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EUROSTAT-OECD DEFINITION OF ICT SPECIALISTS

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FOREWORD

This paper presents a joint EUROSTAT-OECD statistical definition of ICT specialists based on the International Standards Classification of Occupation (ISCO) 2008, following the ILO (2012) recommendation and OECD (2013). This definition was adopted by the Eurostat Working Group meeting on Information Society Statistics on May 3-4 2015.

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Eurostat-OECD Definition of ICT Specialists

1.1. Introduction

The growing awareness of policy-makers of the importance of employment of ICT specialists is reflected in a number of the EU and OECD policy initiatives, including the *Agenda for New Skills and Jobs (2010)*,¹ the *Employment Package (2012)*,² the *Grand Coalition for Digital Jobs (2013)*³ and the forthcoming *OECD Ministerial Meeting on the Digital Economy – Panel 4.2.: Skills for a Digital World*.⁴ In order to be effective, these policy initiatives need to be supported by reliable official databased evidence and a well-grounded conceptual framework to define and measure employment dynamics for ICT specialists.

Eurostat and OECD support policy-making in the area of ICT employment by publishing estimates of the ICT specialists derived from the Labour Force Survey (LFS) data.⁵ This benchmarking indicator is conceptually in accordance with the data collected by Eurostat in the survey *ICT usage and e-commerce in enterprises*⁶ and by the OECD in the *Model Survey on the Use of Information and Communication Technologies (ICTs) by Businesses*.⁷ Both data operate with the same concept (ICT specialists) but provide different perspectives: one from the point of view of the enterprise and another from the perspective of the Labour Force.

This document presents a joint EUROSTAT-OECD statistical definition of ICT specialists based on the International Standards Classification of Occupations (ISCO) 2008, following the ILO (2012) recommendation, the OECD (2013) proposal and further inputs by the OECD Working Party on Measurement and Analysis of the Digital Economy (MADE) in 2015 (Sabadash (2014)). This definition was adopted by the Eurostat Working Group meeting on Information Society Statistics on May 3-4 2015.

1.2. Defining ICT specialists conceptually

While ICT is often used in relation to skills and employment, it is easy to get confused between different terms and definitions. This document operates with the definitions adopted by the OECD and the International Labour Organization (ILO), and in doing so offers a clear distinction between several categories that – if used carelessly – may create conceptual and methodological misunderstandings.

The OECD (2004) distinguishes between two definitions of ICT employment:

1. *ICT sector employment*, defined as employment in industries traditionally identified as belonging to the **ICT sector** (all occupations, even those with no use of ICTs);
2. *ICT skilled employment*, defined as employment in occupations that use ICT to various degrees across **all industries**.

The ICT skilled employment includes three categories of ICT competences (OECD, 2004): specialists, advanced users and basic users. For the purpose of this document, we concentrate exclusively on the ICT specialists. In past, Eurostat provided estimates for both ICT specialist and ICT users. However, in 2013 it was decided to discontinue providing estimates for ICT users among the Eurostat benchmarking indicators.

Following OECD (2004), Eurostat and OECD define ICT specialists as workers who have the ability to develop, operate and maintain ICT systems, and for whom ICT constitute the main part of their job.

The distinction between ICT specialists and ICT users is important from both the conceptual and the methodological standpoint (Sabadash, 2014).

Conceptually, these two categories capture two different aspects of the need for ICT skills: ICT specialists are involved in the production of ICT goods and services, while ICT users enable diffusion of ICT-based technological innovations across all economic sectors (and also all spheres of consumption).

Methodologically, these two types of skills are not equally reflected in the primary sources of European employment statistics. While ICT specialists can be identified with a fair degree of accuracy using ISCO on its own (see for example OECD, 2004, 2010 and 2013, Empirica, 2013), or in combination with ISCED,⁸ ICT users can be identified in ISCO occupations only in those exceptional cases where technological developments have led to new ways of organising work (Hunter, 2006). This happens mainly because the need for ICT-using skills among the general workforce not only varies significantly from one job to another (even within the same ISCO occupational category), but also evolves swiftly over time. For example, as described in Hunter (2006), though nursing professionals had little requirement for general skills in the use of ICT in the past, nowadays they are often required to exchange patient and diagnostic information electronically within and between hospitals and are increasingly more involved in the advanced use of ICT and ICT-enabled tools.

1.3. Defining ICT specialists statistically based on ISCO-08

Until 2015, the estimates of the ICT specialist's produced by Eurostat for the ICT benchmarking indicators contained the following ISCO-08 codes:

133 ICT Service Managers

25 Information and communications technology professionals

35 Information and communications technicians

7422 ICT Installers and Servicers

The main limitation of this approach is that it relies mostly on the occupations at the 2- and 3-digits level of aggregation leaving many of the ICT occupations out of scope and, hence, produces downward-biased estimates.⁹

In 2013 the OECD proposed a definition of ICT specialists based on 4-digit [ISCO-08], which was discussed by the Working Party on Indicators for the Information Society (WPIIS, now MADE).

In July 2012, the ILO released *the ISCO-08 Volume 1: Structure, Group Definitions and Correspondence Tables*, which introduced a thematic view for ICT occupations. More specifically, in Chapter 3.3, this thematic view identifies *professional and associate professional occupations* in ICT as major sub-groups, and suggests the inclusion of a number of *other unit groups* that primarily involve the production of ICT goods and services.

The guiding principle for inclusion of occupations into this thematic view is their primary involvement in the production of ICT goods and services. On the other hand, occupations which require specialised skills in using ICT only as a tool, not involved in the production of ICT goods and services, are excluded. This ILO reasoning further reinforces our belief that ICT users (either advanced or basic) cannot be accurately identified through the ISCO-based occupations.

Based on the ILO thematic views for ICT occupations, we devise the measure of ICT-skilled employment by including two additional occupations: *3114 Electronics engineering technicians* and *7421 Electronics mechanics and servicers*.

The Eurostat-OECD statistical definition of ICT specialists is therefore the following:

1.3.1. ICT managers, professional and associate professional occupations

133 ICT Service managers

25 Information and communications technology professionals

251 Software and multimedia developers and analysts

2511 Systems analysts

2512 Software developers

2513 Web and multimedia developers

2514 Application programmers

2519 Software and multimedia developers and analysts not elsewhere classified

252 Database specialists and systems administrators

2521 Database designers and administrators

2522 Systems administrators

2523 Computer network professionals

2529 Database and network professionals not elsewhere classified

35 Information and communications technicians

351 ICT operations and user support technicians

3511 ICT operations technicians

3512 ICT user support technicians

3513 Computer network and systems technicians

3514 Web technicians

352 Communications technicians

3521 Broadcasting and audio-visual technicians

3522 Telecommunications engineering technicians

1.3.2. Other groups that are primarily involved in the production of ICT goods and services

2152 Electronic engineers

2153 Telecommunication engineers

2166 Graphic and multimedia designers

2356 Information technology trainers

2434 ICT sales professionals

3114 Electronics engineering technicians

7421 Electronics mechanics and servicers

7422 ICT installers and servicers

ANNEX A

1.4. Implementing the definition of ICT specialists

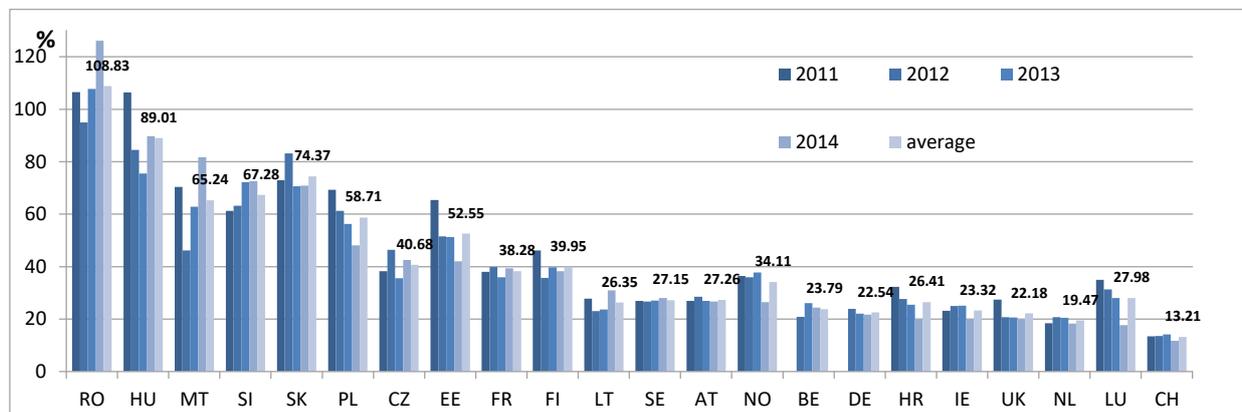
The Annex discusses alternative approaches to the implementation of the definition of ICT specialists. The discussion is provided for information only and is not part of the definition. As each approach has pros and cons, the choice of the most suitable approach is left to statisticians and researchers depending on the purpose and context of their work.

Applying the ICT-specialised employment definition that contains ISCO occupations at the 4-digit level of aggregation to the LFS data on employment inevitably leads to an *important practical problem*: about one third of the European Member States and several OECD countries do not collect data on occupations at the 4-digit level of aggregation.

One way to get round this practical problem is to limit the definition of ICT-skilled employment to the 3-digit ISCO codes (like, for example, in OECD, 2004 and OECD, 2010). However, this approach leads to biased estimates due to under-estimation (when some 4-digit occupations are left out) or over-estimation (when the whole 3-digit group containing both ICT and non-ICT occupations is included). When tested on data, this method left many of respondents with ICT occupations out of scope and, hence, produces downward-biased estimates. Figure 1 shows the difference between the estimates produced using 3-digits and 4-digits levels of aggregation (for the countries that report 4-digit data in the LFS).

Figure 1. Difference between 3- and 4-digit levels of aggregation approaches

As a percentage increase in ICT specialists estimates when using 4-digit codes compared to 3-digit codes



Source: Estimates, based on EU LFS.

Note: Data labels show the average difference over 4 years; BE and DE did not report 4-digit ISCO codes in 2011.

Another way of dealing with the problem is to produce estimates for the missing data based on the available country-year observations. The simplest technique to apply this approach would be to assume that the share of the 4-digit occupations in the correspondent 3-digit group in the countries with the missing data equals to the average value calculated for the countries that provide data at the 4-digit level. This method should, however, rely on the

assumption that these shares are stable across countries and over time. As Figure 2 shows, cross-country and year variations in the shares of the 4-digit ICT occupations is too high to use this technique for inputting the missing values in the countries that do not report LFS data at the 4-digit level of aggregation.

Figure 2. Share of the 4-digit ICT occupation in the corresponding 3-digit ISCO groups



Source: Estimates, based on EU LFS.

Furthermore, even if the missing values could have been imputed using the average as described above, country- and year-specific aspects (reflecting both labour demand and supply factors that influence the employment dynamics of these specific occupations) would need to be carefully taken into account to ensure reliable results. While methodologically interesting, this approach could turn into a very challenging task due to the lack of a comprehensive set of variables capable of fully capturing country- and year-specific factors of labour demand and supply. Moreover, this approach may still produce

inconsistent estimates of total ICT-skilled employment if the share of the missing occupations is significant.

An alternative to the above ways of operationalising a definition of ICT specialists in the EU LFS data can be an approach based on the combination of occupations and education taxonomies.¹⁰

The EU LFS data provides information on the ICT skills proxied by ICT-related education (independently from the official allocation to any specific industry of occupation) on the basis of uniform and internationally-agreed definitions. In particular, the field defined in International Standard Classification of Education, ISCED-97, as *48 Computing* covers all types of education related to computer system design, computer programming, data processing, networks, and operating systems dealing with software development (those related to the hardware development are classified with the engineering fields). This group comprises two sub-groups:

481 Computer science

482 Computer use.

ISCED-97 field *481 Computer science* (R. Andersson and A-K. Olsson, 1999) is the study of the design and development of computer systems and computing environments. It includes the study of the system design, computer programming, data processing, networks, and operating systems - i.e. design, maintenance and integration of software applications. Programmes with the following main content are included to this ISCED-97 group: Computer programming; Computer science; Computer system analysis; Computer system design; Informatics; Network administration; Operating systems; Programming languages (Visual Basic, C++ etc.).

ISCED-97 field *482 Computer use* (Sabadash (2014)), is the study of using computers and computer software and applications for different purposes. Study programmes with the following main content are included into this group: Computer use; Software for calculating (spreadsheets); Software for data processing; Software for desk top publishing; Software for word processing; Use of Internet.

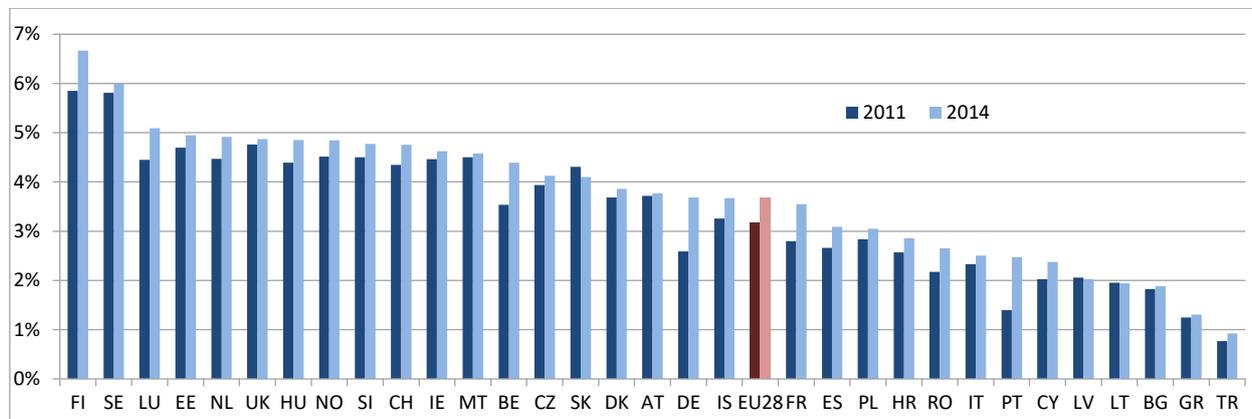
A number of ICT-specific programs, such as Broadcasting electronics, Computer engineering, Computer repairing, Data processing technology, Digital technology, Electronic engineering, Electronic equipment servicing, Network technology, Robotics, Telecommunication technology fall outside the above two ISCED-97 fields and are included into the field *523 Electronics and automation*. Unfortunately, EU LFS does not include this code in the set of categories used to capture fields of education.

When data on the occupation of a person is not available at 4-digit level, it can be estimated using the corresponding 3-digit group and filtering it by the variable that captures the field of education. For example, in order to identify the 4-digit occupations group *3114 Electronics Engineering Technicians* in ISCO-08, we use the 3-digit ISCO-08 code *311 Physical and engineering technicians* and select only those workers from this group who have ICT-specific education, i.e. those workers where the educational field according to ISCED-97 is categorised as *48 Computing*.

Estimates based on this method are shown on Figure 3.

Figure 3. ICT specialists in EU-28¹¹, 2011 and 2014

As a percentage of total employment



Source: Estimates, based on EU LFS.

This method has the advantage of being easily applied to the LFS data without involving complex estimation techniques. It could, however, be criticised on the grounds that there is no perfect match between field of education and type of occupation. Indeed, one's choice of occupation can be influenced by many factors besides education. However, educational attainment still remains a key variable in all studies looking at occupational outcomes. Moreover, in a professional labour market, which is as highly specialised as the ICT one, the field of education is instrumental in the occupational choices.

In principle, applied to the EU LFS data, this method can produce estimates of ICT specialists starting from 2004.¹² The lower bound of the timeframe is determined by the availability of data on the field of education based on the ISCED¹³. Implementation of the ISCED 1997 classification in the EU LFS started in 1998, however many countries¹⁴ were still not collecting information in the field of education until 2003. Only from 2004 onwards, the majority of countries provided information on the field of education in their national LFSs, with only several breaks in series in specific years: in 2004 for Czech Republic, Hungary, Malta and Turkey, in 2005 for Czech Republic, Malta and Spain, and in 2007 for Ireland.

The above estimates suggest that the combination of occupations (ISCO) and skills (ISCED) taxonomies permits to measure the *number* of the ICT specialist with greater precision than the other two approaches. Nonetheless, the three approaches lead to similar estimates of the *proportional changes* in the number of ICT specialists over time.

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End Notes

1. <http://ec.europa.eu/social/main.jsp?catId=958&langId=en>
2. http://ec.europa.eu/commission_2010-2014/andor/headlines/news/2012/04/20120418_en.htm
3. <http://ec.europa.eu/digital-agenda/en/digital-jobs-0>
4. 22-23 June 2015, Cancún (Mexico) <http://www.oecd.org/fr/sti/dep-ministerial-2016.htm>.
5. Table *Percentage of persons employed with ICT specialist skills (isoc_ic_bispe)* in the [Eurostat Data Navigation Tree](#); OECD 2014 and 2015.
6. Module "ICT specialists and skills" of the model questionnaire includes 13 mandatory questions aimed at establishing the modes in which an enterprise address its needs in ICT skills (recruiting new ICT specialists, providing training or outsourcing tasks) and whether it encounters difficulties in filling in the ICT vacancies.
7. Module H, <http://www.oecd.org/sti/ieconomy/measuringtheinformationeconomy.htm>
8. International Standard Classification of Education
9. Because not all countries report information on ISCO-08 7422, employment in 7422 in non-reporting countries was estimated based on the average employment share of sub-group 7422 in group 742 in countries where data are available.
10. See Sabadash (2012) for more information on different taxonomies used to define ICT employment and Sabadash (2014) for operationalization of the combined ICT occupations and ICT skills taxonomies.
- 11 Note by Turkey:
The information in this document with reference to "Cyprus" relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the "Cyprus issue".
Note by all the European Union Member States of the OECD and the European Union:
The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.
12. It should be remembered though that usage of ISCO has an important drawback related to the break in the time series in 2011. Since the transition of the EU LFS to ISCO-08 in the first quarter of 2011, the national statistical offices stopped collecting ISCO-88-based information for reasons of survey cost. At the same time, due to the absence of one-to-one correspondence tables between ISCO-88 and ISCO-08, the new classification cannot be used to re-construct the old series retrospectively. In practice, this means that two separate ISCO-based definition corresponding to two sub-periods, prior to 2010 and from 2011 onwards, need to be used to estimate ICT specialists.
13. <http://www.uis.unesco.org/Education/Pages/international-standard-classification-of-education.aspx>
14. Austria, Belgium, Hungary, Ireland, Latvia, Malta, Poland, Portugal, Romania, Sweden, the UK