ESCO v1.1 launch event
The use of artificial intelligence in updating ESCO
10 February 2022

Using machine learning to continuously update ESCO

Work done for ESCO v1.1

Future versions of ESCO

Related data science activities

Synergies with other projects

European Commission

Work done for ESCO v1.1

Detect potentially duplicate skills

- Avoid skills with identical meaning in ESCO

Identify relation between skills and occupations

- Avoid ESCO orphan skills, i.e. skills not linked to any ESCO occupation

Identify relationships between skills

- Link new transversal skills to non-transversal skills

Labelling green skills and knowledge concepts

- Develop a ML classifier to distinguish green and non-green concepts

European Commission

Detect potentially duplicate skills

Goal: avoid skills with identical meaning in ESCO

Methodology: machine learning (ML) model to detect duplicate skills in the classification

1. Input: single ESCO skill
2. Output: ranked ESCO skills based on the **semantic similarity score**
3. Filter the highest scores and **manually validate** the result: one person validates, another person reviews. Further discussion and a third validator in case of disagreement.
4. Remove duplicates and consider the output skill as **obsolete**

Input Preferred Term	Input Description	ML Score	Output Preferred Term	Output Description
Accept criticism and guidance	Handle negative feedback from others and react openly to criticism, trying to identify in it potential areas for improvement.	0,97	Accept constructive criticism	React to valid and well-reasoned opinions about one's work in a positive manner.
		0,92	Demonstrate enthusiasm	Display great effort driven by an interest or enjoyment in work itself, in the absence of external pressures.
		0,92	Demonstrate consideration	Act in an understanding and supportive manner that is sensitive to others' needs and feelings.

Identify relations between skills and occupations

Goal: avoid orphan ESCO skills, i.e. skills not linked to any ESCO occupation

Methodology: analyse relation between ESCO skills and occupations in online vacancies, support by ML model

1. Dataset with **relations between skills and occupations** from the EURES platform (i.e. ESCO skills and ESCO occupation within the same job vacancy)
2. Set orphan skill as input and rank occupations based on their **frequency in the EURES vacancies & semantic similarity score**
3. Filter the highest frequencies and scores and **manually validate** the result: one person validates, one person reviews. Further discussion and a third validator in case of disagreement. Take in consideration other skills linked to the suggested occupations.
4. **Link the orphan skill** to the occupation

Input Preferred Term	Input Description	ML Score	Output Preferred Term	Frequency (#vacancies)
Implement a firewall	Download, install and update a network security system designed to prevent unauthorized access to a private network.	0,78	ICT network administrator	297
		0,73	ICT network architect	267
		0,61	Radio technician	1

European Commission

Identify relations between skills

Goal: link new transversal skills to non-transversal skills

Methodology: analyse existing relations between ESCO skills and use ML model to detect appropriate matches with non-transversal skills

1. Build a **ML model trained on existing relationships** between ESCO skills
2. Set one new transversal skill as input, rank non-transversal skills based on the ML results and additional set of rules (e.g. existing relationships with other skills, etc.)
3. Filter the highest scores and **manually validate** the result: one person validates, one person reviews. Further discussion and a third validator in case of disagreement.
4. **Link the transversal skills** to non-transversal skills

Input Preferred Term	Input Description	ML Score	Output Preferred Term	Output Description
Participate actively in civic life	Actively engage in activities for the common or public interest such as civic, community or neighbourhood initiatives, volunteering opportunities and non-governmental organisations.	0,99	Raise awareness on local community's priorities	Intervene and implement programs or activities that raise awareness of issues relevant for the respective local community, such as social or economic inequality, gender issues, violence, and drug abuse.
		0,98	Promote inclusion in organisations	Promote diversity and equal treatment of genders, ethnicities and minority groups in organisations in order to prevent discrimination and ensure inclusion and a positive environment.
		0,98	Perform street interventions in social work	Conduct outreach activities by providing direct information or counselling services to individuals in their neighbourhood or in the streets, usually targeted at youth or homeless people.

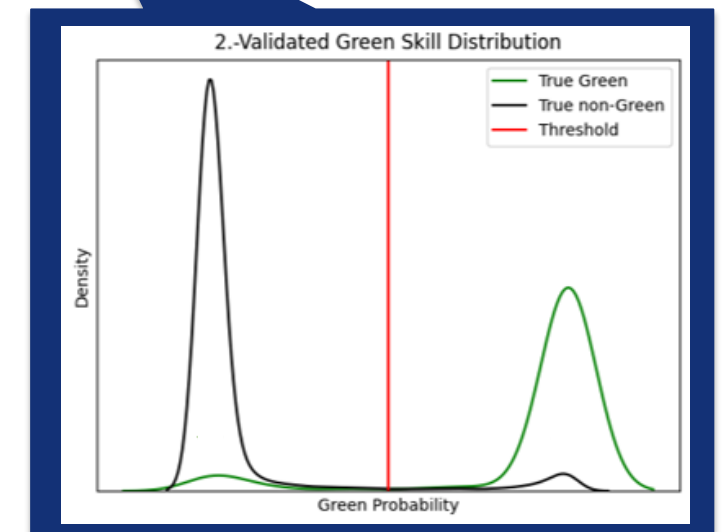# Labelling green ESCO skills and knowledge concepts

STEP 1
Manual labelling

STEP 2
Machine learning classifier

STEP 3
Comparison and manual validation

The knowledge, abilities, values and attitudes needed to live in, develop and support a society which reduces the impact of human activity on the environment (Cedefop, 2012).

The training data is composed of text that describes activities considered as environmentally sustainable, polluting, or none of the two by official classifications, job vacancies, European or national legislation, and reports.

2.-Validated Green Skill Distribution

True Green
True non-Green
Threshold

Density

Green Probability

Work planned for future versions of ESCO

Identify potential NPTs for new occupations

- Enrich ESCO occupations with alternative labels that are used in the labour market

Improve the allocation of ESCO occupations in the hierarchy

- Quantify relations between occupations and compare with current ISCO mapping

Detect quality issues

- Conduct more advanced work to ensure correctness and representativeness of ESCO

Support experts comparing their suggestions to existing ESCO concepts

- Set up a collaborative environment to avoid the proposal of duplicates

European Commission

Identify potential NPTs for new occupations

Goal: enrich ESCO occupations with alternative labels used in the labour market

Methodology: collect job titles from online vacancies and use ML model to detect similarities with ESCO occupations

1. Dataset of **job titles** from the EURES platform ([European cooperation network of employment services](#))
2. Set new occupation as input and rank EURES job titles based on **semantic similarity** score
3. Filter EURES job titles already suggested by experts
4. Filter the highest scores and **manually validate** the result: one person validates, one person reviews. Further discussion and a third validator in case of disagreement.
5. Include the job titles as **alternative labels** for the new ESCO occupation

Input Preferred Term	Input Description	ML Score	Output Preferred Term	Suggested by experts?
Mobility services manager	Mobility services managers are responsible for the strategic development and implementation of programs that promote sustainable and interconnected mobility options, reduce mobility costs and meet the transportation needs of customers, employees and the community as a whole such as bike sharing, e-scooter sharing, carsharing and ride hailing and parking management. […]	0,95	Mobility manager	YES
		0,82	Mobility program coordinator	NO
		0,81	Campus mobility planning manager	NO

European Commission

Improve the allocation of ESCO occupations in the hierarchy
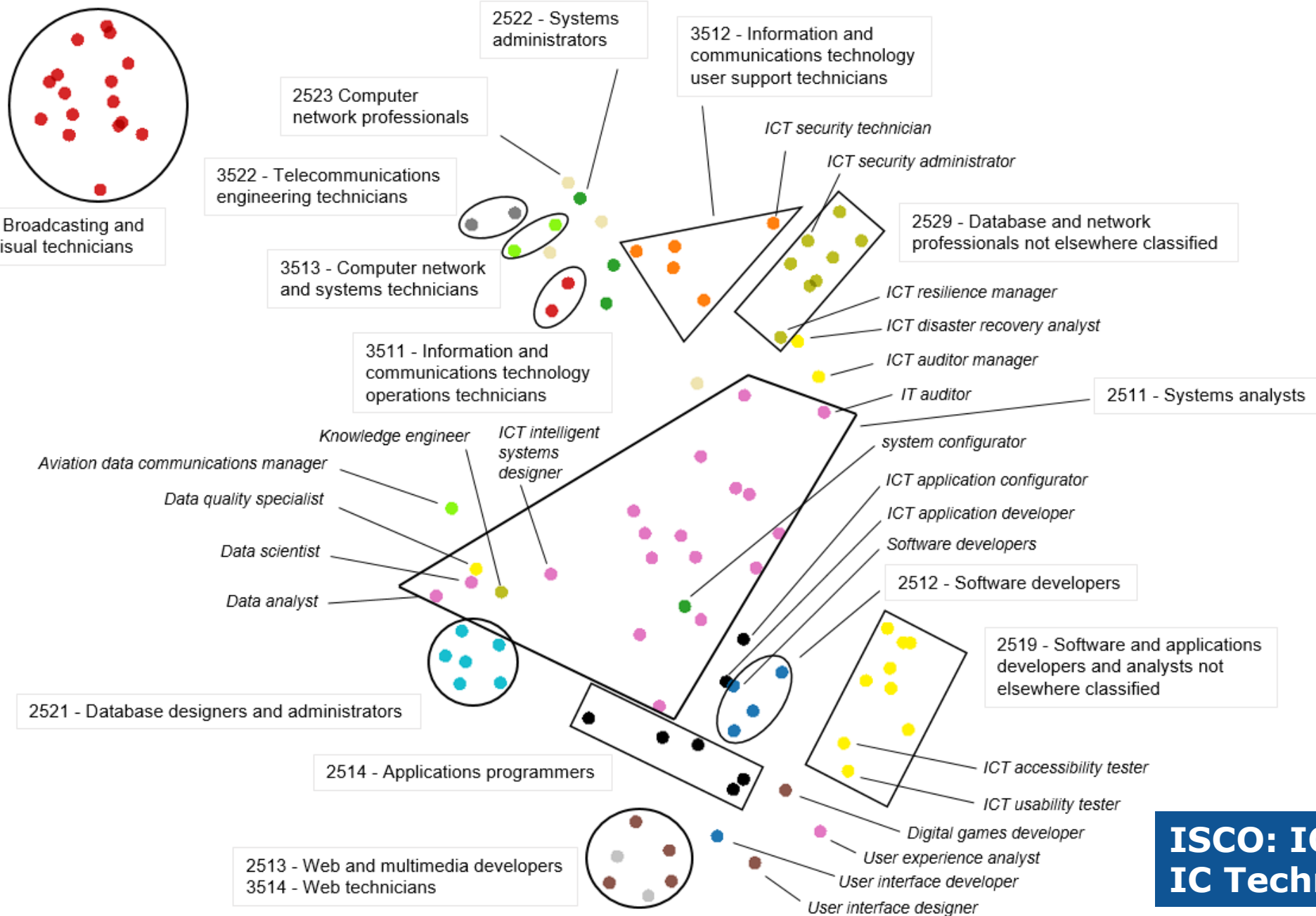
Unit Group	Intra-cluster Dispersion	Inter-cluster Distance
2511	**0.158**	**0.072**
2512	0.043	0.159
2513	**0.124**	**0.106**
2514	0.114	0.110
2519	**0.120**	**0.122**
2521	0.025	0.199
2522	0.068	0.152
2523	0.081	0.153
2529	*0.101*	*0.150*
3511	0.016	0.216
3512	**0.122**	**0.117**
3513	**0.138**	**0.101**
3514	0.019	0.194
3521	**0.116**	**0.213**
3522	0.032	0.215

ISCO: ICT Professionals/ IC Technicians Space

Detect Quality Issues

Representativeness of job titles

- Ensure the inclusion of terms (e.g. job titles and alternative labels) that are used in the real world

Create or test clusters

- Identify similar occupations and investigate whether they are grouped properly

ICT intelligent systems designer

Discuss this topic in the Online Forum 💬

Code
2511.10

Description

ICT intelligent systems designers apply methods of artificial intelligence in engineering, robotics and computer science to design programs which simulate intelligence including thinking models, cognitive and knowledge-based systems, problem solving, and decision making. They also integrate structured knowledge into computer systems (ontologies, knowledge bases) in order to solve complex problems normally requiring a high level of human expertise or artificial intelligence methods.

Scope notes

Excludes people performing managerial activities.

Alternative label

AI system designer
linked data engineer, intelligent systems developer
semantic technologies engineer
designer of intelligent systems
machine learning systems designer
intelligent systems engineer
intelligent system designer
intelligent systems designers
artificial intelligence designer

FREQUENCY IN ONLINE JOB VACANCIES	
ICT intelligent systems designer	0
AI system designer	0
artificial intelligence designer	6

```
>>> _ = listClosestTerms(nearestGslTermPredictor, 50, 'AI system designe
r; artificial intelligence designer; machine learning systems designer;
linked data engineer; semantic technologies engineer; intelligent system
s engineer; intelligent
system designer; intelligent systems designers; intelligent systems deve
loper; designer of intelligent systems')
0.9841111157403566      machine learning researcher
0.9783286728602151      machine learning lead
0.9777773160659856      machine learning team lead
0.9773717894470939      data scientist - machine learning
0.9769597542242552      ai researcher - explainable ai (xai) - associate
0.962509922402417       artificial intelligence, manager - applied artif
0.9585450367401241      principal ai / ml strategist
```

2511.3 - Data scientist
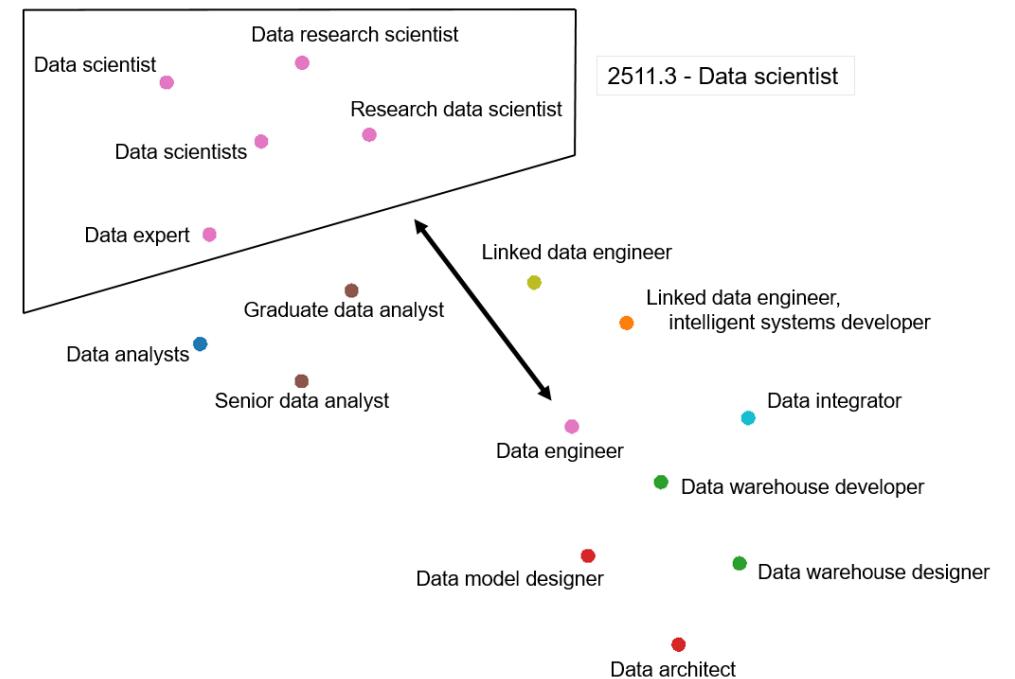
Support experts comparing external sources to existing ESCO concepts

Goal: assist experts providing tailored feedback to improve ESCO by comparing their suggestions with existing ESCO concepts

Methodology: use a ML model to match external sources such as descriptions of tasks in one occupation to the ESCO classification

1. Set one description as input and rank ESCO skills based on the **semantic similarity score**
2. Filter the highest scores and have experts or ESCO team **manually validate** result. Validations are reviewed and discussed.
3. Distinguish existing concepts from potentially new concepts
4. Potential starting point to create a new concept

Input Description	ML Score	Output Preferred Term
Determine energy saving potential regarding human behaviour	0,98	Analyse energy consumption
	0,97	Conduct energy audit
	0,96	Develop energy saving concepts

European Commission

Related data science activities

Link learning outcomes to ESCO skills

- Map the description of learning outcomes from qualifications to ESCO

Build an ESCO-O*NET cross-walk

- Link the European and U.S. occupation classifications

Provide supporting materials and visual tools

- Offer additional insights and visualisations of ESCO

European Commission

Link learning outcomes to ESCO skills

Build an ESCO-O*NET cross-walk (Occupations)

Machine learning
- 200 O*NET to ESCO occupations
- #10 suggestions

Human labelling
- Select among 6 labels
- 12 working days

Quality assurance
- Validation and discussion
- ± 2 working days

Machine learning
- 79 O*NET to ISCO occupations
- #5 suggestions

Human labelling
- Select among 2 labels
- ± 2 working days

Quality assurance
- Validation and discussion
- >1 working day
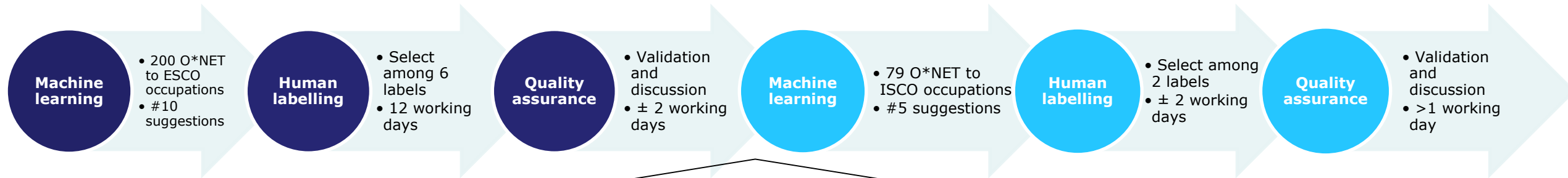
	3262		f_x	Foreign Language and Literature Teachers, Postsecondary									
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Id	ONET title	ONET description	ESCO concept match score	ESCO concept PT	ESCO concept ISCO	Past mapping	ESCO concept URI	Exact Match	Onet NARROWER than esco	Onet BROADER than esco	Close Match	Relat	Wrong Match
52	19-403:	Chemical Technicians	Conduct chemical and physical laboratory tests	0.9517837(	chemistry technician	3111	[3111]	http://data.eur	x					
53	19-403:	Chemical Technicians	to assist scientists in making qualitative and	0.9367534	chemical engineering technic	3116	[3111]	http://data.eur					x	
54	19-403:	Chemical Technicians	quantitative analyses of solids, liquids, and	0.9364157(	chemical tester	2113	[3111]	http://data.eur					x	
55	19-403:	Chemical Technicians	gaseous materials for research and	0.9248056:	analytical chemist	2113	[3111]	http://data.eur					x	
56	19-403:	Chemical Technicians	development of new products or processes,	0.9146203(	chemical application specialis	2113	[3111]	http://data.eur						x
57	19-403:	Chemical Technicians	quality control, maintenance of environmental	0.9136518:	chemist	2113	[3111]	http://data.eur					x	
58	19-403:	Chemical Technicians	standards, and other work involving	0.9078607	scientific laboratory technicia	3141	[3111]	http://data.eur		x				
59	19-403:	Chemical Technicians	experimental, theoretical, or practical	0.9051017(	biochemistry technician	3141	[3111]	http://data.eur			x			
60	19-403:	Chemical Technicians		0.8938918:	chemical manufacturing qual	3116	[3111]	http://data.eur			x			

European Commission

Provide supporting materials and visual tools

Skill – occupation matrix tables
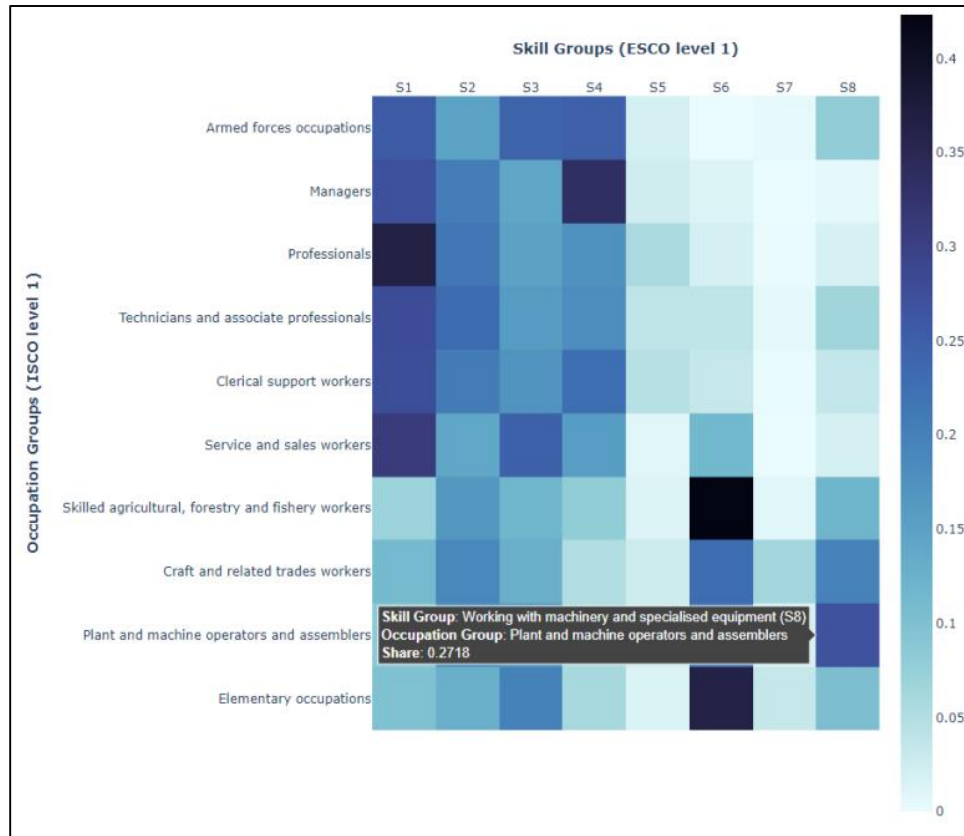
Occupation embedding space
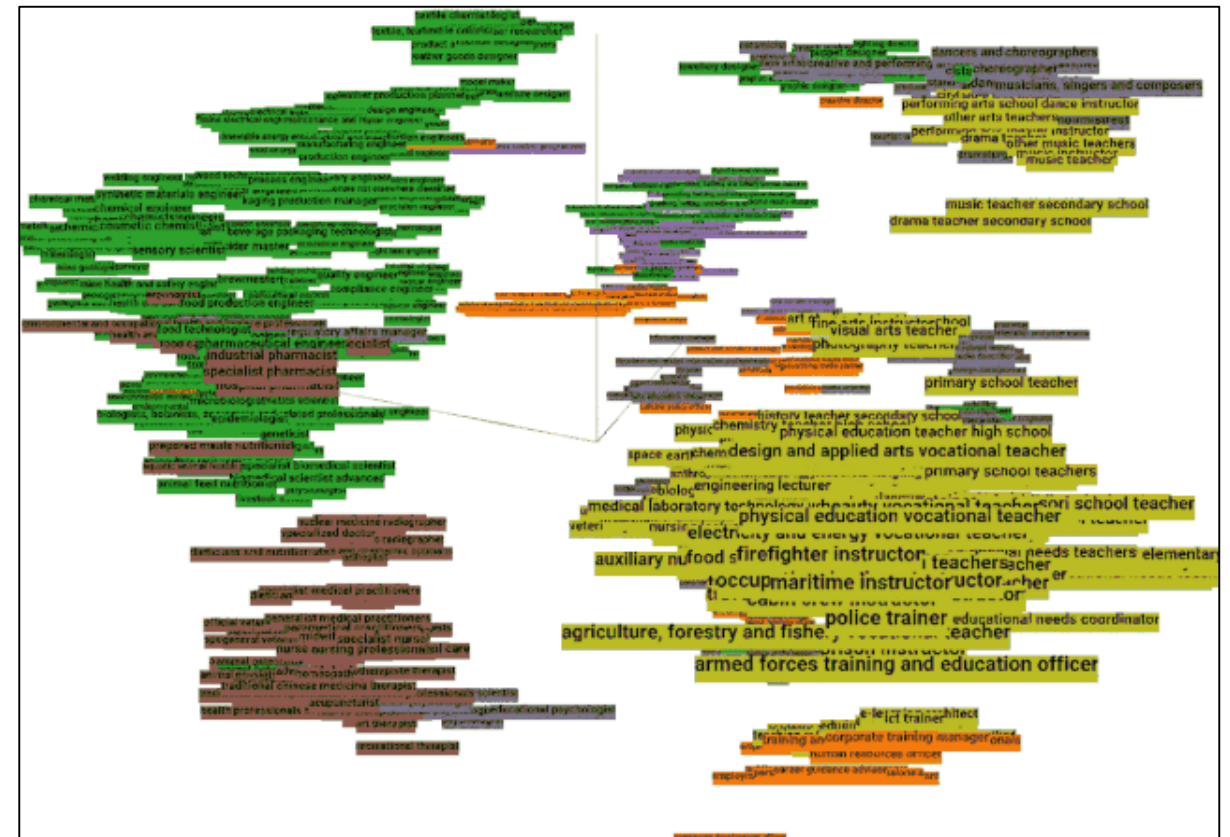
Synergies with other projects

EURES

- European cooperation network of employment services, designed to facilitate the free movement of workers

Member State mapping tables

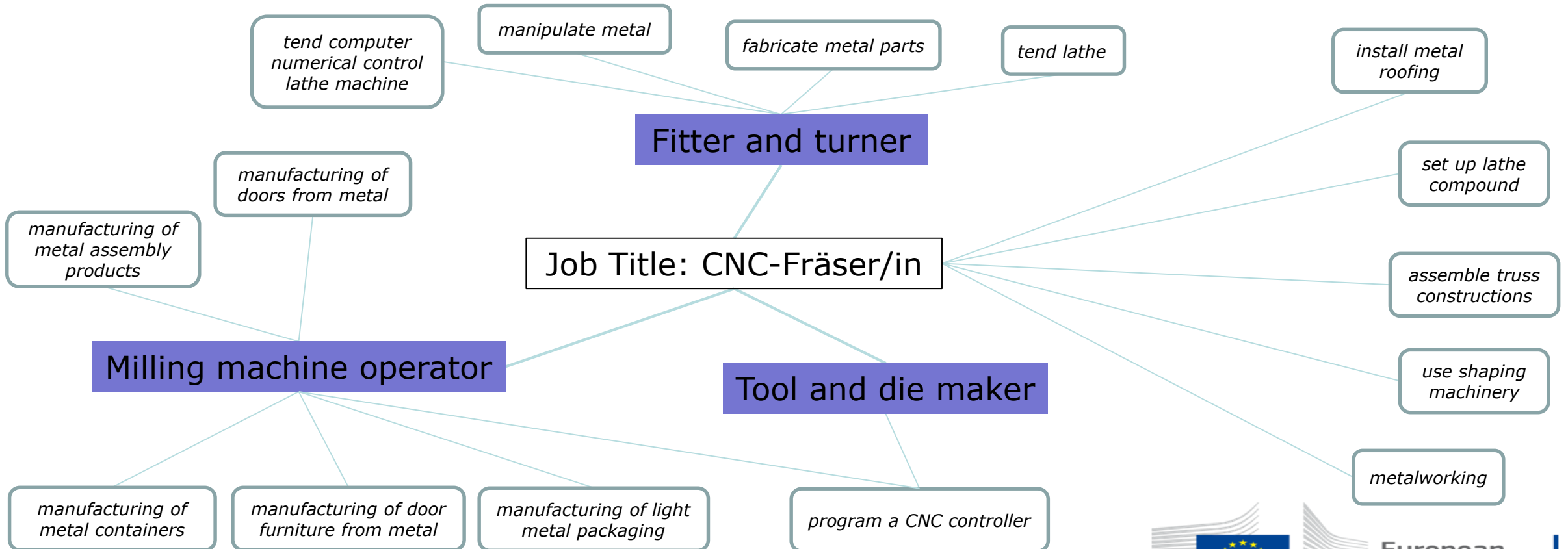- Creating a correspondence table between national classifications and ESCO

Europass

- Platform with free set of online tools and information that helps users to manage every step of their learning and career

European Commission

EURES

Feedback on ESCO on a European scale from online job vacancies

We are a medium-sized metal construction company and **manufacture individual items, prototypes, tools and devices**. In July 2021 we will move into new company premises (easily accessible by public transport) and continue to expand our offer for our customers. To do this, we definitely need reinforcement in the team now. We are looking for you as a **CNC milling cutter**. Your task is to **manufacture individual pieces, prototypes, tools and devices using CNC milling**. The operation and **programming of our Heidenhain or Siemens controlled machines** is the focus of your **independent, responsible work**. The prerequisite is a completed vocational training in the **machining** sector or as a **tool mechanic** and thus initial basic experience in **programming CNC machines**. We are also happy to give career starters a chance. Basic knowledge: **metal construction**, **metalworking**, **turning**. Advanced knowledge: **CNC knowledge**, **CNC programming**, **milling**

tend computer numerical control lathe machine

manipulate metal

fabricate metal parts

tend lathe

install metal roofing

Fitter and turner

manufacturing of doors from metal

set up lathe compound

manufacturing of metal assembly products

Job Title: CNC-Fräser/in

assemble truss constructions

Milling machine operator

Tool and die maker

use shaping machinery

manufacturing of metal containers

manufacturing of door furniture from metal

manufacturing of light metal packaging

program a CNC controller

metalworking

Member State mapping tables

Connecting national classifications with ESCO

1	http://data.europa.eu/esco/occupation/bf89925d-00a1-4f94-ab3b-2148c887af33	detailhandelaar	Bedrijfsleider / ondernemer verkoop gedenkstenen	skos:narrowMatch
2	http://data.europa.eu/esco/occupation/d5eb6150-bbff-4a9c-9d0c-21eab4dbe2b6	restaurantmanager	Manager cateringbedrijf	skos:narrowMatch
3	http://data.europa.eu/esco/occupation/cb3b2662-774a-4e6f-841e-f120244d7031	sergeant	Onderofficier logistieke dienst verzorging (ldv) koninklijke marine	skos:broadMatch
4	http://data.europa.eu/esco/occupation/a79d9e58-36be-4e67-a4db-ea6c8ff445fc	afdelingsmanager detailhandel	Afdelingsmanager verkoop herenkleding	skos:narrowMatch
5	http://data.europa.eu/esco/occupation/8ec8df02-e9dd-43b7-b416-5846ae0414ab	vastgoedmakelaar	Verhuurmedewerker woondiensten	skos:narrowMatch
6	http://data.europa.eu/esco/occupation/664f7498-8e4b-48f8-9fe2-436a692f1204	manager detailhandel muur- en vloerbekleding	Afdelingsmanager verkoop woningtextiel en vloerbedekkingen	skos:narrowMatch
7	http://data.europa.eu/esco/occupation/810e5e67-acd5-499a-b307-cf5bea330859	ict information manager	Hoofd informatievoorziening en automatisering	skos:exactMatch
8	http://data.europa.eu/esco/occupation/d792974a-077b-44a7-9421-b3ab7fdc7c40	operator persmachine	CNC-forceur	skos:broadMatch
9	http://data.europa.eu/esco/occupation/9e81adde-9983-44fa-b74b-c548d0dbfbdd	winkelmanager	Bedrijfsleider / ondernemer verkoop parket en laminaat	skos:closeMatch
10	http://data.europa.eu/esco/occupation/544cd9cf-e2ee-4ac0-8a02-7147af6b97d7	manager bedrijfseenheid	Algemeen directeur	skos:broadMatch
11	http://data.europa.eu/esco/occupation/cb3b2662-774a-4e6f-841e-f120244d7031	sergeant	Marechaussee	skos:narrowMatch
12	http://data.europa.eu/esco/occupation/aa9c6416-6a17-4e2f-a7c4-6d47c205d480	verkoopspecialist zorgartikelen en -hulpmiddelen	Verkoopspecialist zorgartikelen en -hulpmiddelen	skos:exactMatch
13	http://data.europa.eu/esco/occupation/0a5356bc-7f81-4e40-971d-c1dc789c5fb4	nanny	Kinderoppas particulieren	skos:exactMatch
14	http://data.europa.eu/esco/occupation/731ecac4-06e8-4ec2-a559-101fecbd9183	medewerker huishoudelijke dienst	Huishoudelijk medewerker (hotel, instelling)	skos:broadMatch
15	http://data.europa.eu/esco/occupation/3cc87d40-f402-4f57-9353-4b36a031cfc5	verhuurmedewerker autoverhuurbedrijf	Verhuurmedewerker autoverhuurbedrijf	skos:exactMatch
16	http://data.europa.eu/esco/occupation/0368c4d4-94cf-4168-a84d-283a25880e0d	manager metaalproductie	Manager metaalbewerkingsbedrijf / constructiebedrijf	skos:narrowMatch
17	http://data.europa.eu/esco/occupation/771955d9-e988-47f3-b60f-207adb2cd571	manager recreatie-accommodatie	Manager recreatie-accommodatie	skos:narrowMatch
18	http://data.europa.eu/esco/occupation/a9068f84-cecd-4cbb-9acb-e20c714435ec	betonafwerker	Betonreparateur	skos:narrowMatch
19	http://data.europa.eu/esco/occupation/c6a26e11-bdf1-47a1-849d-fdcf819d458d	officier	Officier vlieger en loadmaster koninklijke luchtmacht	skos:broadMatch
20	http://data.europa.eu/esco/occupation/c6e5e0e7-fa99-4f71-9fc1-9889d85282a5	generaal	Marechaussee	skos:narrowMatch
21	http://data.europa.eu/esco/occupation/0ab64770-9fd7-4baf-8abf-b1ac0e1538ba	bediener hydraulische smeedpers	Metaalperser	skos:narrowMatch
22	http://data.europa.eu/esco/occupation/9ba74e8a-c40c-4228-9998-eb3c7a5c11df	verkoopmedewerker	Verkoopmedewerker boeken, tijdschriften en kantoorartikelen	skos:narrowMatch
23	http://data.europa.eu/esco/isco/C1323	Leidinggevende functies in de bouwnijverheid	Bedrijfsleider / ondernemer kabel- en leidinginfra	skos:narrowMatch
24	http://data.europa.eu/esco/occupation/e9cf8b24-6b8b-47cc-9dd3-b601aa135960	functionaris van een belangengroep	Bestuurder sportbond	skos:narrowMatch
25	http://data.europa.eu/esco/occupation/02d4f153-8e43-444d-8bd4-8171d49eab12	werktuigkundige aandrijvingen	CNC-draaier (inclusief programmeren)	skos:broadMatch
26	http://data.europa.eu/esco/occupation/bbd1fe06-1b55-4937-9317-fc162311ab38	brigadegeneraal	Marechaussee	skos:narrowMatch
27	http://data.europa.eu/esco/occupation/985400a7-362f-4f91-941a-2e149d94ac2a	biersommelier	Medewerker bediening horeca (luxe restaurant)	skos:broadMatch
28	http://data.europa.eu/esco/occupation/068c2787-58ff-468e-bbb6-c4e5dd6ee482	raadgevend actuaris	Actuaris	skos:exactMatch
29	http://data.europa.eu/esco/occupation/94e0bedd-e56e-42be-a5a4-b74a260f437c	afdelingsmanager	Afdelingsmanager verkoop elektrotechnische artikelen en apparaten	skos:narrowMatch
30	http://data.europa.eu/esco/occupation/6e8917c8-d883-4475-954c-ec241215ca18	manager fotowinkel	Bedrijfsleider / ondernemer verkoop fotografische artikelen	skos:exactMatch
31	http://data.europa.eu/esco/occupation/6426ada1-4d8c-4612-99e3-91bc569805ee	productiemanager	Chef textielindustrie	skos:narrowMatch
32	http://data.europa.eu/esco/occupation/5779aa3b-b32f-42f7-9581-ef5ce2092621	verkoopmanager vlees en vleeswaren	Bedrijfsleider / ondernemer verkoop vlees en vleeswaren	skos:exactMatch
33	http://data.europa.eu/esco/occupation/64e38ce7-3901-4261-bfee-77c7a77397f2	beleidsverantwoordelijke	Manager organisatieadviesbureau	skos:narrowMatch

Europass

Feedback on ESCO on a European scale from millions of 'experts'

Thank you!

The ESCO Secretariat is always available to support implementers.
May you have any question, please contact us via email at EMPL-ESCO-SECRETARIAT@ec.europa.eu, use our hashtag #ESCO_EU and join our online forum.