



TRAILS

**Enabling Data Analytics for Actions
Tackling Skills Shortages & Mismatch**

When Jobs Change: Skills Mismatch and the Value of Training

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Paul Redmond, Lorcan Kelly, Luke Brosnan ESRI
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Changing Skills and Skills Mismatch

- Every job requires a specific set of skills
- These skills can change over time
- Different events and time periods may see an accelerated rate of change
 - E.g., COVID-19, technological change, AI, remote working
- When skill requirements change, skills mismatch may occur



What we do...

- We link data on 70 million job vacancies with EU employee survey data to:
 1. Identify jobs that experienced rapid skill change in recent years
 2. Investigate whether changing skill requirements are associated with skills mismatch
 3. Examine whether training can mitigate negative impacts associated with rapidly changing skill requirements
 4. Make our constructed dataset on occupational skill change freely available for future research in this area

Why is this important?

- Digital technologies are evolving rapidly, requiring workers and firms to continuously acquire new skills (Ciarli et al., 2021)
- If training is not sufficient, workers and firms face skills mismatch and sub-optimal productivity (Georgiadis and Pitelis, 2016)
- Skills mismatch has negative consequences for both employers and employees (Kampelmann and Rycx, 2012; Kampelmann et al., 2020; Sánchez-Sánchez and McGuinness, 2015; Vieira, 2005)
- Existing work often points to labour market frictions as an explanation for skills mismatch. But a changing skills environment may also be important

The Data (I)

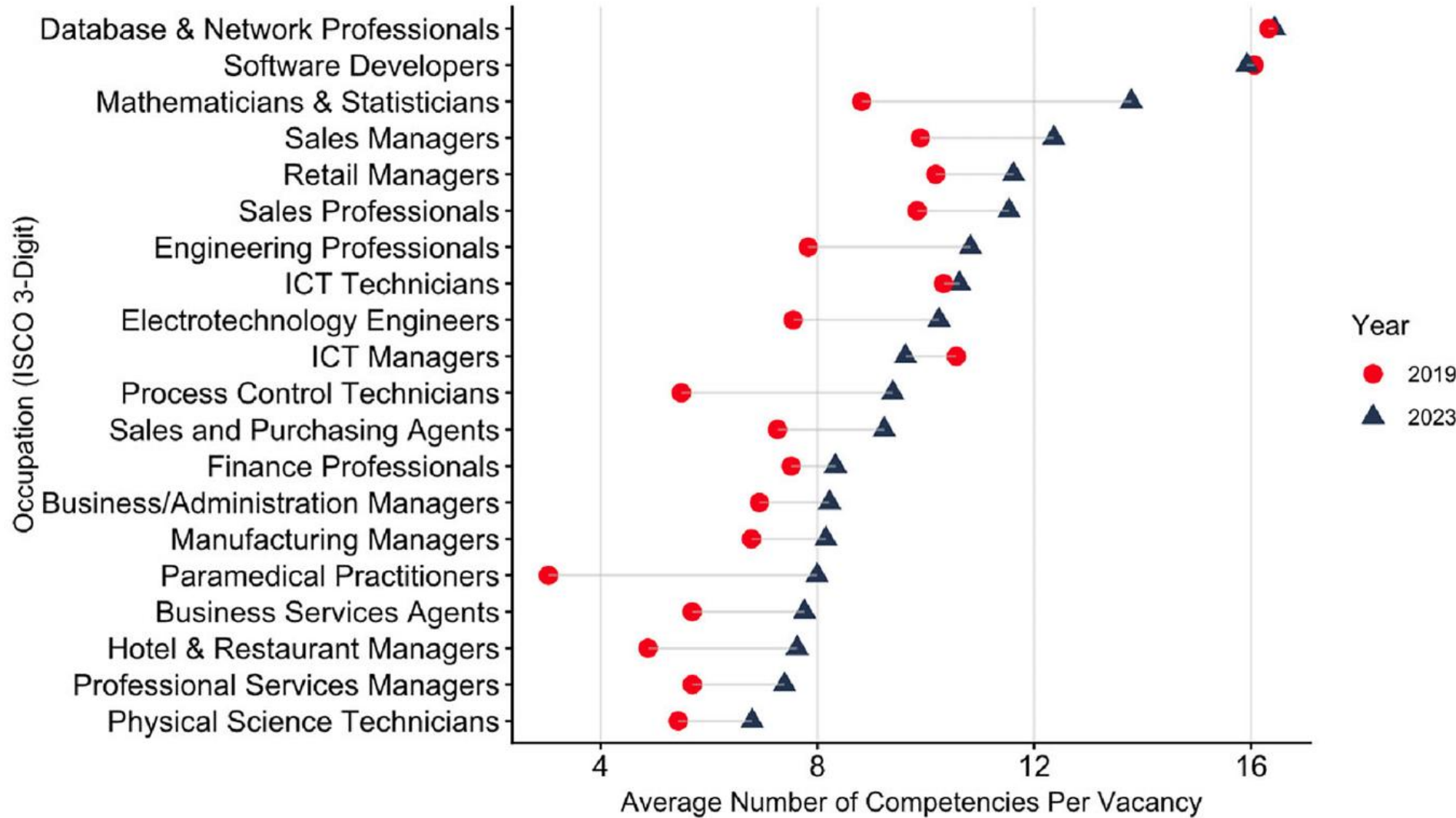
- **Lightcast Data:** 70 million online job vacancies from the EU-27 (+UK)
- Data on approximately 3,000 skills
- Compare skill requirements at the country-occupation level in 2023 to 2019



TABLE 1 | Top 20 'hard skills' in 2019 and 2023.

Rank	2019	%Vacancies	2023	%Vacancies
	Skill		Skill	
#1	have computer literacy	36.05	have computer literacy	33.84
#2	use microsoft office	22.96	use microsoft office	20.95
#3	problem solving	16.30	think proactively	18.69
#4	customer service	14.64	problem solving	16.18
#5	think proactively	14.47	communication	15.04
#6	office software	14.23	use office systems	14.65
#7	communication	13.37	customer service	13.17
#8	project management	12.69	office software	12.98
#9	use office systems	12.69	brainstorm ideas	12.46
#10	use spreadsheets software	10.19	project management	10.91
#11	communication/collaboration software	8.65	quality standards	10.62
#12	computer programming	7.94	use spreadsheets software	9.88
#13	brainstorm ideas	7.82	tolerate stress	8.22
#14	quality standards	7.71	think analytically	7.73
#15	excel	7.56	database	7.72
#16	office administration	7.32	proactivity	7.41
#17	sales activities	6.78	develop animations	7.06
#18	economics	6.05	customer relationship management	6.52
#19	business ICT systems	5.99	sales strategies	6.35
#20	sales strategies	5.84	office administration	6.19

Source: Lightcast Job Advertisement data. Authors' calculations.



- Based on a measure of occupational skill change used by Deming and Noray (2020) and Acemoglu and Restrepo (2022)
- Using the Lightcast job vacancy data...
- $SkillChange_{o,c} = \sum_{s=1}^S \left\{ \text{Abs} \left[\left(\frac{Skill_{o,c}^s}{Vacancies_{o,c}} \right)_{2023} - \left(\frac{Skill_{o,c}^s}{Vacancies_{o,c}} \right)_{2019} \right] \right\}$

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- An example....
 - 100 Software Develop vacancies in 2019 and 200 vacancies in 2023
 - Python required in 25 vacancies in 2019 and 150 in 2023
 - Skill change value of $|0.25 - 0.75| = 0.50$
 - Repeat the process for all S skills in occupation o in country c

ISCO 3-digit category	Country	SkillChange
Highest values of SkillChange		
Paramedical practitioners	The United Kingdom	22.25
Veterinary technicians and assistants	The United Kingdom	17.70
Software and applications developers and analysts	Bulgaria	17.37
Legislators and senior officials	Ireland	17.00
Database and network professionals	Greece	16.61
Legislators and senior officials	The United Kingdom	16.23
Engineering professionals	Cyprus	15.77
Database and network professionals	Bulgaria	15.42
Mathematicians, actuaries and statisticians	Portugal	15.16
Mining and mineral processing plant operators	The United Kingdom	14.90
Mining and mineral processing plant operators	Ireland	14.68
Database and network professionals	Portugal	14.23
Software and applications developers and analysts	Cyprus	14.16
Refuse workers	Croatia	13.98
Database and network professionals	Spain	13.69
Mathematicians, actuaries and statisticians	Romania	13.62
Mixed crop and animal producers	The United Kingdom	13.50
Wood processing and papermaking plant operators	Croatia	13.38
Database and network professionals	Estonia	13.29
Mathematicians, actuaries and statisticians	Poland	13.20

Lowest values of SkillChange

Agricultural, forestry and fishery labourers	Estonia	0.00
Rubber, plastic and paper products machine operators	Lithuania	0.16
Heavy truck and bus drivers	Slovakia	0.19
Transport and storage labourers	Slovakia	0.26
Building frame and related trades workers	Estonia	0.26
Domestic, hotel and office cleaners and helpers	Estonia	0.32
Transport and storage labourers	Finland	0.37
Domestic, hotel and office cleaners and helpers	Slovenia	0.37
Food and related products machine operators	Finland	0.39
Transport and storage labourers	Czechia	0.40
Heavy truck and bus drivers	Finland	0.41
Wood treaters, cabinet-makers and related trades workers	Austria	0.41
Mobile plant operators	Finland	0.42
Rubber, plastic and paper products machine operators	Czechia	0.48
Domestic, hotel and office cleaners and helpers	Denmark	0.55
Medical doctors	Slovenia	0.55
Transport and storage labourers	Lithuania	0.56
Transport and storage labourers	Latvia	0.58
Car, van and motorcycle drivers	Finland	0.59
Domestic, hotel and office cleaners and helpers	Austria	0.60

Source: Lightcast, authors' calculations.

- **European Skills and Jobs Survey (Second Wave – 2021)**
- Data on approximately 40,000 EU employees
- Administered by Cedefop
- Underskilled measured by,
 - *"...to what extent do you need to further develop your overall level of knowledge and skills to do your main job better?"*

TABLE 2 | Top 20 occupations with the highest rates of underskilling and overskilling (ESJS).

ISCO 3-digit category	Underskilled (%)
Medical doctors	79.3
Software and applications developers and analysts	77.5
Database and network professionals	77.1
Sales, marketing and public relations professionals	75.8
Primary school and early childhood teachers	75.7
Architects, planners, surveyors and designers	75.4
Librarians, archivists and curators	74.9
ICT service managers	74.6
Electrical equipment installers and repairers	74.5
Engineering professionals	73.8
Process control technicians	73.7
ICT operations and user support technicians	73.6
Managing directors and chief executives	72.9
Finance professionals	72.4
Sales, marketing and development managers	71.6
Life science professionals	71.2
Administration professionals	69.7
Secondary education teachers	69.5
Regulatory government associate professionals	69.3
Machinery mechanics and repairers	69.0



Mismatch & Changing Skills

- We examine the relationship between changing skill requirements and underskilling

$$\begin{aligned} &Pr(\text{Underskilled}_{i,o,c} = 1|X) \\ &= \Phi \left(\alpha + \delta \text{SkillChange}_{i,o,c} + Z'_{i,o,c} \beta_z + \sum_{\tau=2}^{28} \theta_{\tau} C_i^{\tau} \right) \quad (3) \end{aligned}$$

- Z is a vector of covariates including gender, sector, firm size, education level, part-time / full-time status and job tenure

Mismatch & Changing Skills

TABLE 4 | Skill change and skills mismatch (marginal effects).

Variables	(1) Underskilled	(2) Underskilled	(3) Underskilled	(4) Overskilled
SkillChange	0.013*** (0.001)	0.014*** (0.002)		
NetSkillChange			0.005** (0.002)	−0.006*** (0.002)

(1) Relationship between absolute value of skill change and being underskilled

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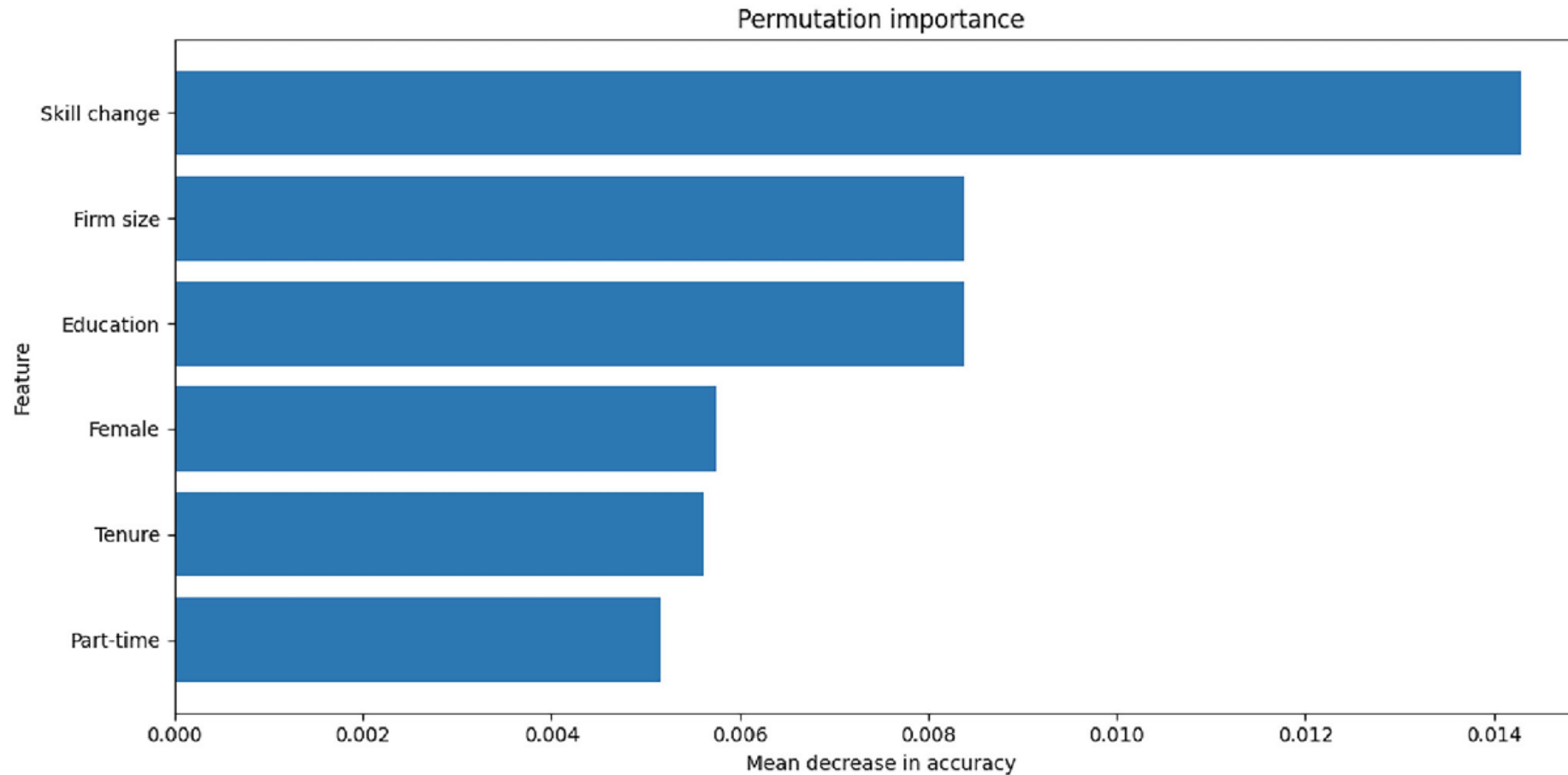
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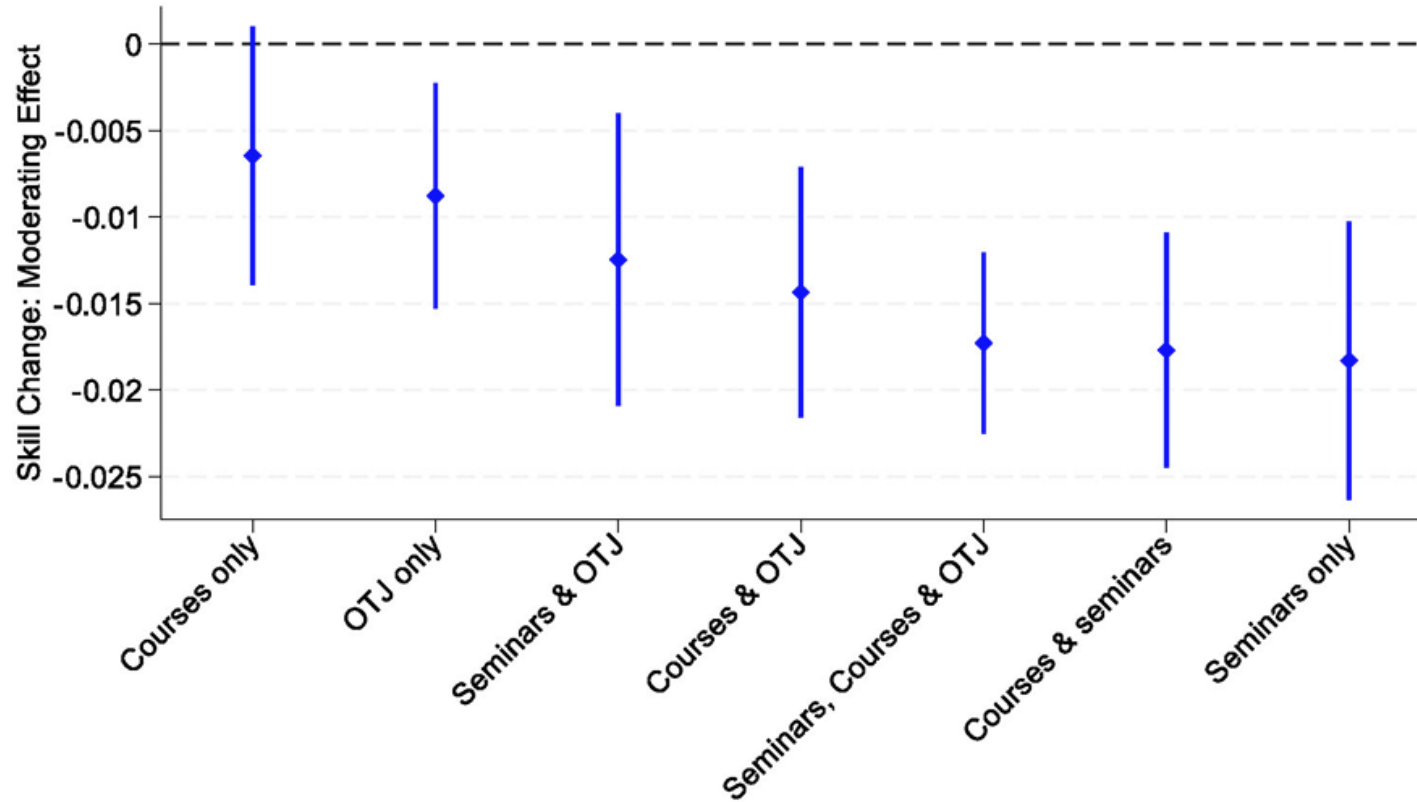
Mismatch & Changing Skills

Permutation importance from a random forest classifier



- In the last 12 months, have you participated in any of the following education or training activities to learn new job-related skills?
- Courses
- Workshops or seminars
- On the job training
- Not mutually exclusive

Moderating Effect of Training



- Effectiveness of seminars may reflect the changing nature of the work environment
- Flexible, manageable and shorter learning options are required to adapt to changing skills needs and respond to emerging skill requirements (Ngoc Ha et al., 2025 ; Prior Filipe et al. 2020).

Conclusion

- Skill requirements evolve over time
- Particularly in recent years (technological change, remote working, AI)
- We show that STEM-type jobs showed significant changes to skill requirements from 2019 to 2023
- This is associated with a higher likelihood of underskilling
- Training appears to mitigate these effects – particularly short, informal seminars
- Our measure of occupational skill change is freely available and should be useful for future research



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Contact us



Paul Redmond



trails-project.eu



paul.redmond@esri.ie



linkedin.com/company/trails-enabling-data-analytics-for-actions-tackling-skills-shortages-and-mismatch

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the European Union





Thank you



Major group	1 Managers
Sub-major group	11 Chief Executives, Senior Officials and Legislators
Minor group	111 Legislators and Senior Officials
Definition	Legislators and senior officials determine, formulate, advise on and direct the implementation of policies of national, state, regional or local governments or communities, and of special interest organizations. They make, ratify, amend or repeal laws, public rules and regulations and plan, organize, direct, control and evaluate the overall activities of government departments and agencies, traditional communities and special-interest organizations.
Tasks include	Tasks performed usually include: presiding over or participating in the proceedings of legislative bodies and administrative councils of governments, legislative assemblies, local communities and special-interest organizations; serving on government administrative boards or official committees; investigating matters of concern to the public and promoting the interests of constituents; formulating and advising on government policy, budgets, laws and regulations; establishing objectives for organizations and formulating or approving and evaluating programmes and policies and procedures for their implementation; recommending, reviewing, evaluating and approving documents, briefs and reports submitted; ensuring appropriate systems and procedures are developed and implemented to provide budgetary control; allocating the use of communal land and other resources; performing ceremonial duties and representing the government, organization or community at official occasions and in meetings, negotiations, conventions and public hearings.
Included occupations	Occupations in this minor group are classified into the following unit groups: 1111 Legislators 1112 Senior Government Officials 1113 Traditional Chiefs and Heads of Villages 1114 Senior Officials of Special-interest Organizations

- Overskilling –
- To what extent can you use your current knowledge and skills in your main job (small extent or not at all)
- In the last 12 months, have you participated in any of the following education or training activities to learn new job-related skills?
- Courses, workshops or seminars, on the job training

