

Member States Working Group on ESCO

State of play of the work on skills clustering: The process of building the skills clusters hierarchy

18 March 2024

Overview

Introduction

- Scope of the project
- Project workflow

Developing a new skills and knowledge structure

- External ontologies and classification systems
- Design principles
- ICT demo
- Health demo
- Agriculture and veterinary demo

Skill-skill co-occurrence links

• Identifying and visualising co-occurrence relations between skills



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Introduction

Why skills clustering?

Scope of the exercise

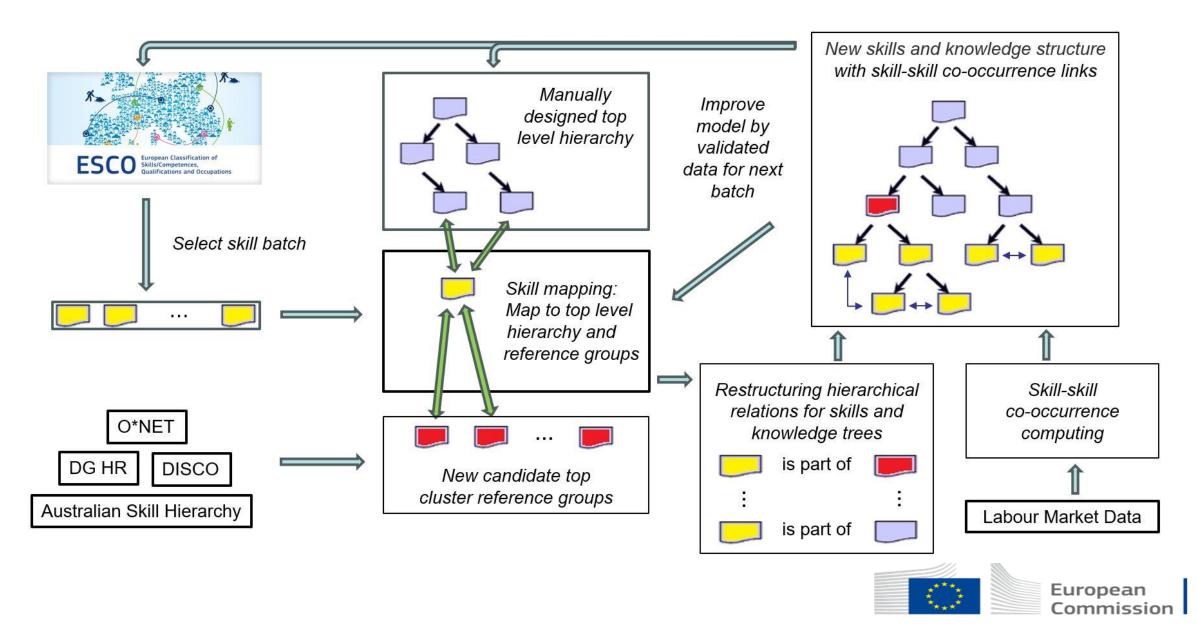
• **Improve classification browsing** by applying an intuitive grouping of skills.

• Support the use case of matching and skills suggestion through logical grouping and co-occurrence data.

- Short term improvement of two use cases. Aim is to create a specific view on top of ESCO.
- In parallel, the skills clustering allows for exploration of strategic improvements to ESCO.



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External classification systems that contributed to skills clusters

- Dewey Decimal Classification
- Library of Congress Classification
- Universal decimal classification
- ISCED-F
- NACE
- Australian skills classification
- Industrial Ontology Foundry
- Common Core Ontologies

- Relations Ontology
- The Food Ontology
- SNOMED
- FIBO
- The Environment Ontology
- Agrovoc
- GEMET



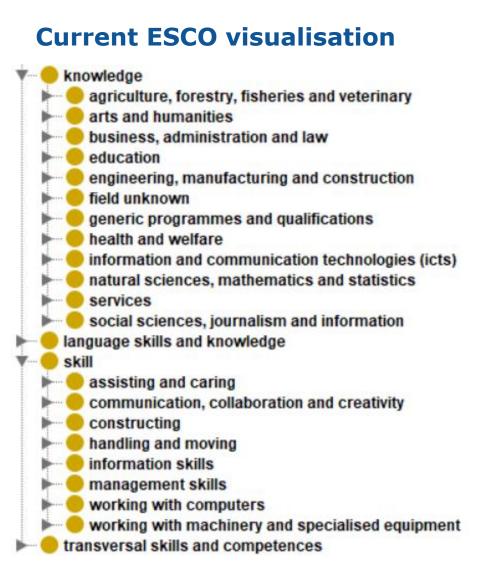
Design principles (heuristics)

- Consistency
- Economy / minimalism
- Completeness / comprehensiveness
- Rules around usage of polyhierarchy

- Meaningful hierarchical relations
- Ontological realism
- Mutual exclusivity
- Being data driven



Top layer architecture



- Not structured around industries / sectors
- Skills concepts and knowledge concepts in 2 different trees

Skills clusters visualisation



- Structured around industries / sectors
- Skills concepts and knowledge concepts all together



Current ESCO visualisation

- information and communication technologies (icts)
- information and communication technologies (icts)
 - 🗝 😑 computer use
 - database and network design and administration
 - information and communication technologies (icts) not further defined
 - Information and communication technologies not elsewhere classified
 - --- esoftware and applications development and analysis

working with computers

- 🗝 🛑 accessing and analysing digital data
- programming computer systems
- setting up and protecting computer systems
- 🗝 🛑 using digital tools for collaboration, content creation and problem solving
- using digital tools to control machinery
- Repetition
- Miscellaneous categories
- Access to little information
- Mutually exclusivity /comprehensiveness
- Not user friendly

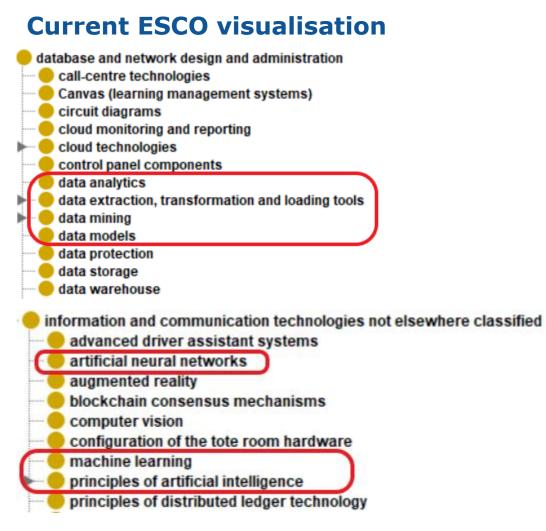
Skills clusters visualisation

information technologies
 cloud solutions knowledge and skills
 computer engineering
 computer programming knowledge and skills
 computer science
 cybersecurity knowledge and skills
 data science knowledge and skills
 database and data storage knowledge and skills
 designing ict systems or applications
 hardware knowledge and skills
 Setting up and protecting computer systems
 software knowledge and skills
 software quality control and testing
 user interface and user experience (ui/ux) design knowledge and skills

- Mutually exclusive / comprehensiveness
- Access to a lot of information
- User friendly
- Ontological realism

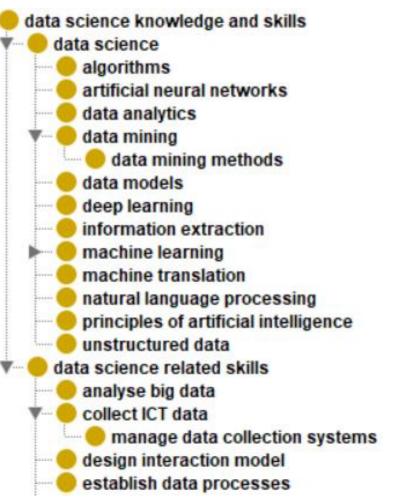


Data Science



- Ontological realism
- Meaningful hierarchical relations
- Long lists of granular concepts

Skills clusters visualisation



- User friendly
- Consistency



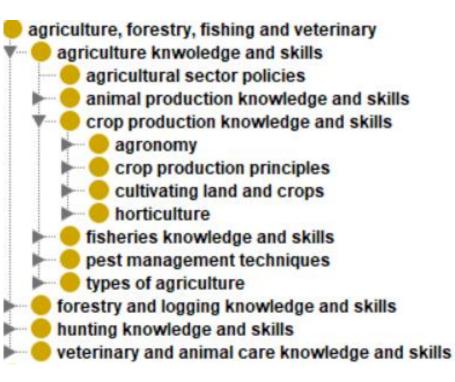
Agriculture



Miscellaneous categories

- Correctness of hierarchical relations
- Comprehensiveness

Skills clusters visualisation



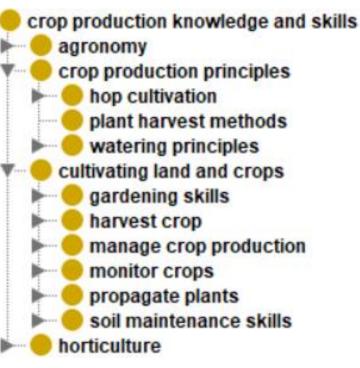


Agriculture

Current ESCO visualisation

crop and livestock production agricultural raw materials, seeds and animal feed products agricultural sector policies agroecology agronomical production principles agronomy animal breeding programmes animal feed ingredients animal nutrition animal production science animal training aquaponics climate smart agriculture computerised feeding systems conservation agriculture crop production principles dairy animal production feed additives fertigation fertilisation principles fertiliser products fruit and vegetable products hatchery design hop cultivation integrated pest management

Skills clusters visualisation

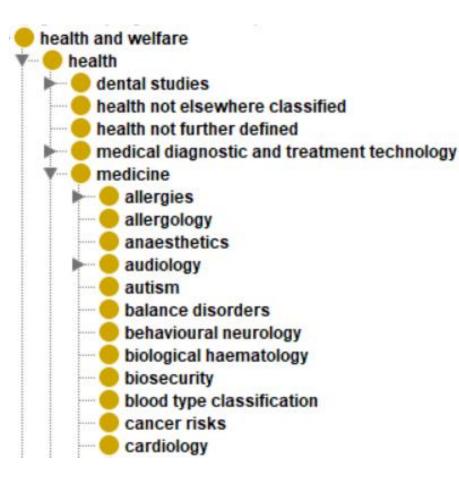


- Ontological realism
- Meaningful hierarchical relations
- Long lists of granular concepts



Health

Current ESCO visualisation



- Ontological realism
- Meaningful hierarchical relations
- Long lists of granular concepts

Skills clusters visualisation



- Comprehensiveness
- Consistency
- User friendly



Mental health

Current ESCO visualisation

psychology adolescent psychological development air passenger behaviour behavioural disorders behavioural science behavioural therapy check methods clinical psychological treatment cognitive behavioural therapy communication disorders conditions for professional practice of clinical psychology conditions for professional practice of health psychology creation of clinical psychological opinions developmental possibilities in music therapy interventions developmental psychology diagnosing health conditions address side effects of menopause analyse X-ray imagery apply radiological health sciences assess animal nutrition assess fish health condition assess healthcare users' risk for harm assess nature of injury in emergency assess patients after surgery assess physical conditions of clients assess the patient's therapeutic needs carry out an autopsy carry out biopsy carry out neuropsychological testing carry out psychiatric assessment of child conduct cancer screening tests

Skills clusters visualisation



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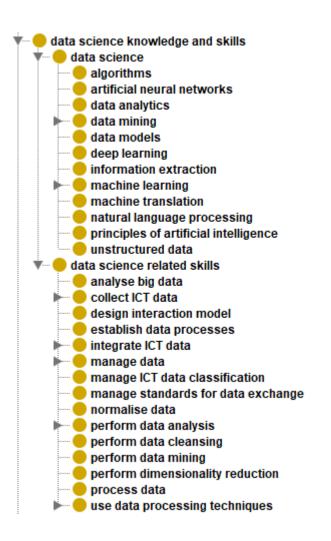
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 New structure provides a more meaningful grouping of concepts

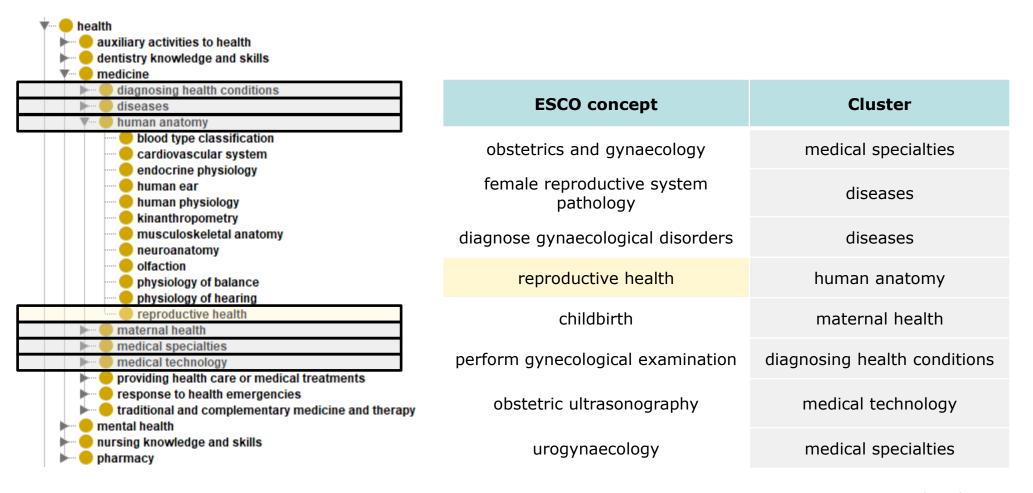




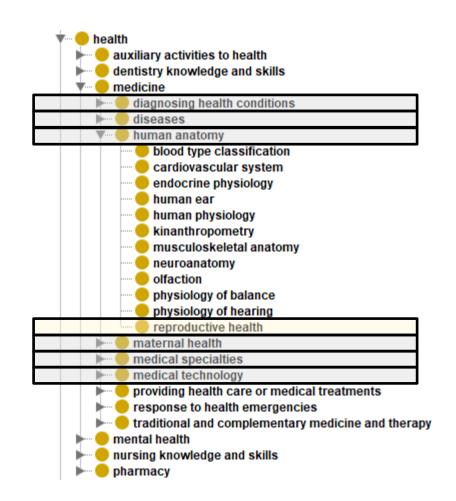
- New structure provides a more meaningful grouping of concepts
- However, for applications such as:
 - Skill suggestions to complete profile (Europass)
 - Job recommendation (EURES)
 - Skills intelligence

complementary skill-skill relations are relevant









Complement new hierarchy with information on how employers and workers request/use combinations of skills

ESCO concept	Cluster	Co-occurrence ratio
obstetrics and gynaecology	medical specialties	1.00
female reproductive system pathology	diseases	0.29
diagnose gynaecological disorders	diseases	0.24
reproductive health	human anatomy	0.16
childbirth	maternal health	0.14
perform gynecological examination	diagnosing health conditions	0.14
obstetric ultrasonography	medical technology	0.13
urogynaecology	medical specialties	0.11



Why additional links instead of integrated in clustering?

- Not feasible to cluster all ESCO skills in non-overlapping groups without rules/guidelines:
 - CAD software
 - CAD for footwear
 - footwear industry
- Relations between concepts are non-symmetric:
 - environmental impact of tourism \Rightarrow applying environmental skills and competences
 - applying environmental skills and competences
 environmental impact of tourism
- Co-occurrence links can later be made more explicit using specific ontology relations, e.g.: software for skill, knowledge for skill, etc.



Skill-skill Co-occurrence Links: Metric Development

How to compute co-occurrences?

- Count in how many vacancies / user profiles skills appear together
- Tested on small sample of 4 million vacancies
- Extend to +100 million vacancies and Europass profiles



Skill-skill Co-occurrence Links: Example

ESCO skill: hearing disability

ESCO PT	Co-occurrence ratio
hearing loss	0.61
support people with hearing impairment	0.52
communication related to hearing impairment	0.33
physiology of hearing	0.22
adapt hearing tests	0.22
hearing aids	0.18
diagnose hearing impairment	0.18
audiology	0.13
recommend hearing aids	0.13
adjust hearing aids	0.13



Skill-skill Co-occurrence Links: Example

ESCO skill: control compliance of railway vehicles regulations

ESCO PT	Co-occurrence ratio
ensure compliance with railway regulation	0.68
railway law	0.64
enforce railway safety regulations	0.60
railway framework legislation	0.54
comply with railway safety standards	0.52
oversee operational safety on trains	0.46
perform maintenance work on rail tracks	0.26
perform rail track inspections	0.21
operate switching locomotives	0.11



Skill-skill Co-occurrence Links: Example

ESCO skill: plan digital marketing

ESCO PT	Co-occurrence ratio
digital marketing techniques	0.79
plan marketing campaigns	0.34
plan social media marketing campaigns	0.30
develop campaigns	0.26
online ads campaign techniques	0.22
content marketing strategy	0.21
search engine optimisation	0.19
web analytics	0.17
conduct search engine optimisation	0.16
manage online content	0.15



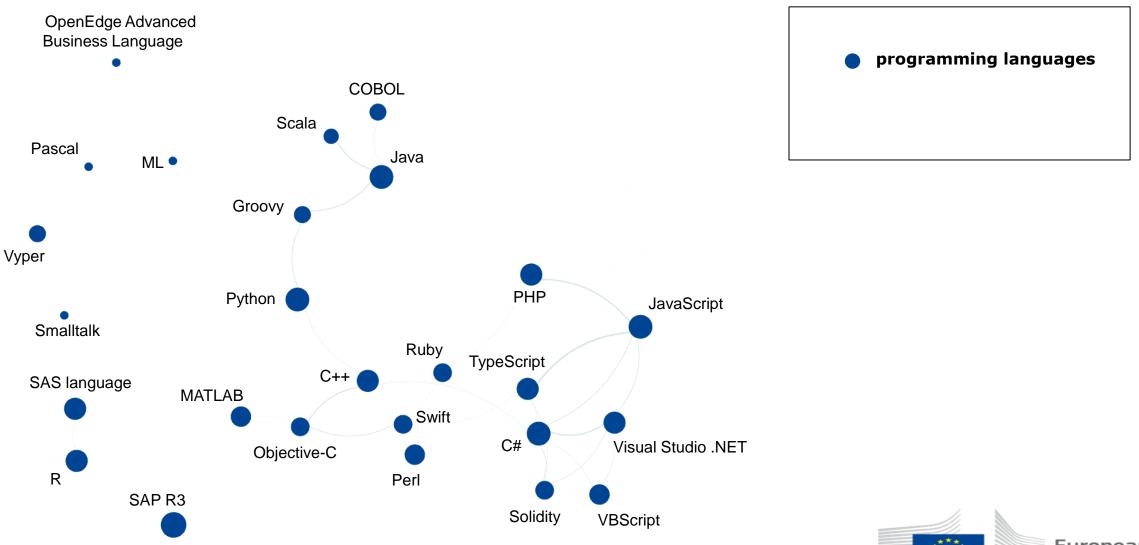
ESCO Portal Visualisation: Example – Digital Marketing Techniques

Relationships	,
Broader conc	epts
marketing and adve	rtising
Essential for	
eBusiness manager	digital marketing manager publications coordinator
Optional for	
fortune teller p	hotographer book publisher print studio supervisor
search engine optim	hisation expert business and marketing vocational teacher
medical sales repre	sentative art director marketing consultant
Co-occurring	with
plan digital marketi	
social media mark	eting techniques plan marketing campaigns

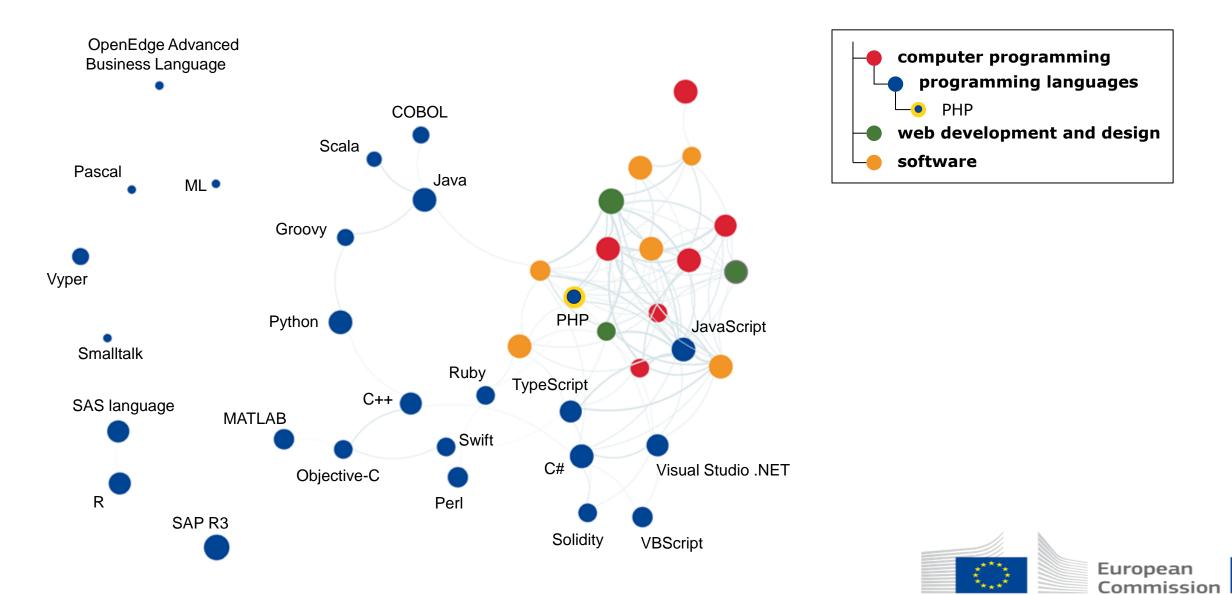
- Include co-occurrence information under *Relationships* on ESCO portal
- Display sorted list of co-occurring concepts
- Provide downloadable files



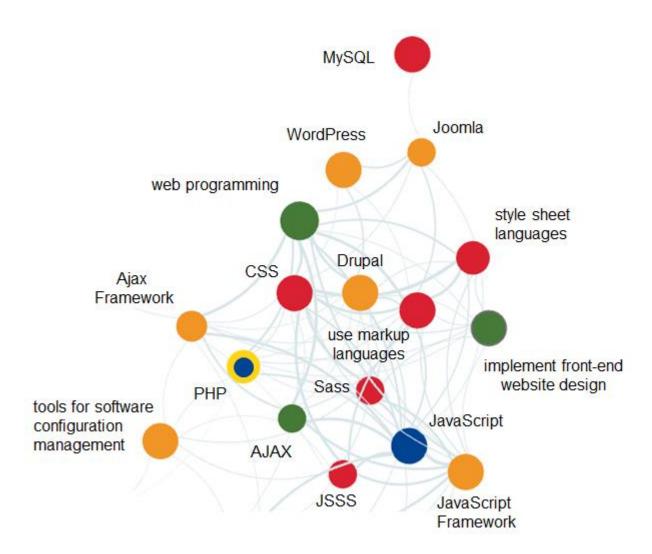
Graphical Visualisation: Example – Programming Languages



Graphical Visualisation: Example – PHP Co-occurring Clusters



Graphical Visualisation: Example – PHP Co-occurring Skills



programming languages	
• PHP	
└─ JavaScript	0.49
— MySQL	0.32
– use markup languages	0.26
- CSS	0.25
— Sass	0.18
– JSSS	0.12
└- style sheet languages	0.11
web development and design	
– web programming	0.58
 implement front-end website design 	0.19
L AJAX	0.13
–• software	
— Drupal	0.54
 JavaScript Framework 	0.41
— WordPress	0.22
tools for software configuration management	0.16
– Ajax Framework	0.12
└─ Joomla	0.11

Summary

- Developed methodology for creating alternative skills hierarchy
- Designed top level hierarchy and restructured hierarchical relations for 5,000 skill concepts based on established taxonomic guidelines
- Test with co-occurrence links provided additional relations between skills from the same and different clusters
- Apply methodology to all ESCO skill concepts
- Extend co-occurrence test to full scale analysis on 100+ million records



Thank you!

The ESCO Secretariat is always available to support implementers.

May you have any question, please contact us via email at <u>EMPL-ESCO-SECRETARIAT@ec.europa.eu</u>, use our hashtag #ESCO_EU.

