit	Similarity of task and duties	42
ISCO-08 3-digit	Similarity of task and duties	131
ISCO-08 4-digit	Occupational unit (similarity)	433
Occupational title (5-digit)	Beyond workplace (coding indexes)	1,000+
Job title	Workplace (coding indexes)	10,000+
Work task	Clustered into jobs	100,000+

2 http://www.ilo.org/public/english/bureau/stat/isco/ISCO-08/, accessed 25 JUL 2014.

In the 1990's, the ILO has undertaken efforts to implement ISCO-88 widely (Hoffmann et al, 1995). At that time, quite number of countries used their own National Occupational Classifications (NOC). These classifications tend to differ cross-nationally with respect to the level of detail, to specific occupational titles included in the classifications, and to their logic (Ganzeboom and Treiman, 1996; Pignatti Morano, 2014). Attempts to harmonize NOC's were, among others, hampered by the fact that ISCO does not allow skill levels of occupations to vary across different national contexts (Elias, 1997). Yet, countries who held their first Labour Force Survey or Census in the late 1980's or in the 1990's mostly adopted ISCO or related versions as their occupational classification. In the early 2000s, ISCO had become the standard classification in many countries (Greenwood, 2004). It has also become the standard to classify occupations in many national and international surveys such as ESS, EVS, ISSP, PIAAC and PISA.[3] The Commission of the European Communities (2009) has adopted ISCO-08 as its occupational classification, and the European statistical agency Eurostat has put effort in supporting European countries in developing coding indexes for their occupation data collected in Labour Force Surveys and similar surveys.

UNSTATS provides an overview of the occupational classifications used in 149 countries in 2012 (see Appendix 3).[4] The overview shows that 78 countries do not apply an occupational classification or do not report using one (53%). The remaining 71 countries apply an occupational classification. 49 of these 71 countries apply the ISCO-08 classification, and another 12 countries still apply ISCO-88. Of these 49 + 12 countries 14 use extended versions of ISCO, hence providing 5-digit codes. Finally, 10 countries employ their own classification, notably Canada, Germany, Ireland, Israel, Italy, Japan, Russian Federation, Switzerland, United Kingdom and the United States of America. The Netherlands used to have its own classification, but changed to ISCO-08 for its 2012 Labour Force Survey (Westerman and Offermans 2014). This overview supports the assumption that increasingly ILO's ISCO classification is adopted for labour force and other surveys. Most likely, more countries will adopt ISCO-08 in the years to come.

2.4 Coding practices

Only a few of the 33 reviewed surveys ask the interviewer to code the occupation during the interview, using a show card with the 2-digit occupational units (field-coding), but most surveys rely on office-coding. Field- and office-coding is usually done by the field institute. Field-coding is advantageous over office-coding because it allows the interviewer to ask additional information if needed, but in case 4-digit coding

3 http://www.harryganzeboom.nl/ISCO-08/index.htm, accessed 28 JUL 2014.
4 http://unstats.un.org/unsd/cr/ctryreg/default.asp?Lg=1, accessed 22 APR 2014.

is required it needs advanced software on the interviewer's laptop. Office-coding is recoding at a later point in time and is disadvantageous in budget terms and timelines.

Coding occupations into a classification requires a coding index, providing codes for frequently mentioned occupational titles. Many national statistical offices (NSO) have developed such an index and provide coding instructions. For example the Index-SSYK of Statistics Sweden (2012) has 8,670 entries. The Austrian Ö-ISCO-08_Index counts 13,314 entries. The Italian Statistical Office has 5,732 entries in its index (ISTAT, 2013). Statistics Netherlands has 1,396 entries in its publicly available CBS codelijsten-ISCO-08. Its index for occupational coding has approximately 5,000 entries and is based on historical data, thus optimized for answers with the highest frequency (Westerman and Offermans, 2014). The German Institute for Employment Research IAB maintains the German KldB occupational classification, which was updated in 2010 and now has a linking to ISCO-08. Approximately 24,000 job titles are assigned to the KldB 2010 (Paulus and Matthes, 2013). The Office for National Statistics (2010) ONS in the United Kingdom has its own classification SOC2010, which has 28,053 entries in its index. To keep up-to-date with new job titles, SOC2010 users are invited to forward information, which will help in the compilation of the job title index and feed into the work for the next update.

Until recently a coding index was used for manual search, requiring alphabetic sorting of the main words in the occupational titles, as for example can be seen in the ONS coding index. A well-known coding software program is CASCOT and its update CASCOT2000.[5] CASCOT is among others used by ONS and survey agencies in the United Kingdom. Statistics Netherlands, also using CASCOT, has applied a four step occupational coding process, whereby the first step coding is based on job titles only. If insufficient the job description is included for coding in a second step. If still insufficient the third step coding is based on industry and – for managers - on the closed questions about managerial tasks. Here codes are assigned according to beforehand specified rules. If still indecisive, in a fourth step manual coding is applied, whereby other auxiliary variables might be used (Westerman and Offermans, 2014). Other survey agencies have developed their own software. For coding EUROFOUND's EWCS for example its survey agency Gallup developed a special software application to assist the ISCO/NACE coding activity (Gallup Europe, 2010). This software allows for multiple and later modifiable selection of items to be coded in one go, for two levels of coding choosing the appropriate 2-digit category first and choosing the 4-digit category from a filtered list based on two-digit code, for the possibility of adding a comment to each encoded item, and for the possibility to review and recode already encoded items.

5 See http://www2.warwick.ac.uk/fac/soc/ier/software/cascot/ accessed 25 JUL 2014

In addition to a coding index and coding software, many survey holders use coding instructions for manual coding. Next to the publication of ISCO-08, ILO has also published such an instruction, called 'ISCO-08 Group definitions - Final draft'.[6] This manual includes instructions which occupations should or should not be classified in which code. In addition, it includes for each 4-digit occupation a job description and a task list.

Multi-country datasets are typically surveyed by national survey agencies with the data merged afterwards.[7] In these cases the survey operations, the question formulations or the coding procedures are mostly not fully harmonized, affecting the comparability of the resulting statistics. The coding instructions are the only source to ensure that the same job titles are coded similarly across countries. The central organisation hardly can exhibit controls over the coding process, particularly not in case of language discrepancies. In the multi-country EWCS coding quality was ensured because for each country the first 50-100 items (test items) of preliminary data were translated into English, and these items were coded independently by all members of the local coding teams in the original language and by one Gallup Europe coder in the English translation (Gallup Europe, 2010). Gallup reports the following: "These test codes were compared with one another, and besides calculating percentage of agreement, in the case of ISCO coding detailed comments about the rationale behind Gallup Europe's coding were provided to facilitate general agreement on coding principles. In the case of NACE coding detailed comments were deemed unnecessary due to generally much higher agreement levels than in the case of ISCO. Test-coding comparisons have been documented in the form of Excel files (one for ISCO and one for NACE for each country). These files contain the measures for the percentage of agreement up to 2-3-4-digits, as well as those items that were coded in the test, and any of the variables that were relevant for coding these 'test- items'. The differences between codes were discussed (in the form of exchanged comments recorded in the coding comparison Excel files) by local and Gallup Europe's coders until agreement was reached on final codes of test items and on coding principles. Verbatim responses in the local language and their codes are included in the final dataset in order to offer the possibility for future clarifications/checks. All verbatim replies were submitted with full English translations from Albania, Kosovo and Montenegro to facilitate central quality control." (Gallup Europe, 2010, p 21)

Auxiliary variables are often used in occupational coding processes, as Table 4 shows for four surveys. For the EWCS coding quite a number of variables were used (Gallup Europe, 2010). The American Community Survey also uses a range of variables (Cheeseman Day, 2014). In contrast, Statistics Netherlands

6 See http://www.ilo.org/public/english/bureau/stat/isco/ISCO-08/ accessed 25 JUL 2014

7 Note that Eurostat has not a centralized coding system for occupations for the European Labour Force Survey (ELFS). The ELFS is merged from national LFS datasets, which NSOs deliver to Eurostat in a described format.

only uses the industry code, but they use extra survey questions to identify whether a respondent whose job title includes the word 'manager' has to be coded as a manager. Coding quality can be compared between coders by examining association with criterium ('validation') variables, such as: education, income and other occupations (Ganzeboom, 2014).

Table 4 Auxiliary variables used to code occupations

Variable	ACS	ESS_ parental occs	EWCS	LFS_NL (EBB)
education level	1	1	1	
age	1			
geographic location	1			
income		1		
other occupations		1		
economic sector of employer			1	1
number of co-workers			1	
age when full time education was completed			1	
employment status			1	
private/public sector			1	
number of people working under the supervision of respondent			1	
MANAGERS ONLY Questions				1

Source: ACS: Cheeseman Day 2014; ESS_parental occs: Ganzeboom 2014; EWCS: Gallup Europe 2010; EBB: Westerman and Offermans CBS 2014

CASCOT and other classification software apply dictionary approaches for automatic occupational coding. Recently, machine learning algorithms such as naïve Bayes or k-nearest-neighbours appear to be a promising development, requiring a substantial amount of manually coded occupations to be used as training data for the automatic classification. To meet the demand for automatic coding in Germany, the IAB launched a project to apply machine learning algorithms to 300,000+ verbatim answers, that were manually coded with high quality.[8] The project resulted in successful coding with this large scale training data. As Bethmann et al (2014) phrase it: 'From a total survey error perspective this would free resources formerly spent on the reduction of processing error and offer the opportunity of employing those resources to reduce other error sources.' The American Community Survey (ACS) uses a so-called occupation auto-coder, which is a set of logistic regression models, data dictionaries, and consistency edits ("hardcodes"), developed from around two million manually coded records. The auto-coder assigns an occupation code if the quality score, based on agreement with clerk-coded records, is sufficiently high (Cheeseman Day, 2014). These automatic coding experiments are single-country operations. In section 5.3 the design for a multi-country occupational auto-coder challenging high coding comparability across countries will be developed.

8 See http://fdz.iab.de/339/section.aspx/Projektdetails/k140424305, accessed 25 JUL 2014.

3 Methods for EU-wide measurement of occupations in web surveys

3.1 Introduction

This section details a method to facilitate the EU-wide measurement of occupations in web (CAWI), computer-assisted personal face-to-face (CAPI) and computer-assisted telephone (CATI) survey modes, using text string matching and search trees, and the requirements for the related look-up database. For the postal (PAPI) mode no other method than an open ended survey question is available, because this mode is not computer-assisted.

3.2 Closed versus open format survey questions about occupations

In PAPI, CATI or CAPI surveys, occupation is mostly asked in an open response format, followed by office coding, as discussed in section 2. In contrast web surveys offer a unique possibility for a closed response format, using a search tree and text string matching. Web surveys allow for a choice-set of thousands of occupational titles, when using text string matching or a search tree for navigating through the choice-set.

For four reasons this method is advantageous over an open format question with office-coding. First, if designed well, the choice-set will consist only of occupations at the same level of aggregation. Second, unidentifiable occupational titles are absent. Third, field- or office-coding is not needed. Finally, in case of cross-country data-collections, survey operations and, in case of a multilingual database, the choice-set will be comparable across countries.

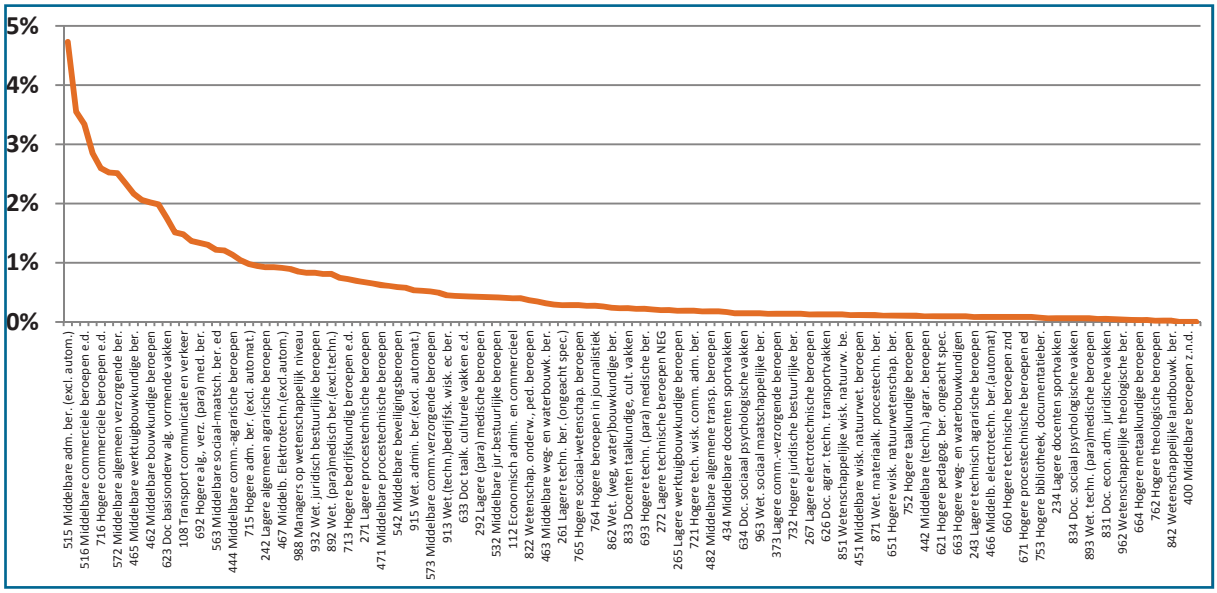
For four reasons this method is however disadvantageous. First, for respondents it is cognitive demanding to search their job title. This is particularly the case when using a search tree only, but less so when in addition a text string matching tool is used. With Google and other search engines so wide spread, text string matching has become a familiar activity for many respondents. Second, the choice-set is by definition incomplete and therefore some respondents may not find their job title or are unable to aggregate it into an occupational title. Third, it may be time-consuming for respondents to search for their job title. Finally, in mixed-mode surveys bias effects will occur when combining open format questions with closed format ones.

3.3 The very long tail of the occupational distribution

The stock of job titles is characterized by two features (Tijdens 2014). First, as said, the stock of job titles in a given country may easily exceed the 10,000s. Hardly any other survey question has such a large response set, probably with the exception of a survey question 'What is the name of the company you work for', because most countries will easily have 10,000s company names.

Second, the labour force is very unequal distributed over occupations, depicting a highly skewed distribution with a very long tail. Graph 1 shows how the Dutch labour force is distributed over 193 ISCO-08 3-digit occupational groups. For the look-up database of occupations this implies that it is important to identify the frequency of occupations. This enables the decisions which occupations should be included and which should not be included in the database. The stock of job titles is very dynamic over time and across countries, which requires regular updating of the database.

Graph 1 The distribution of the Netherlands labour force over 193 ISCO-08 3-digit occupational groups



Source: CBS Statline, accessed 10 FEB 2014

3.4 The search tree

A search tree or an 'IPod menu' as it is sometimes called allows respondents to navigate the look-up table of occupations. The design requirements for search trees depend on the number of entries in the table, as Table 5 shows. A maximum for each step in the search tree is approximately 20, otherwise respondents will not comprehend the list easily. Hence, a 3 step search tree should not have more than 20 * 20 * 20 =

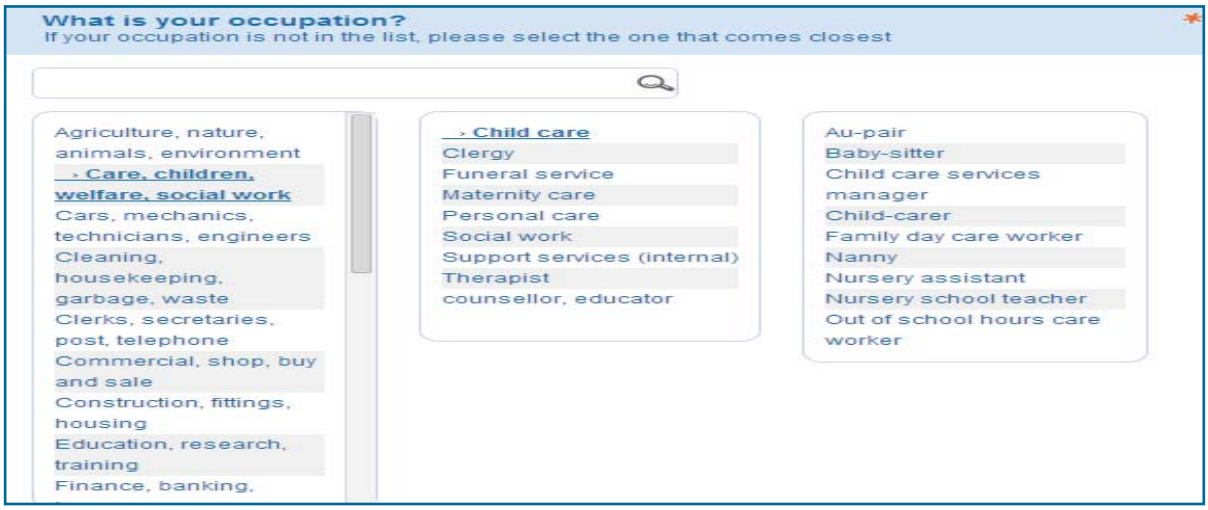
8,000 entries. Given the 10,000s of job titles, respondents will have to aggregate their job title into an occupational title. The search tree will facilitate them to find easily the aggregated occupation.

Table 5 Design requirements for search trees

# entries	Search tree structure	Example
< 20 entries	1 list	e.g. education
20 - 400 entries	2 step search tree	e.g. industry
400 - 8,000 entries	3 step search tree	e.g. occupation

The occupation search tree in the WageIndicator web survey has a 3-step structure, because it uses 1,700 occupational titles in its database. Figure 1 provides a screen shot of the search tree used in this web survey. The principles underlying its search tree and look-up database, such as the search paths, the alphabetic sorting, the skill levels, the corporate hierarchies, and readability issues, such as the wording of occupations and the translations have been explained elsewhere (Tijdens, 2010).

Figure 1 Search tree in the WageIndicator web survey



Source: http://www.paywizard.co.uk/main/pay/salarysurvey/salary-survey-employees, accessed 8 AUG 2014

3.5 The text string matching

Alternatively to a search tree, respondents in the WageIndicator web survey can use text string matching, as Figure 2 shows. The screenshot shows the text string matching in English and Chinese.

Figure 2 Screenshots for text string matching in English and Chinese

Source: http://www.paywizard.co.uk/main/pay/salarysurvey/salary-survey-employees, accessed 8 AUG 2014
http://www.wageindicator.cn/main/salary/survey/employee-survey, accessed 8 AUG 2014

3.6 Next steps

In the InGRID project further work on the measurement of occupations in web surveys is scheduled for 2015. This will result in a paper for InGRID's Task 21.1.3 'Develop methods to facilitate the EU-wide measurement of occupations in web surveys using an Application programming interface (API)'.

4 Tools for testing the comparability of the job content of occupational titles

4.1 Introduction

The ISCO-08 classification defines a job as a set of work tasks and duties performed by one person and jobs with the same set of main tasks and duties are aggregated into the 4-digit occupation units, as discussed in the previous section. Thus, an occupational title refers to the same work activities, even when it is measured in different countries. An empirical basis for this assumption is however lacking. This section details the tools for testing the comparability of the job content of occupational titles, aiming to answer the research objective: Do the same occupations reflect the same tasks across countries? This section presents work in progress, because data-collection is still ongoing. Final results will among others be presented in a paper for InGRID Task 21.1.2 'Develop methods to facilitate the testing of the comparability of the job content of occupational titles as well as the skill requirements for these occupations across EU Member States'. This paper builds on work done by Fabo (2014), Fabo and Tijdens (2014), and Milhaylov and Tijdens (2014).

4.2 Occupations are not similar, findings from the Euroccupations project

A first European attempt to measure the job content of occupations on a large scale was made in the EurOccupations project, which ran from 2006 – 2009.[9] Its research objective was: 'Are occupations similar regarding work activities, i.e. does an Italian plumber engage in the same activities as a plumber from France, Poland or the UK?' (see Tijdens, De Ruijter, De Ruijter, 2011, 2012, 2014). The project had research teams in eight countries and aimed first to build a database containing almost 1,500 of the most frequent 5-digit ISCO-08 occupations.[10] Second, it aimed to test the similarity of the job content for 160 occupations selected from the database across the eight countries. The selection was based on variation in skill level, in gender composition, in number of jobholders, and coverage of all industries. Using desk research, the

9 EurOccupations aimed at developing a detailed 8-country occupations database for comparative socio-economic research in the European Union. Funded by EU-FP6 (no 028987, 2006-09) with BEL, DEU, ESP, FRA, GBR, ITA, NLD, POL, coordinated by KG Tijdens http://www.wageindicator.org/main/Wageindicatorfoundation/projects/euroccp

10 The WageIndicator Foundation has used this database for its continuous, worldwide web survey, but added more occupations and more languages.

project partners drafted and tested 10 task descriptions per occupation, thereby building on the work of the O*NET® Center in the USA and its approach of analyzing work activities by means of job-specific descriptions.[11] A multilingual web survey was designed and in 2007 and 2008 the partners recruited experts through their networks and invited them to complete the survey for the occupations they were knowledgeable about. These experts had to rate the frequency of each task of the occupation at stake on a 5 point linear rating scale, ranging from never to daily. In total 2,468 experts completed 2,950 questionnaires.

The first EurOccupations research objective aimed to measure if occupations are similar. Merging data from the eight countries, the results showed for 51% of the 160 occupations a lack of agreement or no agreement at all, for 38% a weak or moderate agreement, whereas for only 12% a strong agreement. The second research objective detailed the first one, aiming to measure if agreement was higher within countries. Across all occupations, in Spain agreement was 80%, in Germany 58%, in the Netherlands 43%, and in Poland 48%. The third research objective also detailed the first one, aiming to measure if occupations were similar across countries. The survey revealed in Spain a strong agreement, in Germany a weak agreement, and in Poland and the Netherlands a lack of agreement. The final research objective aimed to measure if experts and jobholders rated similarly, comparing the merged dataset. The findings show that jobholder rating does not differ from expert rating. The overall conclusion from the EurOccupations project was that although assumed that occupations are similar across countries, to a large extent they are not. This raised the question how to explain this unexpected finding?

Are occupations not similar across European countries, or are the methods and data sources critical for the results? If the latter is the case, how could these be improved? The assumption that occupations are similar refers to the ISCO 4-digit occupations. The EurOccupations study however tested the similarity of occupations at a 5-digit level. Would testing of 4-digit occupations change the results? The EurOccupations study tested only 160 occupations. Would a larger sample of occupations change the results? The labour force is very unequal distributed over occupations. Even with 4,000 ratings, the EurOccupations study encountered quite a number of occupations with none or insufficient ratings, and when broken down by country, the problem became much worse. Would a larger sample size solve this problem? In the EurOccupations study the recruitment of experts turned out to be burdensome and for some occupations no experts could be identified. The choice to recruit jobholders through teasers in a frequently visited multi-country website turned out to be a good solution for this problem. Would large scale jobholder recruitment solve problems? However, the most important conclusion from the EurOccupations study stood firmly: survey-

11 See http://www.onetonline.org/, accessed 8 AUG 2014

ing occupation-specific task frequencies by means of a web survey was a proper way to test similarity within occupations.

4.3 What next: How to collect data on tasks?

In 2013 a follow-up study could be initiated, as part of the InGRID infrastructure and as part of the EDUWORKS project[12]. Thanks to two InGRID visiting grants Brian Fabo, data and survey manager of the WageIndicator web survey, could visit AIAS at the University of Amsterdam and discuss the design of the task measurement and analyse the first data.[13] In the following the design of the follow-up study will be detailed.

As in the EurOccupations study, in the follow-up study a web survey is needed. The WageIndicator web survey on work and wages seems suitable and is feasible because this paper's author is the scientific coordinator of the web survey. The survey is posted continuously at all national WageIndicator websites.[14] The first website of WageIndicator started in the Netherlands in 2001, and is operational today in 80 countries in five continents, in 2013 receiving in total 23 million visitors. Between 1% and 5% of them completes the survey. The websites consist of job-related content, labor law and minimum wage information, VIP wages and a free Salary Check presenting average wages for occupations based on the web survey data. Web traffic is high due to search engine optimization facilitating search terms for search engines, web-marketing, media attention, word-of-mouth advertising, and social media activities. The websites are consulted by employees, self-employed, students, job seekers, and individuals with a job on the side to find information about wages or for their annual performance talks, job mobility decisions, occupational choices and alike. In return for the free information provided on the websites, web visitors are invited to complete a survey with a lottery prize incentive. Teasers for the web survey are posted continuously on all national websites. The questionnaire is comparable across countries. It is in the national language(s), where needed adapted to country peculiarities. It asks questions about a wide range of subjects, including basic socio-demographic characteristics, wages, occupation, and other work-related topics. In sum, the web survey is a volunteer, continuous, multi-country survey on work and wages.

12 See http://eduworks-network.eu/pages/home, accessed 8 AUG 2014
13 See https://inclusivegrowth.be/downloads/tna-activity-reports/c01-13, accessed 8 AUG 2014
14 See www.wageindicator.org, accessed 8 AUG 2014

For several reasons this web survey is particularly suited for the targeted data collection. The desire to take occupations as the unit of analysis requires a large sample size, which is the case for this web survey with sample sizes, unmet in most other surveys. The desire for an advanced routing from ticked occupation to related task list requires a web survey with advanced technologies. The desire to cover a range of countries requires a multi-country web survey. All demands are met with the WageIndictor web survey. Finally, the raters are no experts, but jobholders who are asked to rate their own job.

Core to both studies are the task descriptions. In the EurOccupations study the project team drafted the tasks for 160 occupations, using desk research. In follow-up study we are able to use the English descriptions of tasks for all 433 occupational units at 4-digit ISCO-08.[15] For the survey in the follow-up study the task lists for 427 of the 433 units have been prepared. For six so-called 'not-elsewhere-classified occupations' no task lists have been included. The number of tasks varies per occupation, but most occupations have seven to ten tasks and for the remaining occupations the number of tasks varies between 5 and 15. In total 3,237 occupation-specific tasks are in use for the 427 occupations, which is on average 7.58 tasks per occupation.

All tasks have been translated from English into six other languages: Spanish, Russian, French, Dutch, Portuguese, and Bahasa. The tasks were not translated with the aim to serve the follow-up study, but were to be posted in the so-called Jobs&Salary pages of the national WageIndicator websites. Each national website has 433 Jobs&Salary pages with information about the occupation. These pages act as so-called landing pages for a wide range of search terms used in Search Engines. The translations could also be used for the web survey. After solving the technical implementation problem that the same question (task) has different labels based on respondent's choice of occupation, the data collection in the WageIndicator web survey started in November 2013.

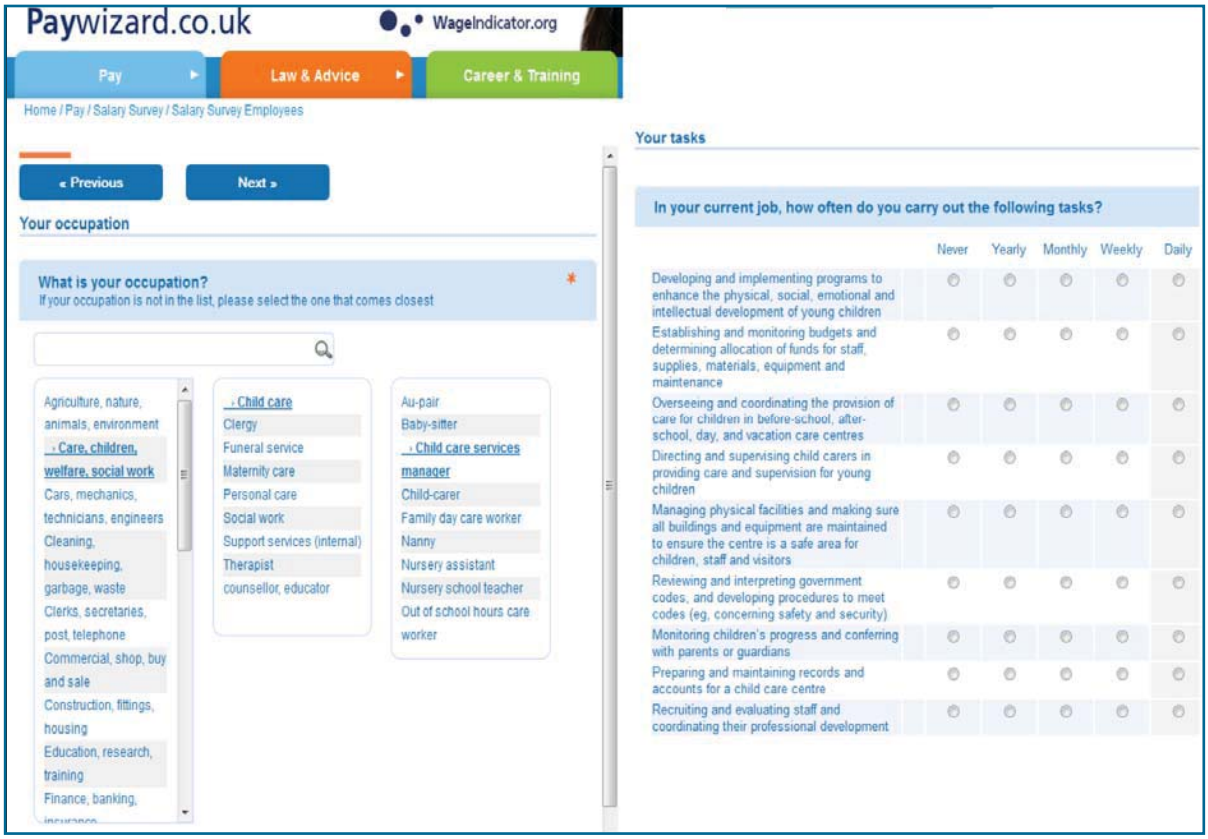
The EurOccupations study included 8 European countries. In the follow-up study 13 countries are included, notably Argentina, Australia, Belarus, Belgium, Brazil, Indonesia, Kazakhstan, Mexico, Netherlands, Russia, South Africa, Spain, and United Kingdom. The choice of these countries is based on the available translations, a sufficient number of respondents in the web survey in the previous months, and the spread of countries over continents.

In the web survey respondents are asked about their occupation, whereby they can choose to use a tool for text string matching or a search tree (see further details section 3 of this paper). The look-up table contains approximately 1,700 occupational titles, all coded ISCO-08. Depending on the ticked occupation,

15 See http://www.ilo.org/public/english/bureau/stat/isco/isco08/, accessed 8 AUG 2014

in a following survey page the task list for the ticked occupation shows up, asking to tick the frequency of each task on a 5-pt scale: How often do you perform the following tasks…? Never, Yearly, Monthly, Weekly, Daily? Figure 3 shows an example.

Figure 3 Two screenshots for choice of occupation and for the task set of the Child care services manager



Source: Mihaylov and Tijdens 2014

As said, the data-collection started in the 13 countries in November 2013. By the end of April 2014 more than 14,000 respondents had completed the tasks list for their occupations. Table 6 presents the number of observations per country. Being a continuous web survey, the task lists will definitely be included for the entire year 2014, and probably also for 2015. In autumn 2014 the first analyses will start. As said, final results will among others be presented in a paper for InGRID Task 21.1.2.

Table 6 Number of observations (after cleaning) per country by end of April 2014

Country	N	Country	N
Argentina	858	Mexico	271
Australia	78	Netherlands	4585
Belgium	682	Russian Federation	650
Brazil	1263	South Africa	1080
Belarus	1735	Spain	308
Indonesia	1120	United Kingdom	178
Kazakhstan	1582	Total	14390

Source: WageIndicator dataset NOV-2013-APR-2014

5 Design for a worldwide occupational coding index

5.1 Introduction

This section presents a design for a system aiming at a worldwide occupational coding index. This design is a first result of the InGRID expert workshop 'Developing and testing new tools to measure occupations and their task and skill requirements', held 10-12 February 2014 in Amsterdam. Section 5.2 of this paper summarizes the findings of the workshop (see for extensive reporting the InGRID website[16]). Section 5.3 builds on work done on behalf of a proposal for an advanced, multi-country occupational coding tool, submitted for funding under the European Union's Horizon2020 program. This multi-country coding tool needs to meet the demand of survey holders for a cross-country harmonized, fast, high-quality and cost-effective coding of occupations. The design will be presented at several conferences in the months to come. The final design will take into account the comments of conference participants. This design will be presented in a paper for InGRID's Task 21.1.4 'Validate these research efforts on standardisation and harmonisation with an expert group of data collectors and data'.

5.2 Validating workshop

The aim of the InGRID expert workshop on 10-12 February 2014 in Amsterdam was twofold. First, it aimed to discuss new approaches of collecting, coding and analysing occupational data, including data collected by web crawlers and web surveys. Second, it wanted to explore possibilities to move towards a joint program of activities for a European-wide harmonised occupational database, including a web-based coding tool.

The first day was dedicated to occupational classifications, the measurement and coding of occupations across countries, in different survey modes and from different sources. This included the design principles of ISCO-08 and the advantages and shortcomings of various occupational categorizations. The CASCOT coding software and the DASISH project for coding job titles from surveys in the UK and abroad were explained. The coding practices of parental occupations in the European Social Survey were detailed, followed

16 For details see https://inclusivegrowth.be/news/News/news47, accessed 8 AUG 2014. The workshop is MS28 Expert workshop meetings of RI pillar working conditions

by the newly developed method for coding job titles from the Labour Force Survey in the Netherlands. In the last presentation of the day, the requirements for look-up databases were discussed, taking into account the long tail in the occupational distribution.

The second day focused on the challenges related to the web-spidering of job titles in vacancies, the classification of these job titles, and the demands regarding the required look-up databases. Presentations addressed the semantic matching of user-side reported job titles using look-up databases, the parsing and semantic matching of vacancies and cv's, and the crawling of the Internet for job knowledge. One presentation detailed how task frequencies of 430 4-digit ISCO occupational units in 13 countries were measured in a web survey (see also section 4 in this paper). Another presentation showed a web-based job analysis tool decomposing jobs into larger and smaller tasks. One paper explored how in Hungary graduate occupations and their skill requirements were measured. The supply and demand skills gap was discussed, based on a comparison of educational requirements of vacancies and educational attainment of jobholders. Another paper detailed job matching given the demographic challenges in the regional labor market in Dalarna County, Sweden. One presentation explored the role of occupations in skills supply and demand forecasts. Finally, the discussion focused on occupations as units of analysis. Presenters discussed occupational segregation in Europe, the socio-economic classifications derived from ISCO-08, and the assessment tools for transversal cognitive skills in individual occupational careers.

The third day was devoted to web-based occupational information systems as well to the discussions about the possibilities for further activities in this field. The relationship between occupations, skills and related training was explored, addressing an ontology-based competency matching between vocational education and the workplace. Another presentation was called 'Increasing the comparability of European occupations by utilising multilingual skills taxonomies: the vision of DISCO and ESCO'. One presentation detailed the method of making occupational forecasts and disseminating occupational information in Sweden. The final presentation concerned the web-based Occupational Information System in Italy. During the conference, one of the leading themes in the discussions focussed on the possibilities and the technical requirements for a multi-country occupational coding tool. Since the conference ideas have taken shape, as will be detailed in the next section.

5.3 Design for an advanced, multi-country occupational coding tool

ISCO-08 defines a 4-digit classification for worldwide use and is available in English. Following its policy towards a harmonized occupational classification, the European Commission has translated the ISCO 4-digit classification into all languages of the European Union to ensure that occupations are coded similarly across countries.[17] When it comes to classifying 5-digit occupations however, two approaches can be distinguished. The first one says that the ILO manual and descriptions are sufficiently detailed and hence it is assumed that national coding of 5-digit occupations leads to valid results across countries, hence that across countries comparable 5-digit occupations will be coded into the same 4-digit code without a need to test the assumed comparability. This method is applied in many multi-country surveys, where the field organisations code the occupations for their respective countries. The second approach states that only English occupational titles should be coded, and that therefore national job titles should be translated. This method is in part followed for the EWCS, as explained in section 2.4 (Gallup Europe 2010). In retrospect Ganzeboom (2014) in his effort to code parental occupations in the European Social Survey, applying the first approach, acknowledges that it would have been much better to ask the coders to translate the occupation files and then code all English titles, particularly because Google Translate has become a big help in this respect. It is not sure which approach is less costly. In the first approach the costs are related to the national coding, while no multi-country quality control can be applied. In the second approach translations might be costly, but central coding of the English occupations for the entire multi-country data collection is relatively cheap. In this proposal for a multi-country occupational coding tool, I follow the second approach and propose to translate all occupational titles in English.

As described in Section 2.4 a huge training set is required for an auto-coder to apply machine learning algorithms. Therefore, a major task consists of compiling a large volume, multilingual database of occupations, acting as the training set. This database falls apart into two components, one with individual level data, and one with occupation level data.

The first individual level database consists of merged and harmonized survey data from as many surveys as available. The merged dataset is harmonized for occupation codes and for the covariates industry, education, field of education, employment status, age, private/public sector, income, and other variables, and it has identifiers for survey name and version, survey mode, survey year, and occupational classification

17 See http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2009.292.01.0031.01.ENG, accessed 8 AUG 2014

used.[18] Whenever available the text responses for the open format questions about job title, job description, and tasks should be included. To increase the body of text related to coded occupations, an open format job description question will be included in the 80-country WageIndicator web survey and the response to will be added to the database.

The second - occupation level - database consists of (a) all available coding indexes from National Statistical Offices (text and codes); (b) multilingual databases of occupational titles, preferably coded (text and codes); (c) job titles, job descriptions and task lists from a wide variety of sources, preferably with coded job titles (text and codes); (d) job titles, job descriptions and additional texts from vacancy databases such as EURES, Indeed and Monster, preferably with coded job titles (text and codes); (e) the millions of web visitors of the WageIndicator Jobs&Salary web pages will be asked to provide job descriptions and tasks in their job (these web visitors have identified their 4-digit occupation based on the web page); (f) as much as possible English translations of non-English job titles. A very first draft of the occupation level database is shown in Appendix 4. Both databases will be used for the machine learning algorithms, while the individual level database will be used for the statistical analyses using auxiliary variables.

Once the two databases have enough content to act as a multi-country training set, next steps can be taken. For each country/language combination in the individual level database all verbatim job titles should be cleaned from misspellings, duplicates, abbreviations, replacement words such as 'worker equals labourer', alternative words, and plural job titles should be converted into singular one and female and male job titles should be harmonized. Per country rules have to be made for these cleaning activities. In this step crude job titles and job titles with multiple meaning such as manager, dealer, editor, and the phrasing of activities 'engineering manager' versus 'engineer, managing a team' should be identified and rules should be drafted for coding this ambiguous text. Then, all job titles should be translated in English, using available translations from the occupation level database or if absent from Google translate.

A next step includes the coding of all English job titles in the two databases into ISCO-08, using CASCOT. Then the initial codes can be compared to the CASCOT codes. Coding differences should be analysed and decision rules should be made to come to the final codes. In case the initial codes are in another classification than ISCO-08, crossover tables have to be applied. Next regression analyses for the probabilities of correct ISCO-08 4-digit codes should be ran. Finally the machine learning algorithms for occupational coding can be developed, including model estimates of the probability that the auto-coder agrees with the

18 I propose to take the data dictionary of the WageIndicator web survey as the base file, particularly because this is a continuous survey, and hence every quarter new data will be added, whereas most other surveys are discrete surveys.

coding in the training set. If this functions well, the cleaning rules and the algorithms can be applied for office-coding of newly added datasets.

Once all job titles are correctly coded, for use in self-coding in web surveys and for interviewer coding in computer-assisted surveys a large, multi-country multilingual look-up database will become available. Using this database for each country the job title frequencies can be identified, needed for the selection of the items to be included in the search tree for web surveys. In the long run, this implies that for in web surveys the look-up table for text string matching is much larger than the items used in the search tree. A major challenge will be to apply the cleaning rules and algorithms for the self-identification in web surveys or for instant field-coding during an interview. No experience has been accumulated with auto-coding for these purposes. Further research is needed to develop this application.

5.4 Conclusions

Workpackage 21 in the InGRID project has largely contributed to shaping ideas about a multi-country coding tool. A proposal for funding has been prepared and submitted. If successful, the tool can be build starting mid or late 2015, and meanwhile preparatory work will be undertaken.

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Appendix 1: WP 21 tasks in InGRID

Task 21.1 in InGRID is called 'New skills new jobs: tools for harmonising the measurement of occupations'. It consists of four parts, which relate to four milestones, as the table shows.

Task #	Task label	MS #	Milestone label	Delivery date
Task 21.1.1	Review the existing knowledge on tools used to measure occupations in EU Member States in various survey modes	MS93	Review of tools measuring occupations in surveys)	Current
Task 21.1.2	Develop methods to facilitate the testing of the comparability of the job content of occupational titles as well as the skill requirements for these occupations across EU Member States	MS94	Methods to facilitate EU-wide comparability of occupations)	Jan-15
Task 21.1.3	Develop methods to facilitate the EU-wide measurement of occupations in web surveys using an Application programming interface (API)	MS95	Methods to facilitate EU-wide measurement of occupations)	Dec-15
Task 21.1.4	Validate these research efforts on standardisation and harmonisation with an expert group of data collectors and data users	MS96	Expert group validation of results 'occupations')	Aug-16

Appendix 2: Surveys reviewed

Survey name	Survey version	Survey organisor	Survey years	Survey mode	Country
World Values Survey	WVS 1999-2002 WORLD VALUES SURVEY QUESTIONNAIRE	World Values Survey Association	1999-2002	F2F (no capi)	World wide
World Values Survey	WVS 2005-2006 Wave, Root Version	World Values Survey Association	2005/06	F2F (no capi)	World wide
World Values Survey	WVS 2010-2012 Wave, revised master, June 2012	World Values Survey Association	2010/12	F2F	World wide
European Working Conditions Survey	Fifth European Survey On Working Conditions	EuroFound	2010	F2F (no capi)	EU27+
European Working Conditions Survey	Fourth European Survey On Working Conditions	EuroFound	2005	F2F (no capi)	EU27+
European Working Conditions Survey	Third European Survey On Working Conditions	EuroFound	2000	F2F	EU27+
European Working Conditions Survey	Second European Survey On Working Conditions	EuroFound	1995	F2F	EU27+
European Quality of Life Survey	Third European Quality of Life Survey (3EQLS)	EuroFound	2011/12	F2F	EU27+
European Quality of Life Survey	Second European Quality of Life Survey (3EQLS)	EuroFound	2007	F2F	EU27+
European Quality of Life Survey	First European Quality of Life Survey (3EQLS)	EuroFound	2003	F2F	EU27+
European Social Survey (ESS)	SOURCE QUESTIONNAIRE AMENDMENT 01 (Round 6, 2012/13)	ESS ERIC	2012/13	F2F	EU27+
European Social Survey (ESS)	SOURCE QUESTIONNAIRE (Round 1, 2002)	ESS ERIC	2002	F2F	EU27+

Survey name	Survey version	Survey organisor	Survey years	Survey mode	Country
International Social Survey Programme (ISSP)	GENERAL SOCIAL SURVEY 2010 (GSS) QUESTIONNAIRE USA Section A –Ballot 2	ISSP	2010	Predominantly F2F	Argentina (AR) Austria (AUT) Bulgaria (BUL) Canada (CAN) Chile (CL) Switzerland (CH) Czech Republic (CZ) Germany (D) Spain (ESP) Finland (FI) Belgium (Flanders) (FL) Great Britain (GB) Croatia (HR) Japan (J) Lithuania (L) Latvia (LV) Norway (N) New Zealand (NZ) Philippines (PH) South Korea (ROK) Sweden (S) Slovakia (SK) Slovenia (SLO) Taiwan (TW) United States of America (USA)
International Social Survey Programme (ISSP)	2009 Social Inequality IV Final questionnaire	ISSP	2008	dk	dk
SHARE - Survey of Health, Ageing and Retirement in Europe	English generic questionnaire Wave 5	SHARE	2013	CAPI main questionnaire	Austria Belgium (Dutch) Belgium (French) Czech Republic Denmark France Germany Greece Israel (Arabic) Israel (Hebrew) Israel (Russian) Italy Luxemburg (French) Luxemburg (German) Netherlands Portugal Slovenia Spain (Spanish) Spain (Catalan) Sweden Switzerland (French) Switzerland (German) Switzerland (Italian)

Survey name	Survey version	Survey organisor	Survey years	Survey mode	Country
SHARE - Survey of Health, Ageing and Retirement in Europe	English generic questionnaire Wave 4	SHARE	2010	CAPI main questionnaire	Austria Belgium (Dutch) Belgium (French) Czech Republic Denmark Estonia (Estonian) Estonian (Russian) France Germany Hungary Italy Netherlands Poland Portugal Slovenia Spain Sweden Switzerland (French) Switzerland (German) Switzerland (Italian)
Higher Education as a Generator of Strategic Competences (HEGESCO)	HEGESCO MASTER QUESTIONNAIRE (continuation of the REFLEX project)	University of Ljubljana, Faculty of Social Sciences	2008	PAPI	14 European countries and Japan
WORLD HEALTH SURVEY	WORLD HEALTH SURVEY B - Individual Questionnaire	WHO	2002	F2F	dk
PIAAC	PIAAC Background questionnaire	MS version 2.1 d.d. 15-12-2010	2010	CAPI	Japan Finland Netherlands Australia Sweden Norway Estonia Flanders (Belgium) Czech Republic Slovak Republic Canada Korea England/N. Ireland (UK) Denmark Germany United States Austria Cyprus1 Poland Ireland France Spain Italy

Survey name	Survey version	Survey organisor	Survey years	Survey mode	Country
European Community Household Panel (ECHP)	Survey Questionnaires Wave 8	Eurostat	2001	F2F, CATI	Belgium, Denmark, Germany, Ireland, Greece, Spain, France, Italy, Luxembourg, the Netherlands, Austria, Portugal, Sweden and the United Kingdom
Arbejdskraftundersøgelsen (AKU) - Labour Force Survey in Denmark	Questionnaire concerning reference week XX, XX 2011 to XX 2011 (English version)	Statistics Denmark	2011	dk	DNK
Enquête Beroepsbevolking (EBB)	Basisvragenlijst CATI/CAPI 2012B	Statistics Netherlands	2014	CATI/CAPI	NLD
Enquête sur les forces de travail - Labour Force Survey	Enquête sur les forces de travail 2013	Statistics Belgium	2013	dk	BEL
Kwaliteit van de arbeid en flexibiliteit	Kwaliteit van de arbeid en flexibiliteit	HIVA-KULeuven Projectnr.: 983619	2000	dk	BEL
American Community Survey (ACS)	American Community Survey (ACS)	US Bureau of the Census	2014	CAWI or PAPI	USA
Current Population Survey (CPS)	CPS Interviewing Manual (revised June 2013)	US Bureau of the Census	2013	CAPI or CATI	USA
Paid Work in Britain	Address Record Form	SCPR	1997	F2F	GBR
Workplace Employment Relations Study (WERS)	Workplace Employment Relations Study 2011	Department for Business, Innovation and Skills	2011	PAPI	GBR
British Household Panel Survey (BHPS)	BHPS Questionnaires and Survey Documents - Wave 18	University of Essex / ISER	2013	F2F	GBR
SOEP	SOEP 2013 – Erhebungsinstrumente 2013 (Welle 30) des Sozio-oekonomischen Panels: Integrierter Personen- und Biografi efragebogen (Erstbefragte 2013), Aufwuchs J+K	DIW Berlin	2013	dk	DEU
NEA	Tiende Nationale Enquête Arbeidsomstandigheden voor werknemers	TNO/CBS	2013	CAWI/PAPI	NLD
EPICURUS	Questionnaire4thRoundForInterviewNSS	EPICURUS	2004	CATI	dk
ENQUÊTE EUROPÉENNE sur le TEMPS et sur la CHARGE de TRAVAIL des CADRES [EUROCADRES}	ENQUÊTE EUROPÉENNE sur le TEMPS et sur la CHARGE de TRAVAIL des CADRES [EUROCADRES}	EURO CADRES	2005	dk	FRA

Appendix 3: Occupational classifications worldwide

Table 7 Occupational classifications in use in 149 countries from a UN questionnaire on country practices in classifications carried out in 2012 (UNstats).

Country	Occupation classifications - 1	Un known	Own class	ISCO-88	ISCO-08	Extended version	Crossover table
Albania	- LKP	0	0	0	1	0	0
Algeria		1	0	0	0	0	0
Angola		1	0	0	0	0	0
Argentina		1	0	0	0	0	0
Armenia	- ISCO	0	0	0	1	0	0
Aruba		1	0	0	0	0	0
Australia	- ANZSCO	0	0	0	1	0	0
Austria	- ÖISCO-08	0	0	0	1	0	0
Azerbaijan	- MT	0	0	0	1	0	0
Bahamas		1	0	0	0	0	0
Bahrain		1	0	0	0	0	0
Bangladesh		1	0	0	0	0	0
Barbados		1	0	0	0	0	0
Belarus	- ОКЗ	0	0	1	0	0	0
Belgium	- ISCO-08	0	0	0	1	0	0
Belize		1	0	0	0	0	0
Bermuda		1	0	0	0	0	0
Bhutan		1	0	0	0	0	0
Bolivia	- COB-2009	0	0	0	1	0	0
Bosnia & Herzegovina		1	0	0	0	0	0
Botswana	- ISCO-88	0	0	1	0	0	0
Brazil		1	0	0	0	0	0
Brunei Darussalam		1	0	0	0	0	0
Bulgaria	- НКПД-2011	0	0	0	1	0	0
Burkina Faso	- CITP-08	0	0	0	1	0	0
Burundi		1	0	0	0	0	0
Cambodia		1	0	0	0	0	0
Cameroon		1	0	0	0	0	0
Canada	- NOC / CNP	0	1	0	0	0	1
Cape Verde	- CNP CV	0	0	0	1	0	0
Central African Republic		1	0	0	0	0	0
Chile		1	0	0	0	0	0
China		1	0	0	0	0	0
China, Hong Kong SAR	- [CES]	0	0	0	1	1	0
China, Macao SAR	- COPM	0	0	1	0	0	0
Colombia	- CIUO-88 A.C.	0	0	1	0	0	0
Congo		1	0	0	0	0	0
Costa Rica	- COCR-2011	0	0	0	1	0	0
Croatia	- NKZ	0	0	0	1	0	0
Cuba	- CNUO	0	0	0	1	0	0
Cyprus	- ISCO-08	0	0	0	1	0	0
Czech Republic	- CZ-ISCO	0	0	0	1	1	0
Denmark	- DISCO-08	0	0	0	1	1	0
Dominica	- ISCO	0	0	0	1	0	0
Dominican Republic		1	0	0	0	0	0
Ecuador		1	0	0	0	0	0
Egypt		1	0	0	0	0	0
El Salvador	- CNOES 08	0	0	0	1	0	0

Country	Occupation classifications - 1	Un known	Own class	ISCO-88	ISCO-08	Extended version	Crossover table
Estonia		1	0	0	0	0	0
Fiji		1	0	0	0	0	0
Finland	- [ISCO]	0	0	0	1	0	0
France		1	0	0	0	0	0
Georgia	- ISCO	0	0	0	1	0	0
Germany	- KldB 2010	0	1	0	0	1	1
Ghana	- ISCO-08	0	0	0	1	0	0
Greece	- ΣΤΕΠ 2010	0	0	0	1	0	0
Guatemala		1	0	0	0	0	0
Guinea-Bissau		1	0	0	0	0	0
Guyana		1	0	0	0	0	0
Honduras	- CIUO-Rev.3/1988	0	0	1	0	0	0
Hungary	- FEOR-08	0	0	0	1	0	0
Iceland		1	0	0	0	0	0
India		1	0	0	0	0	0
Indonesia		1	0	0	0	0	0
Iran, Islamic Republic of	- [CFEI]	0	0	1	0	0	0
Ireland	- <untitled>	0	1	0	0	0	0
Israel	- [SCO]	0	1	0	0	0	1
Italy	- CP 2011	0	1	0	0	1	1
Jamaica	- JSOC 1991	0	0	1	0	0	0
Japan	- JSOC	0	1	0	0	0	1
Jordan		1	0	0	0	0	0
Kazakhstan		1	0	0	0	0	0
Kenya		1	0	0	0	0	0
Korea, Republic of	- KSCO	0	0	0	1	1	0
Kuwait		1	0	0	0	0	0
Kyrgyztan		1	0	0	0	0	0
Lao People's Dem. Rep.		1	0	0	0	0	0
Latvia	- [PK]	0	0	0	1	1	0
Lesotho		1	0	0	0	0	0
Liechtenstein		1	0	0	0	0	0
Lithuania	- LPK	0	0	0	1	1	0
Luxembourg		1	0	0	0	0	0
Malaysia	- MASCO 2008	0	0	0	1	0	0
Maldives	- ISCO	0	0	0	1	0	0
Malta		1	0	0	0	0	0
Mauritania		1	0	0	0	0	0
Mauritius	- NASCO-08	0	0	0	1	0	0
Mexico		1	0	0	0	0	0
Monaco		1	0	0	0	0	0
Mongolia		1	0	0	0	0	0
Montenegro		1	0	0	0	0	0
Morocco		1	0	0	0	0	0
Mozambique	- CPM Rev2	0	0	0	1	0	0
Myanmar		1	0	0	0	0	0
Netherlands	- SBC 1992	0	0	0	1	0	0
Netherlands Antilles		1	0	0	0	0	0
New Caledonia		1	0	0	0	0	0
New Zealand	- ANZSCO	0	0	0	1	0	0
Nicaragua		1	0	0	0	0	0
Niger		1	0	0	0	0	0
Norway	- STYRK-08	0	0	0	1	0	0
Oman		1	0	0	0	0	0
Palestine	- [PSCO]	0	0	0	1	0	0
Panama	- CNO 2010	0	0	0	1	0	0

Country	Occupation classifications - 1	Un known	Own class	ISCO-88	ISCO-08	Extended version	Crossover table
Paraguay	- CPO	0	0	1	0	0	0
Peru		1	0	0	0	0	0
Philippines	- PSOC	0	0	0	1	0	0
Poland	- KZiS	0	0	0	1	1	0
Portugal	- CPP/2010	0	0	0	1	1	0
Qatar	- <untitled>	0	0	1	0	0	0
Republic of Moldova		1	0	0	0	0	0
Romania	- COR	0	0	0	1	0	0
Russian Federation	- OK3	0	1	0	0	0	0
Saint Lucia		1	0	0	0	0	0
Saint Vincent and the Grenadines		1	0	0	0	0	0
Sao Tome and Principe	- CNP	0	0	0	1	0	0
Saudi Arabia		1	0	0	0	0	0
Senegal		1	0	0	0	0	0
Serbia	- JNZ / KZ	0	0	0	1	0	0
Seychelles		1	0	0	0	0	0
Singapore	- SSOC 2010	0	0	0	1	1	0
Slovakia	- ISCO-08	0	0	0	1	0	0
Slovenia		1	0	0	0	0	0
South Africa		1	0	0	0	0	0
Spain	- CNO-11	0	0	0	1	0	0
Sri Lanka		1	0	0	0	0	0
Suriname	- ISCO-08	0	0	0	1	0	0
Swaziland		1	0	0	0	0	0
Sweden	- SSYK	0	0	0	1	0	0
Switzerland	- SBN 2000 / NSP 2000 / NSP 2000	0	1	0	0	1	0
Tajikistan		1	0	0	0	0	0
Thailand	- TSCO 2001	0	0	1	0	1	0
The Former Yugoslav Republic of Macedonia	- <untitled>	0	0	0	1	1	0
Tonga		1	0	0	0	0	0
Trinidad and Tobago		1	0	0	0	0	0
Tunisia		1	0	0	0	0	0
Turkey		1	0	0	0	0	0
Uganda		1	0	0	0	0	0
Ukraine	- КП-2010	0	0	1	0	0	0
United Kingdom	- SOC 2010	0	1	0	0	0	0
United Republic of Tanzania	- TASCO	0	0	1	0	0	0
United States of America	- SOC 2010	0	1	0	0	0	1
Uruguay	- <untitled>	0	0	0	1	0	0
Uzbekistan		1	0	0	0	0	0
Venezuela		1	0	0	0	0	0
Viet Nam		1	0	0	0	0	0
Yemen		1	0	0	0	0	0
Zambia		1	0	0	0	0	0
Zimbabwe		1	0	0	0	0	0
Total		78	10	12	49	14	6

Source: Derived from http://unstats.un.org/unsd/cr/ctryreg/ctrylist2.asp, accessed 22 APR 2014

Appendix 4: First draft of a simple multilingual occupational database (selection of cases)

Name	Version	Organisator	Country	Year/ start year	End year	Classification	Classification code	Classification level	Languag
SOEP	SOEP 2013	DIW Berlin	DEU	2013	2013	KldB	23456	4	German
Standard för svensk yrkesklassificering	SSYK 2012	Statistics Sweden	SVE	2012	-	SSYK-2012	110	4+	Swedish
Standard för svensk yrkesklassificering	SSYK 2012	Statistics Sweden	SVE	2012	-	SSYK-2012	110	4+	Swedish
Standard för svensk yrkesklassificering	SSYK 2012	Statistics Sweden	SVE	2012	-	SSYK-2012	1111	4+	Swedish
Standard för svensk yrkesklassificering	SSYK 2012	Statistics Sweden	SVE	2012	-	SSYK-2012	1112	4+	Swedish
Standard för svensk yrkesklassificering	SSYK 2012	Statistics Sweden	SVE	2012	-	SSYK-2012	1112	4+	Swedish
Standard för svensk yrkesklassificering	SSYK 2012	Statistics Sweden	SVE	2012	-	SSYK-2012	1113	4+	Swedish
Standard för svensk yrkesklassificering	SSYK 2012	Statistics Sweden	SVE	2012	-	SSYK-2012	1113	4+	Swedish
Standard för svensk yrkesklassificering	SSYK 2012	Statistics Sweden	SVE	2012	-	SSYK-2012	1120	4+	Swedish
Standard för svensk yrkesklassificering	SSYK 2012	Statistics Sweden	SVE	2012	-	SSYK-2012	1120	4+	Swedish
Standard för svensk yrkesklassificering	SSYK 2012	Statistics Sweden	SVE	2012	-	SSYK-2012	1120	4+	Swedish
Standard för svensk yrkesklassificering	SSYK 2012	Statistics Sweden	SVE	2012	-	SSYK-2012	1120	4+	Swedish

Name	Version	Organisator	Country	Year/ start year	End year	Classification	Classification code	Classification level	Language	Text	English translation	Translation source
Standard för svensk yrkesklassificering	SSYK 2012	Statistics Sweden	SVE	2012	-	SSYK-2012	1120	4+	Swedish	Skeppsredare	Shipowner	dk
Standard för svensk yrkesklassificering	SSYK 2012	Statistics Sweden	SVE	2012	-	SSYK-2012	1120	4+	Swedish	Generaldirektör, affärsverk	General Director, Enterprise	dk
Standard för svensk yrkesklassificering	SSYK 2012	Statistics Sweden	SVE	2012	-	SSYK-2012	1120	4+	Swedish	Ordförande/ Styrelsemedlem i övriga aktiebolag	Chairman / Member of the Board of other public limited companies	dk
Standard för svensk yrkesklassificering	SSYK 2012	Statistics Sweden	SVE	2012	-	SSYK-2012	1211	4+	Swedish	Ekonomi- och finanschefer nivå 1	Chief Financial Managers Level 1	dk
dk	Ö-ISCO-08_Index	Statistics Austria	AUS	dk	-	Ö-ISCO-08	1342	4+	German	Krankenhausverwalter/ Krankenhausverwalterin	Hospital administrators / hospital administrator	Google translate
dk	Ö-ISCO-08_Index	Statistics Austria	AUS	dk	-	Ö-ISCO-08	1342	4+	German	Kuranstaltsleiter/ Kuranstaltsleiterin	Kuranstaltsleiter / Kuranstaltsleiterin	Google translate
dk	Ö-ISCO-08_Index	Statistics Austria	AUS	dk	-	Ö-ISCO-08	1342	4+	German	Medizinischer Verwaltungsleiter/ Medizinische Verwaltungsleiterin	Medical Administrative Head / Head of Administration Medical	Google translate
dk	Ö-ISCO-08_Index	Statistics Austria	AUS	dk	-	Ö-ISCO-08	1342	4+	German	Oberin, Hospital	Superior, Hospital	Google translate

Name	Version	Organisator	Country	Year/ start year	End year	Classification	Classification code	Classification level	Language	Text	English translation	Translation source
dk	Ö-ISCO-08_Index	Statistics Austria	AUS	dk	-	Ö-ISCO-08	1342	4+	German	Pflegedirektor/ Pflegedirektorin, Gesundheitswesen	Director of Nursing / Nursing Director, Healthcare	Google translate
dk	Ö-ISCO-08_Index	Statistics Austria	AUS	dk	-	Ö-ISCO-08	1343	4+	German	Altenheimleiter/ Altenheimleiterin	Nursing home manager / Nursing Home Director	Google translate
dk	Ö-ISCO-08_Index	Statistics Austria	AUS	dk	-	Ö-ISCO-08	1343	4+	German	Anstaltsleiter/ Anstaltsleiterin, Altenbetreuung	Warden / maintenance manager, elderly care	Google translate
dk	Ö-ISCO-08_Index	Statistics Austria	AUS	dk	-	Ö-ISCO-08	1343	4+	German	Direktor/ Direktorin, Pensionistenheim	Director / Director, retirement home	Google translate
dk	Ö-ISCO-08_Index	Statistics Austria	AUS	dk	-	Ö-ISCO-08	1343	4+	German	Direktor/ Direktorin, Pflegeheim	Director / Director, Nursing Home	Google translate
dk	Ö-ISCO-08_Index	Statistics Austria	AUS	dk	-	Ö-ISCO-08	1343	4+	German	Hausleiter/ Hausleiterin, Altenbetreuung	House manager / head of house, care for the elderly	Google translate
dk	Ö-ISCO-08_Index	Statistics Austria	AUS	dk	-	Ö-ISCO-08	1343	4+	German	Heimleiter/ Heimleiterin, Altenbetreuung	Home manager / director of the home, care of the elderly	Google translate
dk	Ö-ISCO-08_Index	Statistics Austria	AUS	dk	-	Ö-ISCO-08	1343	4+	German	Koordinator/ Koordinatorin in der Altenpflege	Coordinator / coordinator in the elderly	Google translate
dk	Ö-ISCO-08_Index	Statistics Austria	AUS	dk	-	Ö-ISCO-08	1343	4+	German	Pflegeanstaltsleiter/ Pflegeanstaltsleiterin	Nursing home manager / director of nursing home	Google translate
dk	Ö-ISCO-08_Index	Statistics Austria	AUS	dk	-	Ö-ISCO-08	1343	4+	German	Pflegedirektor/ Pflegedirektorin, Altenbetreuung	Director of Nursing / Nursing Director, elderly care	Google translate

Name	Version	Organisator	Country	Year/ start year	End year	Classification	Classification code	Classification level	Language	Text	English translation	Translation source
dk	Ö-IS-CO-08_In-dex	Statistics Austria	AUS	dk	-	Ö-ISCO-08	1343	4+	German	Seniorenheim-leiter/ Senioren-heimleiterin	Nursing home manager / senior warden	Google translate
dk	Ö-IS-CO-08_In-dex	Statistics Austria	AUS	dk	-	Ö-ISCO-08	1344	4+	German	AMS-Ge-schäftsstellen-leiter/ AMS-Geschäftsstel-lenleiterin	AMS-Geschäftsstel-lenleiter/AMS-Ge-schäftsstellenleiterin	Google translate
dk	Ö-IS-CO-08_In-dex	Statistics Austria	AUS	dk	-	Ö-ISCO-08	1344	4+	German	Führungskraft, soziales Woh-nen	Leadership, social housing	Google translate
dk	Ö-IS-CO-08_In-dex	Statistics Austria	AUS	dk	-	Ö-ISCO-08	1344	4+	German	Führungskraft, Sozialzentrum	Leadership, social center	Google translate

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