D2.4. Report on the amalgamation of existing exposure assessment resources

An online inventory was set-up to collect meta-data on exposure assessment tools: https://occupationalexposuretools.net/inventory/. Occupational health researchers were invited to provide details on job-exposure matrices (JEMs), exposure databases, and occupational coding systems and their associated crosswalks, with a focus on Europe. As of May 2021, meta data have been collected on 39 JEMs, 9 national exposure databases, 24 occupational coding systems, and 3 crosswalks. This inventory forms the basis for a searchable web-based database, so that researchers can find the available tools for assessing occupational exposures in their cohort.

Content

Table 1. Metadata on the 39 Job-Exposure Matrices in OMEGA-NET inventory

JEM name	Occupational coding (Number of digits used)	Exposure metrics	Year JEM was developed	Agents	Data source(s)	Region	Key Reference
ALOHA+ JEM	ISCO 1988 (4)	Intensity:	2008	Dusts and Fibres Solvents Pesticides Metals and Metal Oxides Other Chemicals Other	Expert assessment	Developed European and North American countries	Skorge, et al. 2009. "Occupational Exposure and Incidence of Respiratory Disorders in a General Population." Scandinavian Journal of Work, Environment & Health 35 (6): 454–61. https://doi.org/10.5271/sjweh.1352.
Asbestos JEM	ISCO 1968 (4)	Intensity: semi-quantitative (0.01-0.5 fibers/m^3; 0.5-1; 1-2; 2-5; 5-10; 10 plus), Probability: proportion of exposed persons: 0-5%; 5-20%, 20-80%; 80-100%	2008	Dusts Fibres	Expert assessment Direct measurements	Europe (Netherlands)	Swust, et al. Linking expert judgement and long-term trends in occupational exposure into a job-exposure matrix for historical exposure to asbestos in The Netherlands. Ann Occup Hyg 2008;52:397-403.
AsbJEM	N/A	Intensity: quantitative (f/mL) Duration: month, Frequency: days/year, Peaks: 15 minutes	2015	Dusts Fibres	Expert assessment Direct measurements	Oceania (Australia)	van Oyen, et al. Development of a job-exposure matrix (AsbJEM) to estimate occupational exposure to asbestos in Australia. Ann Occ Hyg. 2015; 59(6):737-48
BEN-JEM	ISCO 1998 (4)	Intensity: quantitative (ppm), Probability: 0.01-0.5	2016	Solvents	Expert assessment Direct measurements	Europe and North America	Spycher, et al. 2017. "Parental Occupational Exposure to Benzene and the Risk of Childhood Cancer: A Census-Based Cohort Study." Environment International 108 (Supplement C): 84–91. https://doi.org/10.1016/j.envint.2017.07.022.
C19-JEM	ISCO 2008	Probability: none, low, elevated and high	2021	Biological Factors Employment conditions	Expert assessment	Europe	

CANJEM	ISCO 1968 SOC 2010 CITP 1968 NOC 2011 CCDO 1971 (6)	Intensity: semi-quantitative (Within a cell: proportion of workers unexposed and exposed at low/medium/high intensity + derived median quantitative time weighted average), Probability: direct probability, Frequency: <2 hours, [2-12[hours [12-40[hours and 40 hours out of a typical 40-hour workweek	2015	Dusts and Fibres Solvents Pesticides Metals and Metal Oxides Other Chemicals	Expert assessment	North America	Siemiatycki,, Lavoué. (2018) Availability of a New Job-Exposure Matrix (CANJEM) for Epidemiologic and Occupational Medicine Purposes. J Occup Environ Med. 2018 60(7):e324-e328. PMID:29642096 Sauvé, et al. (2018) Development of and Selected Performance Characteristics of CANJEM, a General Population Job-Exposure Matrix Based on Past Expert Assessments of Exposure. Annals of Work Exposures and Health 62(7):783-795. PMID:29897403
Cement production		Intensity: quantitative (mg/m^3), Duration: half a shift/shift/ year, Frequency: N per job type/year	2007-2011	Dusts Fibres	Direct measurements	Norway	Notø, et al. 2017. Job Tasks as Determinants of Thoracic Aerosol Exposure in the Cement Production Industry. Annals of Work Exposures and Health, 62(1), pp.88-100.
dBAR-JEM	ISCO 1988 (4)	Intensity:	2019	Physical Agents	Expert assessment Direct measurements	Denmark	Stokholm, et al. 2020. A Quantitative General Population Job Exposure Matrix for Occupational Noise Exposure. Annals of Work Exposures and Health, 64(6), pp.604-613.
DEE-JEM	ISCO 1968 (5)	Intensity: quantitative (µg/m^3), Probability: Assigned probabilities in the DEE-JEM consisted of	2019	Other Chemicals	Expert assessment Direct measurements	Europe and North America	Ge, et al. Diesel Engine Exhaust Exposure, Smoking, and Lung Cancer Subtype Risks. A Pooled Exposure-Response Analysis of 14 Case-Control Studies. Am J Respir Crit Care Med. 2020;202(3):402-411.

		one of three values in 0.1, 0.25, 0.5. A few ISCO-68 occupations at the 2- or 3-digit level received probabilities of 0.4 (n=3) and 0.6 (n=4) as median values of probabilities assigned to their respective 5-digit daughter occupations.					
DOM-JEM	ISCO 1968 (5)	Intensity:	2010	Dusts and Fibres Solvents Metals and Metal Oxides Other Chemicals Biological Factors	Expert assessment	Europe and North America	Peters, et al. Comparison of Exposure Assessment Methods for Occupational Carcinogens in a Multi-Centre Lung Cancer Case–Control Study. Occup. Environ. Med. 2011, 68 (2), 148–153.
ELF-JEM	ISCO 1968 ISCO 1988 (4)	Intensity: quantitative (μT)	2014	Physical Agents	Expert assessment Direct measurements	Europe and North America	Turner, et al. 2014. "Occupational Exposure to Extremely Low Frequency Magnetic Fields and Brain Tumour Risks in the INTEROCC Study." Cancer Epidemiology, Biomarkers & Prevention 23 (9): 1863–72.
FINJEM	ISCO 1958 (3)	Intensity: quantitative (several depending on agent), Probability: %, Frequency: frequency taken into account when assessing the base period 1960-84	1998	Dusts and Fibres Solvents Pesticides Metals and Metal Oxides Other Chemicals Biological Factors Physical Agents Ergonomics, Physical Workload, and Injury Related	Expert assessment Self-reported data Direct measurements	Finland	Kauppinen, et al. From cross-tabulations to multipurpose exposure information systems: a new job-exposure matrix. Am J Ind Med. 1998 Apr;33(4):409-17 Kauppinen, et al. Use of the Finnish Information System on Occupational Exposure (FINJEM) in epidemiologic, surveillance, and other applications. Ann Occup Hyg. 2014 Apr;58(3):380-96.

				Psychosocial Domains Organisation of Work including Working Time			
INTEROCC-JEM	ISCO 1968 ISCO 1988 (5)	Intensity: semi-quantitative (various), Probability: Yes	2010	Dusts and Fibres Solvents Metals and Metal Oxides Other Chemicals	Expert assessment Based on Finjem	Europe	van Tongeren, et al. Assessing Occupational Exposure to Chemicals in an International Epidemiological Study of Brain Tumours, Annals of Occupational Hygiene, 57:610–626
JEM-hospital workers	ISCO 1988 (4)	Intensity: semi-quantitative (1-4), Probability: 1-3, Duration: 1-4, Frequency:	2003	Biological Factors Physical Agents Ergonomics, Physical Workload, and Injury Related Psychosocial Domains Organisation of Work including Working Time	Expert assessment Self-reported data	Turkey	
JEM-Constances	ISCO 1988 (4)	Intensity:	2019	Ergonomics, Physical Workload, and Injury Related	Expert assessment Self-reported data	France	Yung, et al. Musculoskeletal symptoms associated with workplace physical exposures estimated by a job exposure matrix and by self-report. Am J Ind Med. 2019
LUXAR-JEM	ISCO 1988 (4)	Intensity: quantitative(lux), Peaks: lux	2019	Physical Agents	Expert assessment Direct measurements	Southern Scandinavia	Vested, et al. A Quantitative General Population Job Exposure Matrix for Occupational Daytime Light Exposure, Annals of Work Exposures and Health, 63: 666–678

MatEmESp	Spanish Classification of Occupations (CNO94)	Intensity: qualitative, quantitative, Probability: Frequency: Peaks:	2012	Dusts and Fibres Solvents Pesticides Metals and Metal Oxides Physical Agents Ergonomics, Physical Workload, and Injury Related Psychosocial Domains Organisation of Work including Working Time	Expert assessment Self-reported data FINJEM exposure estimates (default values)	France	García, et al. A Job-Exposure Matrix for Research and Surveillance of Occupational Health and Safety in Spanish Workers: MatEmESp. Am J Ind Med. 2013;56(10):1226-38.
Matgéné	ISCO 1968 PCS 1994	Intensity: semi-quantitative (None; low; medium; high), Probability (%)		Dusts and Fibres Solvents Pesticides Other Chemicals Physical Agents Organisation of Work including Working Time	Expert assessment	France	
NOCCA-JEM	NYK (3)	Intensity: semi-quantity, Probability:	2009	Dusts and Fibres Solvents Metals and Metal Oxides Other Chemicals Biological Factors Physical Agents Ergonomics, Physical Workload, and Injury Related Organisation of Work including Working Time	Expert assessment Direct measurements	Nordic countries	Kauppinen, et al. Construction of job-exposure matrices for the Nordic Occupational Cancer Study (NOCCA). Acta Oncol. 2009;48(5):791-800.

NORJEM - Mechanical exposures	STYRK-98 (4)	Probability: Exposed/Non-exposed	2018	Ergonomics, Physical Workload, and Injury Related Psychosocial Domains	Self-reported data	Norway	Hanvold, et al. Mechanical and psychosocial work exposures: the construction and evaluation of a gender-specific job exposure matrix (JEM). Scand J Work Environ Health. 2019;45(3):239-247.
NORJEM - Psychosocial exposures	STYRK-98 (4)	Intensity:	2018	Psychosocial Domains	Self-reported data	Norway	Hanvold, et al. Mechanical and psychosocial work exposures: the construction and evaluation of a gender-specific job exposure matrix (JEM). Scand J Work Environ Health. 2019; 45(3): 239-47.
Norwegian Silicon Carbide JEM	N/A	Intensity: qualitative (Asbestos: exposed if working in departments with asbestos being used in the time period asbestos was used), Quantitative (Total dust, respirable dust, quartz, cristobalite, silicon carbide: mg/m^3)	2012	Dusts and Fibres Other	Expert assessment Direct measurements	Norway	Føreland, et al. 2012. A Novel Strategy for Retrospective Exposure Assessment in the Norwegian Silicon Carbide Industry. J Occup Environ Hyg;9(4):230-41.
OAsJEM	ISCO 1988 (4)	Intensity: semi-quantitative ('high' (high probability of exposure and moderate-to-high intensity); 'medium' (low-to-moderate probability or low intensity); and 'unexposed')	2018	Dusts and Fibres Solvents Pesticides Metals and Metal Oxides Other Chemicals	Expert assessment data from the literature	Europe and North America	Le Moual, et al. Update of an occupational asthma-specific job exposure matrix to assess exposure to 30 specific agents. Occup Environ Med. 2018;75(7):507-514.

Physical workload factors JEM	ISCO 1988 (4)	Probability: Duration: differs by exposure, Frequency: differs by exposure	2012	Ergonomics, Physical Workload, and Injury Related	Self-reported data	Finland	Solovieva S, Pehkonen I, Kausto J, Miranda H, Shiri R, et al. (2012) Development and Validation of a Job Exposure Matrix for Physical Risk Factors in Low Back Pain. PLoS ONE 7(11): e48680.
POLLEK	N/A	Intensity: Probability: Duration: Frequency:	2019	Psychosocial Domains	Self-reported data Direct measurements	Poland	Szemik S, et al. [The review of prospective studies on mental health and the quality of life of physicians and medical students]. Med Pr. 2020 Jul 24;71(4):483-491. Polish.
Psychosocial JEM	ISCO 1988 (4)	Intensity: quantitative (mean score)	2012	Psychosocial Domains	Self-reported data	Finland	Solovieva S, Pensola T, Kausto J, Shiri R, Helio¨ vaara M, et al. (2014) Evaluation of the Validity of Job Exposure Matrix for Psychosocial Factors at work. PLoS ONE 9(9): e108987.
RF JEM	ISCO 1988 (4)	Intensity: quantitative (Time weighted average ICNIRP squared ratios for Electric (E) and Magnetic (H) fields), Probability: Quantitative - Prevalence of exposure	2019	Physical Agents	Expert assessment Self-reported data Direct measurements Literature data	Europe Northern America Oceania	Migault, et al. Development of a Job-Exposure Matrix for Assessment of Occupational Exposure to High-Frequency Electromagnetic Fields (3 kHz-300 GHz). Ann Work Expo Health. 2019;63(9):1013-1028.
Shiftwork JEM (Australian)	ISCO 1968 (5)	Probability: Numerical probability and 10%, 30%, 50% cutpoints	2014	Organisation of Work including Working Time	Expert assessment Self-reported data	Australia	Fernandez, et al. Assessment of exposure to shiftwork mechanisms in the general population: the development of a new job-exposure matrix. Occup Environ Med. 2014;71(10):723-9.
SHOCK-JEM	ISCO 1988 (4)	Intensity:	2013	Physical Agents	Expert assessment Direct measurements	Europe and North America	Huss, et al. 2013. "Electric Shocks at Work in Europe: Development of a Job Exposure Matrix." Occupational and Environmental Medicine 70 (4): 261–67.

SIOPS-JEM	ISCO 1968 ISCO 1988 (5)	Intensity: quantitative (Treiman's Standard International Occupational Prestige Scale (SIOPS))	2016	Psychosocial Domains	Expert assessment	Europe and North America	Behrens, et al. 2016. "Occupational Prestige, Social Mobility and the Association with Lung Cancer in Men." BMC Cancer 16: 395.
Swedish Noise JEM	ISCO 1958 ISCO 1988 ISCO 2008 NYK SSYK (4)	Intensity:	2014	Physical Agents	Expert assessment Direct measurements	Sweden	Sjostrom, et al. A Job-Exposure Matrix for Occupational Noise: Development and Validation Annals of Occupational Hygiene 2013.
Swedish physical workload JEM	ISCO 1988 SSYK96	Duration: Proportion of time: Two scales: 1. Every day 2. A couple of days per week 3. One day per week 4. A couple of days per month 5. Not at all/rarely, 1. Almost all the time 2. About ¾ of the time 3. Half of the time 4. About ¼ of the time 5. About 1/10 of the time 6. Not at all, Frequency: Proportion of time: Two scales: 1. Every day 2. A couple of days per week 3. One day per week 4. A couple of days per month 5. Not at all/rarely, 1. Almost all the time 2. About ¾ of the time 3. Half	2018	Ergonomics Physical Workload Injury Related	Self-reported data	Sweden	https://ki.se/imm/ett-hallbart-nytt-arbetsliv-sustainable-work

		of the time 4. About ¼ of the time 5. About 1/10 of the time 6. Not at all.					
Swedish psychosocial JEM	ISCO 1988 SSYK96	Duration: Proportion of time: Three scales: 1) a. Always, b. Mostly (3 out of 4 days), c. Mostly not (1 day out of 4), d. Never; 2) a. Every day, b. A couple of days per week, c. One day per week, d. A couple of days per month, e. Not at all/rarely; 3) a. Almost all the time, b. About ¾ of the time 3, c. Half of the time, d. About ¼ of the time, e. About 1/10 of the time, f. Not at all.	2018	Psychosocial Domains	Self-reported data	Sweden	https://ki.se/en/imm/a-sustainable-new-working-life-sustainable-work
SWEJEM Chemicals and Particles	FOB 80 SSYK 96 (3)	Intensity: quantitative (mg/m^3), Probability: %	2018	Dusts and Fibres Solvents Pesticides Metals and Metal Oxides Other Chemicals	FINJEM Expert assessment Direct measurements	Sweden	
SYN-JEM	ISCO 1968 (5)	Intensity: quantitative (mg/m3 for silica, chromium, and nickel; f/ml for	2012	Dusts and Fibres Metals and Metal Oxides Other Chemicals	Expert assessment Direct measurements	Europe and Canada	Peters, et al. SYN-JEM: a quantitative job-exposure matrix for five lung carcinogens. Annals of Occupational Hygiene (2016) 60(7):795-811

		asbestos; ug/m3 for BaP)					
The Lower Body JEM	ISCO 1988 (4)	Intensity: quantitative (Total load lifted (kg/day)), Duration: mean number of hours per day spent standing/walking, kneeling/squatting, and exposed to whole-body vibration (in half-hour intervals), Frequency: lifting loads weighing ≥20 kg (times/day)	2014	Ergonomics, Physical Workload, and Injury Related	Expert assessment	Denmark	Rubak, et al. An expert-based job exposure matrix for large scale epidemiologic studies of primary hip and knee osteoarthritis: the Lower Body JEM. BMC Musculoskelet Disord. 2014;15:204.
The Shoulder JEM	ISCO 1988 (4)	Intensity: Yes, Duration: Rated in ½ hour intervals, Frequency: moderate (≥4 to <15/min) or high (≥15/ min).	2014	Ergonomics, Physical Workload, and Injury Related	Expert assessment Direct measurements	Denmark	Dalbøge, et al. Upper arm elevation and repetitive shoulder movements: a general population job exposure matrix based on expert ratings and technical measurements. Occup Environ Med. 2016;73(8):553-60.
US Pesticide JEM	IPUM-USA 2000	Duration: sum the total exposure by job task categories * duration (years and months)	2014	Pesticides	Self-reported data	USA	Liew, et al. Job exposure matrix (JEM)-derived estimates of lifetime occupational pesticide exposure and the risk of Parkinson's disease. Arch Environ Occup Health. 2014;69(4):241-51.
WOOD DUST JEM	ISCO 1988	Intensity: quantitative (mg/m^3 Inhalable dust)	2016	Dusts Fibres	Expert assessment Direct measurements	Europe	Basinas, et al. Development of a quantitative job exposure matrix for wood dust in the wood manufacturing industry. P723, IOM, UK 2017b 14

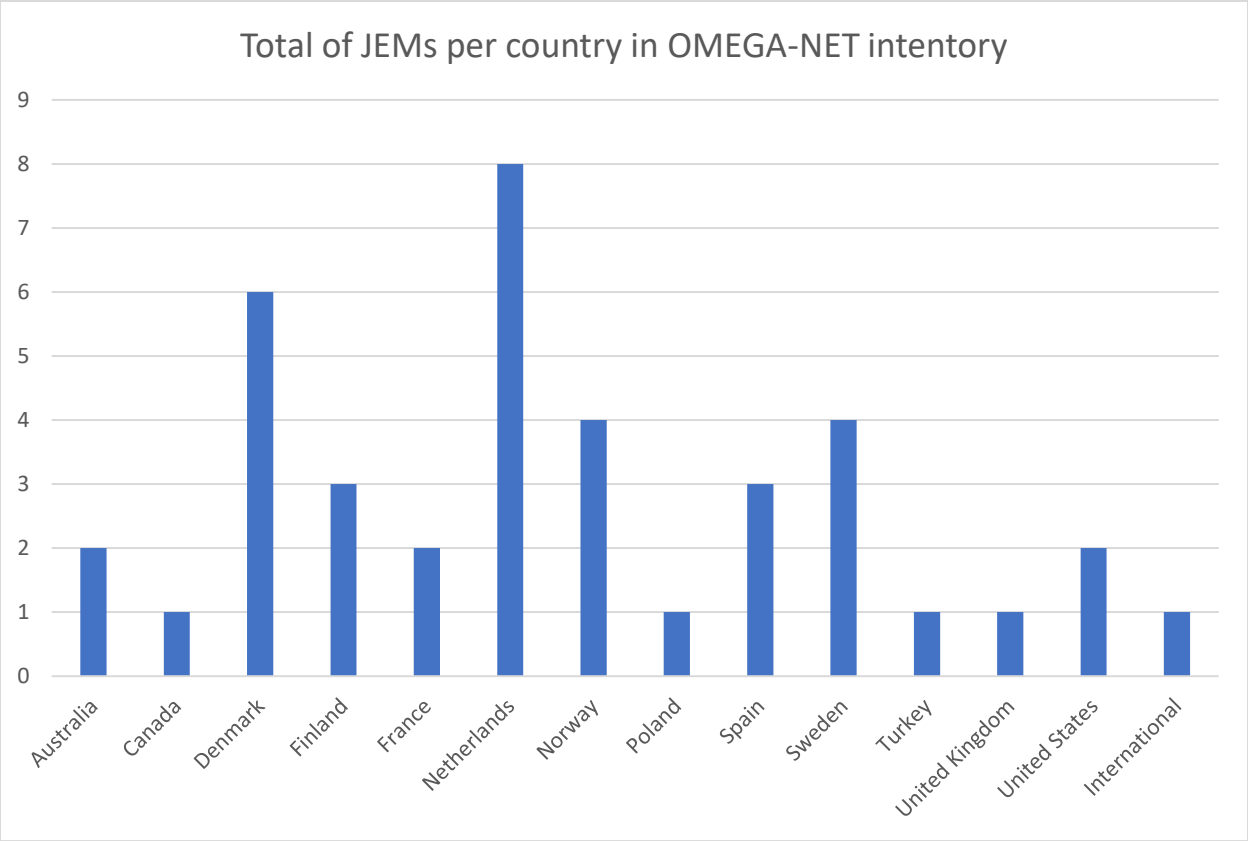

Figure 1. Total of JEMS per country of origin in OMEGA-NET inventory

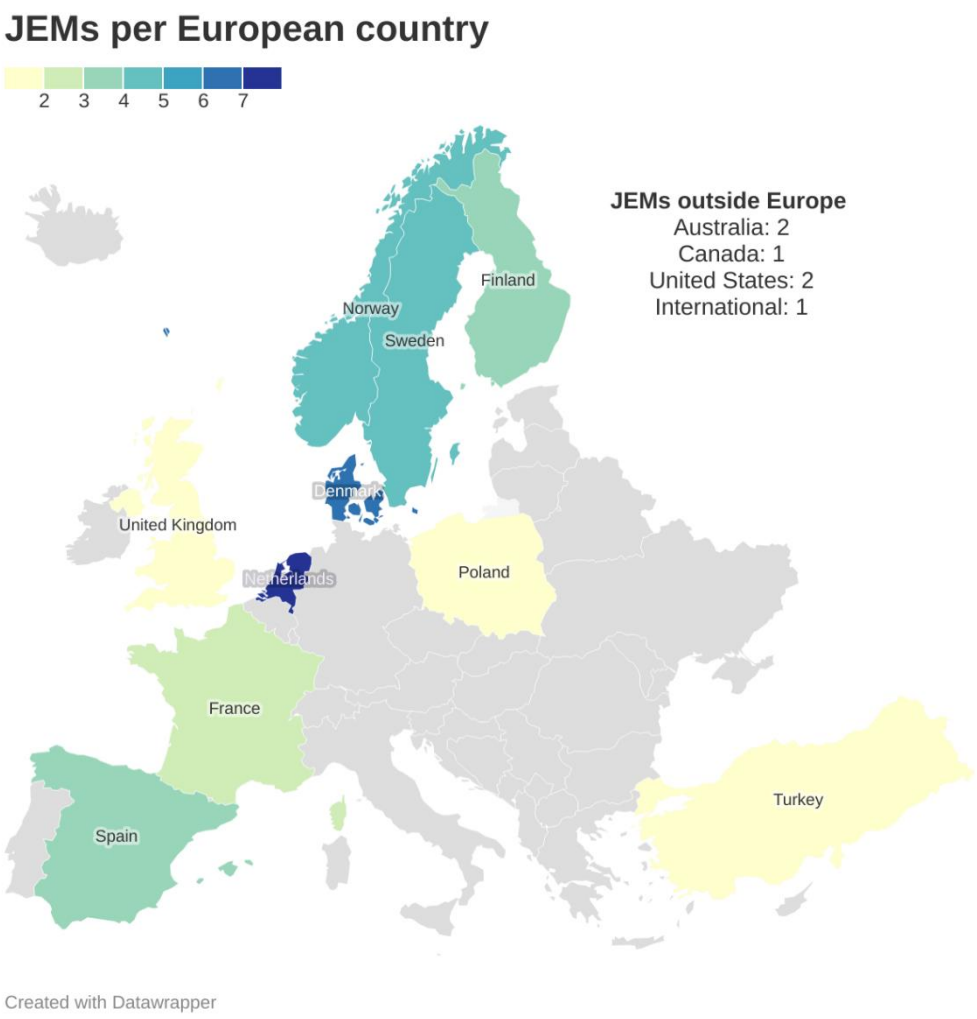

Figure 2. Map of JEMs available in OMEGA-NET inventory

Figure 3. Word Cloud showing the agents covered by JEMs (the more a specific agent of the JEMs was mentioned in the meta-data, the bigger and bolder it appears in the word cloud)

Table 2. Metadata on the 9 exposure databases in OMEGA-NET inventory

JEM name	Type	Occupational coding	Industry coding	Years covered	Agents	Region	Key Reference
ART 1.5	General	SOC 2000	SIC	1998-2010	Dusts and Fibres Solvents Pesticides	Netherlands	doi:10.1093/annhyg/mes103
BROWSE	Industry-specific	N/A	N/A	1980-2011	Pesticides	Netherlands	https://secure.fera.defra.gov.uk/browse/index.cfm
COLCHIC	General	ROME 2018	NAF rev02		Dusts and Fibres Solvents Pesticides Metals and Metal Oxides Other Chemicals Engineered Nanoparticles Biological Factors	France	http://www.inrs.fr/publications/bdd/fibrex.html
EMF OEMD	General	N/A	N/A	1974-2013	Electromagnetic fields	Spain	https://pubmed.ncbi.nlm.nih.gov/26493616/
Ev@lutil	General	ISCO 1968 PCS 1994 CITP 1968	ISIC rev 2	1965-2021	Dusts and Fibres Engineered Nanoparticles	France	doi: 10.1002/ajim.22498
EXPO	General		SIC 2007	1971-2020	Dusts and Fibres Solvents Pesticides Metals and Metal Oxides Other Chemicals	Norway	https://stami.no/vare-tjenester/expo/
ExpoSYN	General	ISCO-68	ISIC rev 2	1951-2009	Dusts and Fibres Metals and Metal Oxides Other Chemicals	Europe, Canada	doi:10.1093/annhyg/mer081

NECID	General	ISCO-08	NACE rev 2	2008-2021	Engineered Nanoparticles	Netherlands	http://www.perosh.eu/research-projects/perosh-projects/necid/
SCOLA	General	ROME 2018	NAF rev 2	2007-2020	Dusts and Fibres Solvents Metals and Metal Oxides Other Chemicals	France	https://onlinelibrary.wiley.com/doi/abs/10.1002/ajim.22569

Table 3. Metadata on the 24 occupational coding systems in OMEGA-NET inventory

System Name	Version Year	Country/Region	Related Version(s)	Reference/link
CH-ISCO-19	2019	Switzerland	SSCO 2000	https://www.bfs.admin.ch/bfs/en/home/statistics/work-income/nomenclatures/ch-isco-19.html
CITP-08	2008	France	ISCO-08	https://www.ilo.org/public/french/bureau/stat/isco/index.htm
CNO-11	2011	Spain		https://www.ine.es/dyngs/INEbase/en/operacion.htm?c=Estadistica_C&cid=1254736177033&menu=ultiDatos&idp=1254735976614
DISCO-88	1996	Denmark	DISCO-08	https://www.dst.dk/en/Statistik/dokumentation/nomenklaturer/disco-08?id=ec4f3246-ea1a-4e8b-b229-f03c0dc680c6#
DISCO-08	2010	Denmark	DISCO-88	https://www.dst.dk/en/Statistik/dokumentation/nomenklaturer/disco-08
ISCO-58	1958	International	ISCO-68 ISCO-88 ISCO-08	https://www.ilo.org/public/libdoc/ilo/1958/58B09_81_engl.pdf
ISCO-68	1968	International	ISCO-58 ISCO-88 ISCO-08	https://www.ilo.org/public/libdoc/ilo/1969/69B09_35_engl.pdf
ISCO-88	1988	International	ISCO-58 ISCO-68 ISCO-08	https://www.ilo.org/public/english/bureau/stat/isco/press1.htm
ISCO-08	2008	International	ISCO-58 ISCO-68 ISCO-88	http://www.ilo.org/public/english/bureau/stat/isco/docs/publication08.pdf
NOC 2006	2006	Canada	NOC 2011 NOC 2016	https://noc.esdc.gc.ca/
NOC 2011	2011	Canada	NOC 2016 NOC 2006	https://www.statcan.gc.ca/eng/subjects/standard/noc/2011/introduction
NOC 2016	2016	Canada	NOC 2006 NOC 2011	https://www.statcan.gc.ca/eng/subjects/standard/noc/2016/indexV1.3
NUP06	2006	Italy	ISCO-88	https://www.istat.it/en/archive/18421
PCS	2003	France		https://www.insee.fr/fr/information/2400059

SBC 1992	1992	Netherlands	ISCO-88	https://www.cbs.nl/en-gb/onze-diensten/methods/definitions/dutch-standard-classification-of-occupations--sbc---1992
SSCO 2000	2000	Switzerland	CH-ISCO-19	https://www.bfs.admin.ch/bfs/en/home/statistics/work-income/nomenclatures/sbn2000.html
STYRK-08	2011	Norway	ISCO-08	https://www.ssb.no/emner/06/90/notat_201117/notat_201117.pdf
UK SOC 1990	1990	United Kingdom	UK SOC 2000 UK SOC 2010 UK SOC 2020	https://webarchive.nationalarchives.gov.uk/20160108055058/http://www.ons.gov.uk/ons/guide-method/classifications/archived-standard-classifications/soc-and-sec-archive/index.html
UK SOC 2000	2000	United Kingdom	UK SOC 1990 UK SOC 2010 UK SOC 2020	https://www.ons.gov.uk/methodology/classificationsandstandards/standardoccupationalclassificationsoc
UK SOC 2010	2010	United Kingdom	UK SOC 1990 UK SOC 2000 UK SOC 2020	https://www.ons.gov.uk/methodology/classificationsandstandards/standardoccupationalclassificationsoc/soc2010
UK SOC 2020	2020	United Kingdom	UK SOC 1990 UK SOC 2000 UK SOC 2010	https://www.ons.gov.uk/methodology/classificationsandstandards/standardoccupationalclassificationsoc/soc2020
US SOC 2000	2000	United States	US SOC 2010 US SOC 2018	https://www.bls.gov/soc/2000/home.htm
US SOC 2010	2010	United States	US SOC 2018 US SOC 2000	https://www.bls.gov/soc/2010/#publications
US SOC 2018	2018	United States	US SOC 2000 US SOC 2010	https://www.bls.gov/soc/2018/#publications