



Co-funded by
the European Union

Project id n. 101103982



EXCEED

WP2 observatory

23.01.2025

PROJECT TITLE:

EXCELLENCE IN GREEN
AND DIGITAL
MANUFACTURING

PRESENTED BY:

Ari Vuokila
Ari.Vuokila@oulu.fi



EXCEED
Excellence in green and
digital manufacturing



SKILLS EVALUATION FOR ADVANCED MANUFACTURING

Technical report



 Co-funded by
the European Union

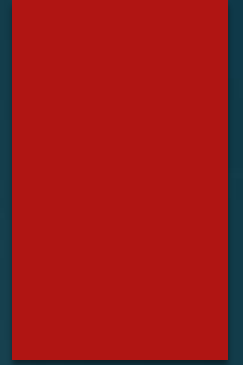
www.exceed-cove.eu



Skills evaluation technical report

- ▶ The document will be available in the [project website](#).
- ▶ Two parts
 - ▶ Desk research
 - ▶ Manufacturing, automotive, mechatronics and shipbuilding sectors
 - ▶ Macrotrends
 - ▶ Skill needs in twin transitions
 - ▶ Occupation related skills
 - ▶ Oulu COVE survey

Main source materials for desk research

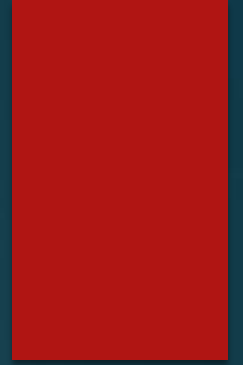


- ▶ The Future of Jobs 2023 (World Economic Forum)
 - ▶ The Future of Jobs 2020
- ▶ ESCO (European Skills, Competences, Qualifications, and Occupations)
- ▶ O*NET OnLine (Occupational information network)
- ▶ Cedefop reports

Macrotrends in business transformation

- ▶ Most likely transformation drivers
 - ▶ New and cutting-edge technologies 86.2%
 - ▶ Broadening digital access 86.1%
 - ▶ Environmental, social, and governance standards 80.6%
 - ▶ Green transition investments 69.1%
 - ▶ Climate-change induced investments 65.1%

Macrotrends in business transformation



- ▶ Most important technology drivers in the near future
 - ▶ Big data
 - ▶ Cloud computing
 - ▶ AI
- ▶ Most important job growth drivers
 - ▶ Big data analytics
 - ▶ Climate change
 - ▶ Environmental managements technologies
 - ▶ Encryption and cybersecurity

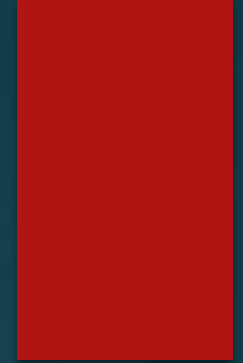
EU waste directives

- ▶ European Environment Agency
 - ▶ Goal is to reduce health and environment effects
 - ▶ Keep valuable resources in the economy
 - ▶ By 2030, all EU states must recycle at least 60% of their municipal waste
- ▶ EU waste directives targeting other types of waste include:
 - ▶ [The Waste Framework Directive](#) -> targets for municipal waste recycling and preparing for reuse.
 - ▶ [The Waste Electrical and Electronic Equipment \(WEEE\) Directive](#) -> targets for the separate collection and recycling of electrical and electronic waste.
 - ▶ [The Packaging and Packaging Waste Directive](#), which defines targets for recycling packaging waste.

Macrotrends in AM and automotive and aerospace

- ▶ Automation acceleration
 - ▶ 80-90% within the next 5 years
- ▶ AI technologies adoption for operation
 - ▶ 72% AM and 85% of automotive and aerospace
- ▶ Pace of automation is much slower than anticipated
 - ▶ Overall automation remained at 34% between 2020 and 2023
 - ▶ Estimation was in 2020 that the automation level for 2025 would be 47%
 - ▶ Estimation in 2023 was that the automation level for 2027 would be 42%

Macrotrends in AM



- ▶ Digital skills ambitions in action – Cedefop's skills forecast digitalisation scenario (2024)
- ▶ Metal, machinery, and related trades jobs will be highly affected by AI and machine learning
 - ▶ Intelligent production, automation and industrial robots
 - ▶ Operator and production manager decision making is supported with statistical analysis software, algorithms, and probability calculations
 - ▶ Need for employees to have fundamental understanding of IT and advanced manufacturing technologies.
 - ▶ Personnel tasked with servicing of advanced systems require thorough process knowledge and being able to use information stored in cloud computing systems.

Macrotrends in AM

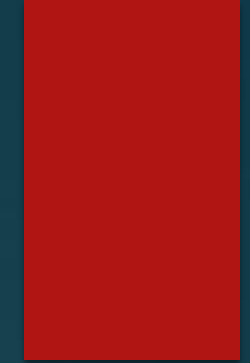
- ▶ Corporate Sustainability Reporting Directive (CSRD)
 - ▶ Environmental impact of products and services throughout their lifecycle
 - ▶ Production technologies, circularity, reusability, durability and repairability.
 - ▶ New design and workers in product repair
- ▶ Right to Repair (R2R) directive
 - ▶ New manufacturing materials and methods and production ways
 - ▶ Sustainability and Repairability, safe working, green chemicals, manuals, repair documents, (digital)communication
 - ▶ Sustainable practices, adaptability, and problem-solving skills
 - ▶ Repair, maintenance, and diagnostics skills
 - ▶ 3D-printing of spare parts is singled out as a technology in the directive

Macrotrends in shipbuilding sector



- ▶ Essential for achieving the EU Green Deal's goal of decarbonizing maritime transport and the Smart and Sustainable Mobility Strategy
- ▶ New Industrial Strategy for Europe
 - ▶ Highlighting shipbuilding's crucial role in driving twin transitions, enhancing industrial competitiveness, and improving connectivity
- ▶ The industry's vision for 2030 and 2050
 - ▶ Green and Clean Waterborne Transport
 - ▶ Safer and More Secure Waterborne Transport
 - ▶ Connected and Automated Waterborne Transport
 - ▶ Competitiveness in Eco-Friendly Shipyards

Automotive industry - Renault Group



- ▶ The traditional combustion engine skills will lessen, but there is a need for skilled mechanics for repairs and spare parts recycling
- ▶ Circular economy requires new skill sets in refurbishment, retrofitting, recycling, and vehicle life span extension
- ▶ Skills are not new, but existing skills need to change within the industry as for example skills to dismantle vehicles for repurposing is something that is not yet part of the existing skill sets
- ▶ <https://www.linkedin.com/pulse/what-skills-needed-next-generation-automotive-company-renaultgroup-la88e>

Skills needed in twin transitions

- ▶ Basic level of digital knowledge has become standard requirement for more than 90% of professional roles
 - ▶ 42% of European adults were lacking in basic digital skills in 2021
 - ▶ “We’ve been teaching maths and science for many years, but now students must graduate with digital literacy as a basic skill and competency. Bringing it back to ‘how do you make a better planet?’, none of this happens without broadly available and transactional digital literacy skills – I would almost argue that it’s a human right.” Says Avi Reichental, CEO, chairman and co-founder from Nexa3D

Skills needed in twin transitions

- ▶ Cedefop (2024) estimates that the AI education and training programmes are needed at all levels. The basic digital skills training should be overall increased to cover 80% of the individuals, but it isn't enough to keep people employable.
- ▶ Shiohira (2021) states that digital skills have become a basic requirement
 - ▶ AI-related skills gradually become essential in nearly all occupations
 - ▶ AI literacy skills
 - ▶ Work with AI rather than developing it at the most complex levels
 - ▶ There is significant gap in AI-related skills among teaching staff, so their skills need to be updated as well
 - ▶ Transversal skills, such as critical thinking, learning to learn, communication, and financial and media literacy, are applicable in a wide range of life and work settings.
 - ▶ Adaptability to changes and identify and seize career opportunities
 - ▶ Individuals are now expected to continuously acquire new, marketable skills throughout their lives

AI qualification

- ▶ Needs and requirements for an additional AI qualification during dual vocational training: Results from studies of apprentices and teachers (2022)
 - ▶ “AI qualification requires competent teachers with extensive knowledge of the content”
 - ▶ “Additional AI qualification would be of particular interest to apprentices in technical occupational fields, especially to apprentices in computer science, in the automotive industry or in electrical engineering”
 - ▶ Understand concepts of AI, data science and machine learning, apprentices will also need certain mathematical skills
 - ▶ Address ethical concerns regarding AI
 - ▶ Critical thinking skills
 - ▶ “Garbage in, garbage out”
 - ▶ Learn AI through the experience of solving problems that could also arise in their workplace
 - ▶ Prepare data for further analysis or train an AI agent themselves

AI qualification



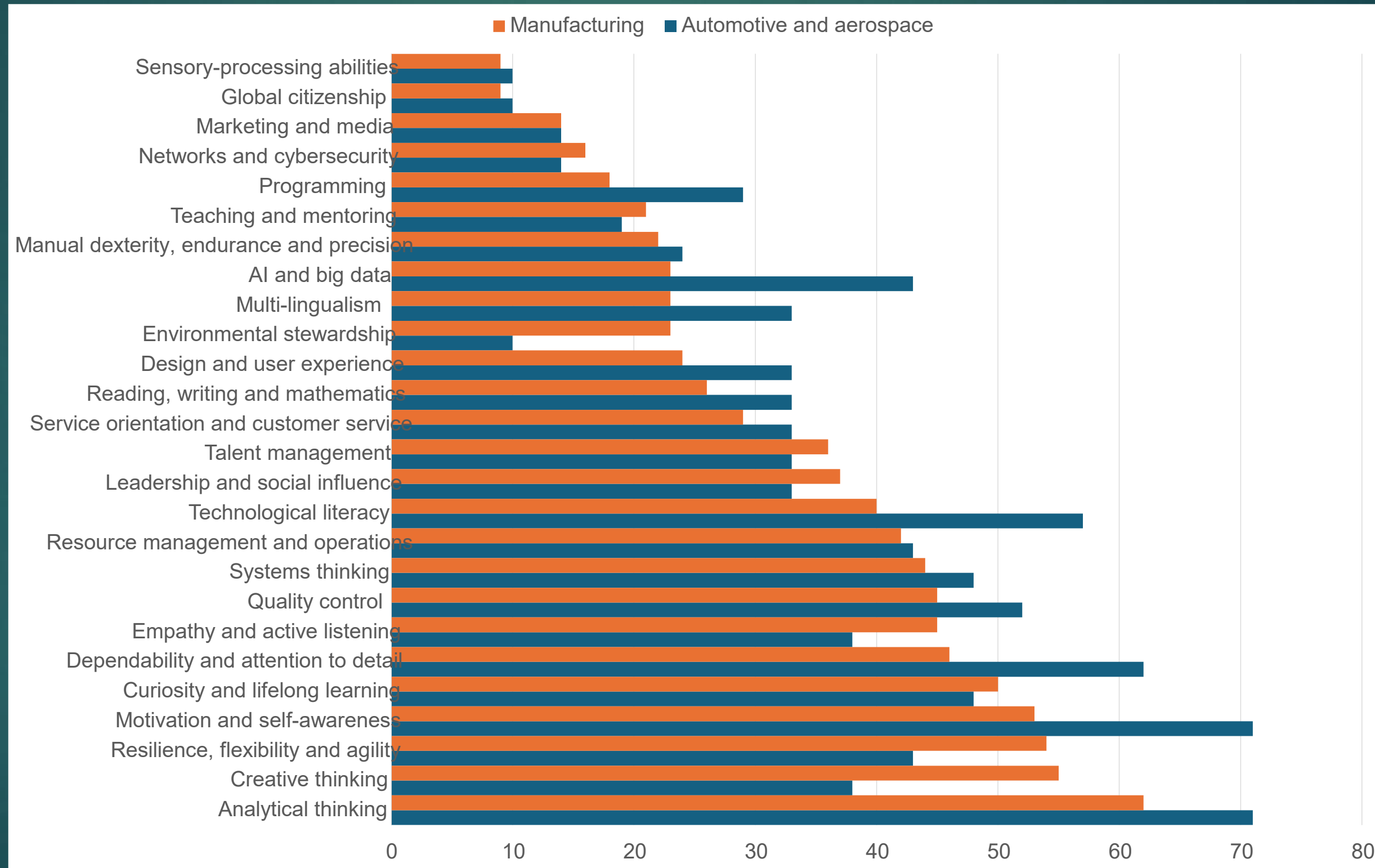
Apprentices views on AI

Topic	Percentages
Importance of AI in society	80.7
Importance in their everyday lives	43.7
Importance in professional careers	91.2

Apprentices interest in topics of AI

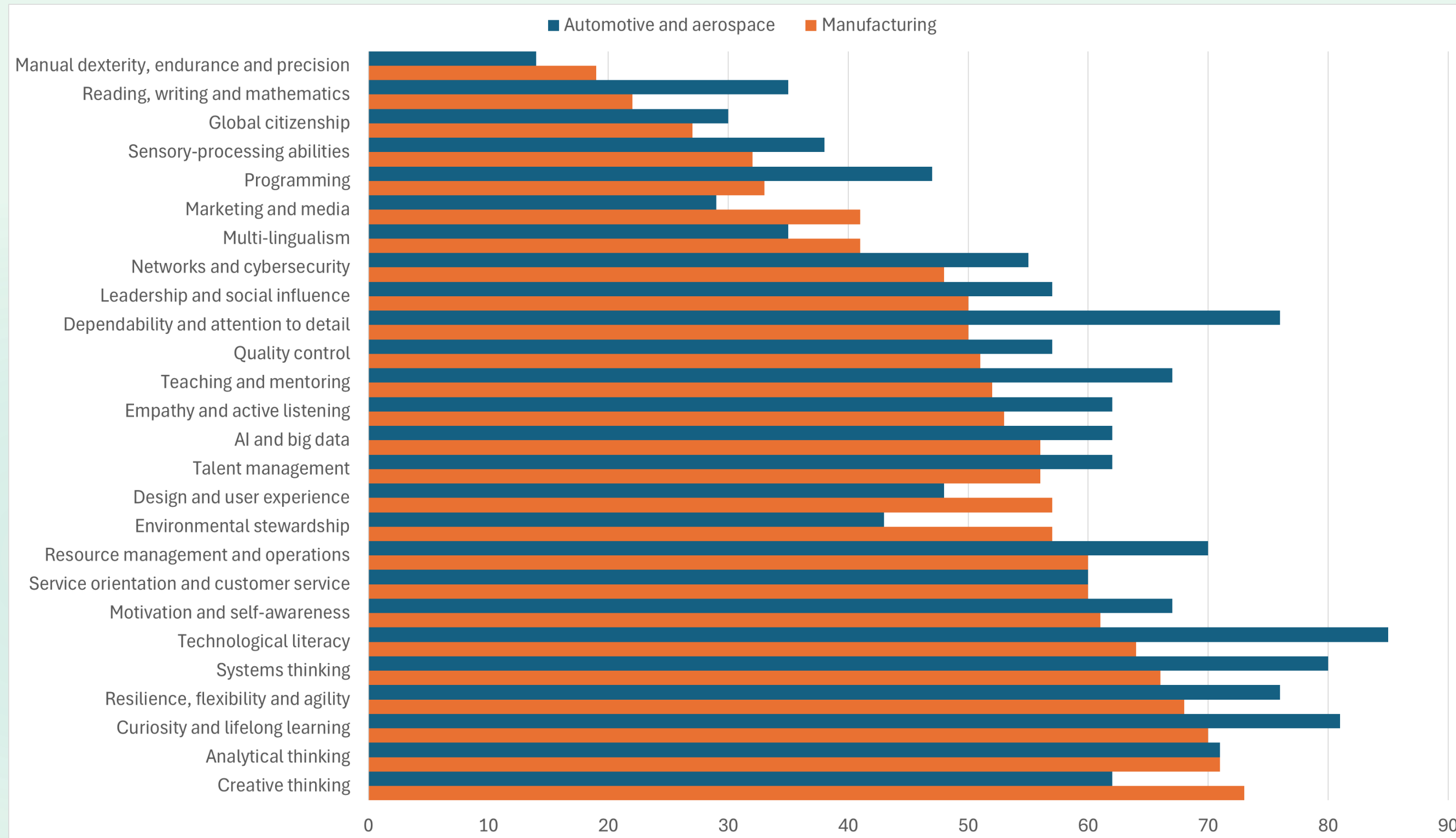
Topic	Percentages
Basic concepts of AI	69.0
Practical examples	52.8
Machine learning	47.6
(Potential) Areas of application	47.1
Data management	44.2
Ethical aspects and critical questions	41.2
Programming	36.2

WEF – Future of Jobs Report 2023



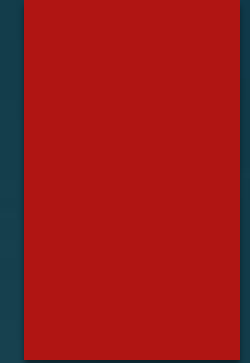
Share of organizations considering skills to be core skills for their workers in 2023 modified from WEF data. (World Economic Forum 2023).

WEF – Future of Jobs Report 2023



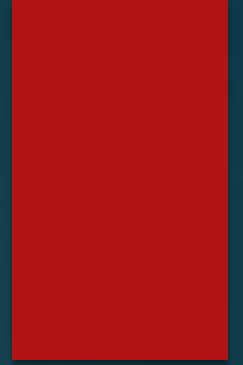
Share of organizations considering skills evolution between 2023-2027 for their workers in 2023 modified from WEF data.

WEF – Future of Jobs Report 2023



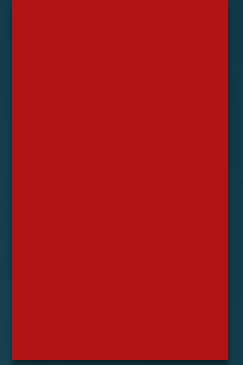
- ▶ Almost all skills are expected to increase between 2023-2027
- ▶ Aerospace and Automotive
 - ▶ Environmental stewardship 330% increase
 - ▶ Networks and cybersecurity 293%, Sensory-processing abilities 280%, Teaching and mentoring 253%, and Global citizenship 200%
 - ▶ Manual dexterity, endurance, and precision (-42%)
- ▶ Manufacturing
 - ▶ Sensory-processing abilities 256% increase
 - ▶ Global citizenship 200%, Networks and cybersecurity 200%, and Marketing and media 193%
 - ▶ Reading, writing and mathematics is projected to decrease by 15.4%
 - ▶ Manual dexterity, endurance, and precision -14%

Shipbuilding Pact for Skills 2021



- ▶ Upskilling and reskilling
 - ▶ Robotics
 - ▶ Advanced manufacturing, 3D and 4D printing
 - ▶ IoT connectivity, Big Data, cybersecurity
 - ▶ Augmented and virtual reality
 - ▶ Advanced energy generation, storage, and distribution technologies

Shipbuilding Pact for Skills 2021



- ▶ Data scientists
- ▶ 3D printing technicians
- ▶ System architects
- ▶ Cybersecurity specialists.
- ▶ Industrial, mechanical, and electrical engineers, along with naval architects

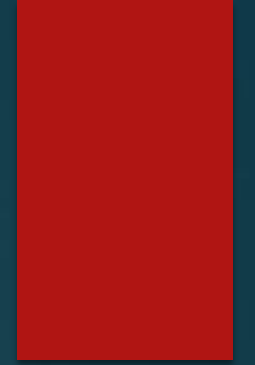
European Skills, Competences, Qualifications and Occupations (ESCO)

- ▶ ESCO dataset v1.2.0 (May 2024) was compared to the ESCO datasets v1.1.2 (2022) and v1.0.9 (2017) v1.2.0
 - ▶ Can we capture trends in these datasets?
- ▶ Mechatronics assembler, motor vehicle assembler, computer numerical control machine operator

Skills and competencies of mechatronics assembler. (EUROPEAN COMMISSION 2024)

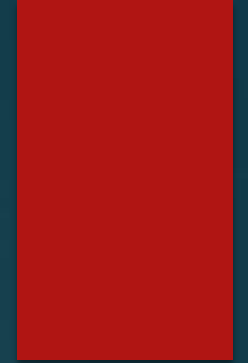
Skills and competences	Broader concept	Optional Skills and Competences	
Essential skills and competences			
Align components	Handling and moving	Adjust manufacturing equipment	Working with machinery and specialised equipment
Apply assembly techniques	Handling and moving	Assemble hardware components	Working with computers
Apply soldering techniques	Constructing	Assemble machines	Working with computers
Assemble mechatronic units	Handling and moving	Assemble robots	Handling and moving
Clean components during assembly	Handling and moving	Check system parameters against reference values	Information skills
Ensure conformity to specifications	Assisting and caring	Inspect quality of products	Information skills
Follow standards for machinery safety	Assisting and caring	Install automation components	Working with computers
Install mechatronic equipment	Working with machinery and specialised equipment	Install blinds drive systems	Working with machinery and specialised equipment
Maintain mechatronic equipment	Working with machinery and specialised equipment	Interpret circuit diagrams	Information skills
Meet deadlines	Management skills	Keep up with digital transformation of industrial processes	Information skills
Monitor machine operations	Information skills	Measure electrical characteristics	Information skills
Perform metal work	Constructing	Measure parts of manufactured products	Information skills
Read assembly drawings	Information skills	Operate precision measuring equipment	Working with machinery and specialised equipment
Read standard blueprints	Information skills	Program firmware	Working with computers
Remove defective products	Handling and moving	Replace defect components	Working with machinery and specialised equipment
Troubleshoot	Communication, collaboration, and creativity	Replace machines	Information skills
Essential knowledge		Report defective manufacturing materials	Information skills
Computer equipment	Information and communication technologies	Resolve equipment malfunctions	Communication, collaboration, and creativity
Electronics	Engineering, manufacturing, and construction	Set up the controller of a machine	Working with computers
Mechatronics	Engineering, manufacturing, and construction	Test mechatronic units	Constructing
Quality standards	Business, administration, and law	Use CAM software	Working with computers
Safety engineering	Engineering, manufacturing, and construction	Provide power connection from bus bars	Working with machinery and specialised equipment
		Optional knowledge	
		ICT system programming	Information and communication technologies
		Automation technology	Engineering, manufacturing, and construction
		Computer engineering	Engineering, manufacturing, and construction
		Crimping	Engineering, manufacturing, and construction
		Electrical discharge	Engineering, manufacturing, and construction
		Electromechanics	Engineering, manufacturing, and construction
		Electronics principles	Engineering, manufacturing, and construction
		Hydraulics	Engineering, manufacturing, and construction
		Instrumentation engineering	Engineering, manufacturing, and construction
		Mechanical engineering	Engineering, manufacturing, and construction
		Microelectronics	Engineering, manufacturing, and construction
		Pneumatics	Natural sciences, mathematics, and statistics
		Robotics	Engineering, manufacturing, and construction

ESCO main findings



- ▶ Mechatronics assembler skills and competences had remained practically the same since 2017
- ▶ Motor vehicle assembler, only change since 2017 was vehicle type approval
- ▶ CNC machine operator
 - ▶ 3D printing related skills and knowledge and 3D computer graphics appear between 2017 and 2022

Other EU tools



- ▶ Skills-OVATE
 - ▶ detailed information on the jobs and skills employers demand in 32 EU countries based on online job advertisements
- ▶ Job and skill trends in EU
<https://europa.eu/europass/eportfolio/screen/skills-intelligence?lang=en>
 - ▶ Combining Skills-OVATE and ESCO occupations

Skills-OVATE

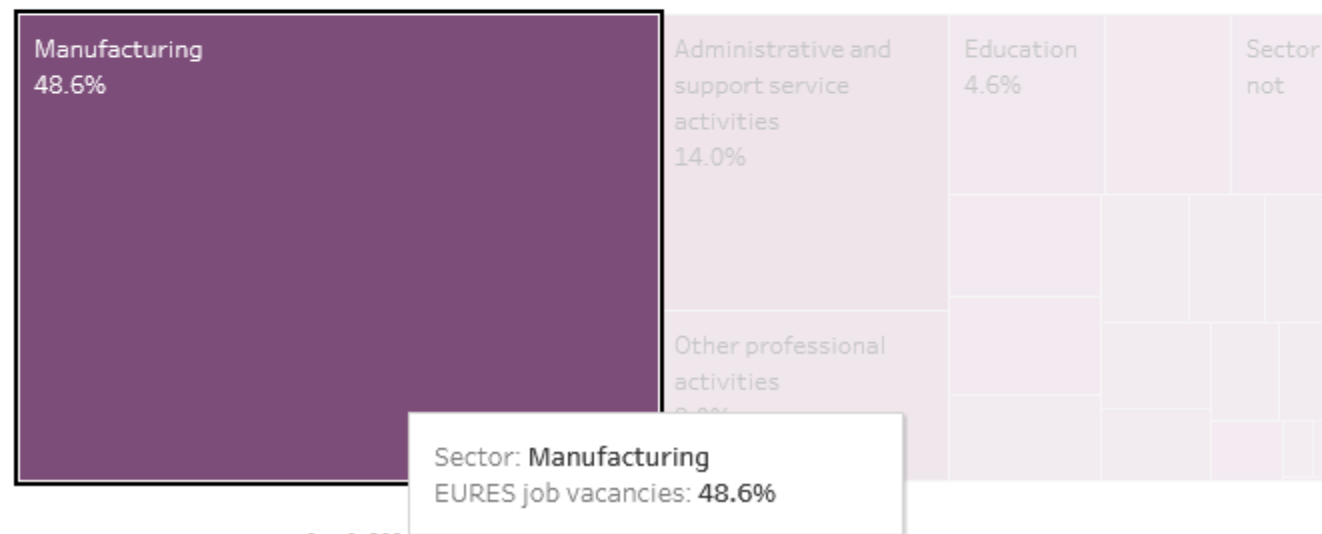


Select EURES country:
(All)

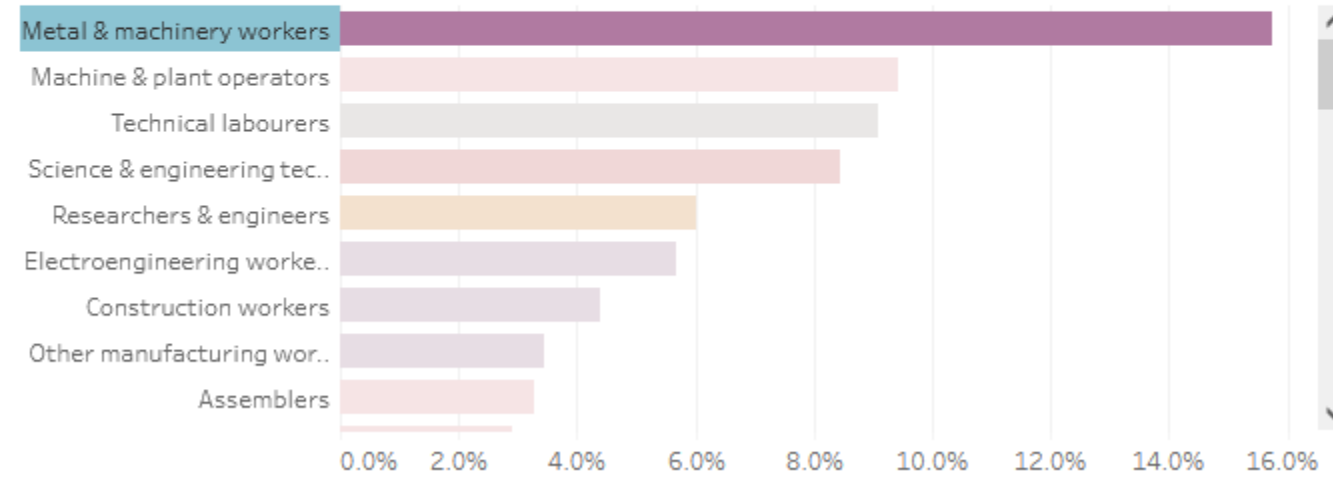
Data on: 1 January 2024 – 30 September 2024



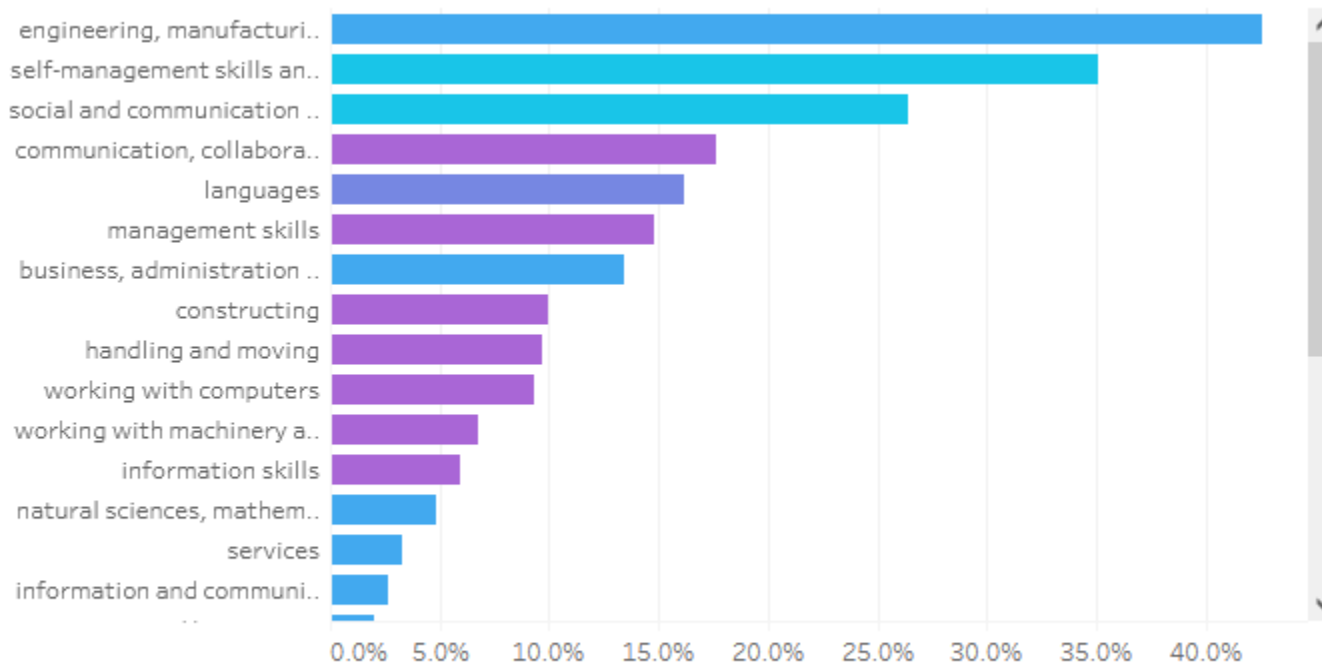
EURES job vacancies by sector



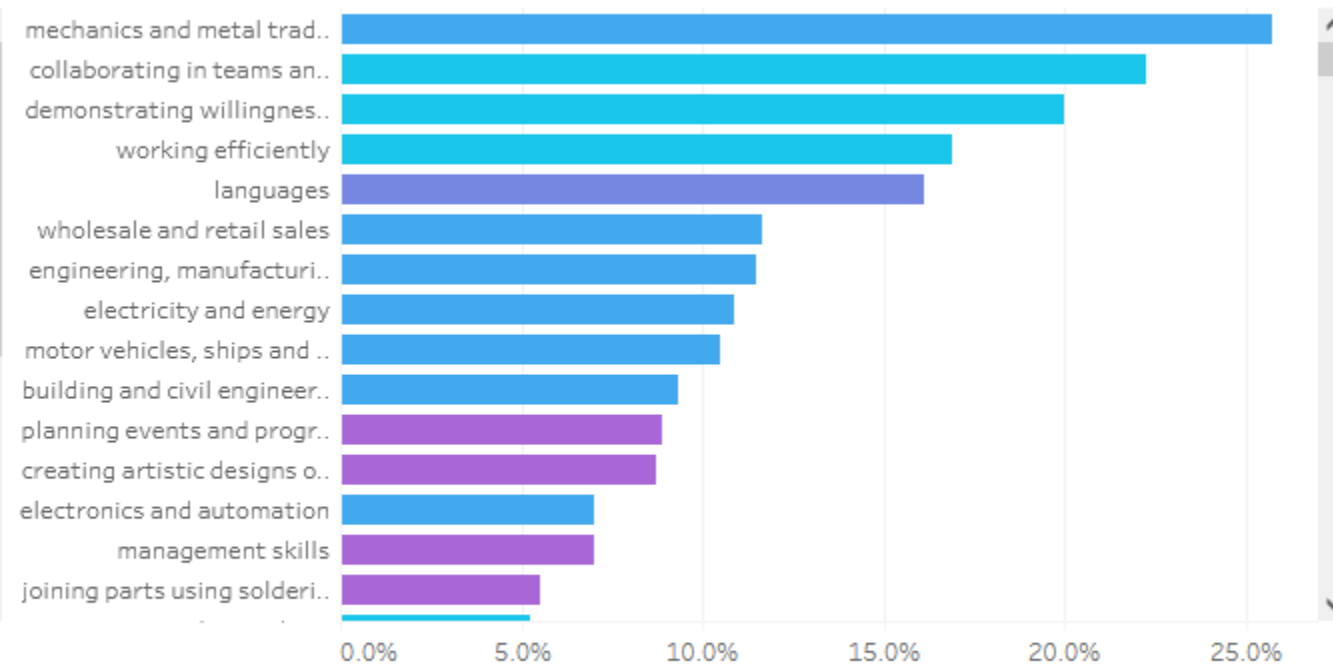
EURES job vacancies by occupation group (2-digit ISCO)



Most requested skills: level 1 ESCO



Most requested skills: level 3 ESCO



Europass

► Metal additive manufacturing operator

Top Skills	Top Knowledge Groups
1. Operating metal, plastic or rubber forming equipment ▼	1. Mechanics and metal trades ▼
2. Complying with health and safety procedures ▼	2. Work skills ▼
3. Collaborating and liaising ▼	3. Textiles (clothes, footwear and leather) ▼
4. Technical or academic writing ▼	4. Community sanitation ▼
5. Positioning materials, tools or equipment ▼	Items per page: <input type="text" value="10"/> ▼
6. Monitoring operational activities ▼	Showing 1–4 of 4
7. Maintaining mechanical machinery ▼	⏪ ◀ (1) ▶ ⏩
8. Using precision measuring equipment ▼	
9. Maintaining electrical, electronic and precision equipment ▼	
10. Working with machinery and specialised equipment ▼	
11. Complying with environmental protection laws and standards ▼	
12. Developing solutions ▼	
13. Handling and disposing of hazardous materials ▼	
14. Operating precision industrial equipment ▼	
15. Training on operational procedures ▼	
Items per page: <input type="text" value="20"/> ▼	⏪ ◀ (1) ▶ ⏩
Showing 1–15 of 15	

O*net OnLine

- ▶ Occupational information in the USA
- ▶ O*NET lists the most frequently listed requirements as Hot Technologies and also In Demand skills, which are frequently added to job postings
- ▶ Skills, knowledge, and competences match well with ESCO, it is just written in a different way
 - ▶ In ESCO, you have to visit e.g. the skill page to get the definition and direct relation
 - ▶ In O*NET the skills are defined and opened directly
- ▶ O*NET contains information about projected growth and occupation specific importance of each skill

Skills		Knowledge	
Programming	Writing computer programs for various purposes.	Computers and Electronics	Knowledge of circuit boards, processors, chips, electronic equipment, and computer hardware and software, including applications and programming.
Monitoring	Monitoring/Assessing performance of yourself, other individuals, or organizations to make improvements or take corrective action.		
Operations Monitoring	Watching gauges, dials, or other indicators to make sure a machine is working properly.	Mechanical	Knowledge of machines and tools, including their designs, uses, repair, and maintenance.
Active Learning	Understanding the implications of new information for both current and future problem-solving and decision-making.		
Complex Problem Solving	Identifying complex problems and reviewing related information to develop and evaluate options and implement solutions.	Mathematics	Knowledge of arithmetic, algebra, geometry, calculus, statistics, and their applications.
Critical Thinking	Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions, or approaches to problems.		
Judgment and Decision Making	Considering the relative costs and benefits of potential actions to choose the most appropriate one.	Production and Processing	Knowledge of raw materials, production processes, quality control, costs, and other techniques for maximizing the effective manufacture and distribution of goods.
Mathematics	Using mathematics to solve problems.		
Reading Comprehension	Understanding written sentences and paragraphs in work-related documents.	Design	Knowledge of design techniques, tools, and principles involved in production of precision technical plans, blueprints, drawings, and models.
Systems Analysis	Determining how a system should work and how changes in conditions, operations, and the environment will affect outcomes.		
Writing	Communicating effectively in writing as appropriate for the needs of the audience.	Engineering and Technology	Knowledge of the practical application of engineering science and technology. This includes applying principles, techniques, procedures, and equipment to the design and production of various goods and services.
Active Listening	Giving full attention to what other people are saying, taking time to understand the points being made, asking questions as appropriate, and not interrupting at inappropriate times.		
Systems Evaluation	Identifying measures or indicators of system performance and the actions needed to improve or correct performance, relative to the goals of the system.	English Language	Knowledge of the structure and content of the English language including the meaning and spelling of words, rules of composition, and grammar.
Coordination	Adjusting actions in relation to others' actions.		
Operation and Control	Controlling operations of equipment or systems.	Administration and Management	Knowledge of business and management principles involved in strategic planning, resource allocation, human resources modeling, leadership technique, production methods, and coordination of people and resources.
Operations Analysis	Analyzing needs and product requirements to create a design.		
Quality Control Analysis	Conducting tests and inspections of products, services, or processes to evaluate quality or performance.	Education and Training	Knowledge of principles and methods for curriculum and training design, teaching and instruction for individuals and groups, and the measurement of training effects.
Speaking	Talking to others to convey information effectively.		
Time Management	Managing one's own time and the time of others.		
Troubleshooting	Determining causes of operating errors and deciding what to do about it.		

Technology Skills	
Analytical or scientific software	Simulation software
Computer aided design CAD software	Autodesk AutoCAD In-Demand Hot technology ; Dassault Systemes CATIA; Dassault Systemes SolidWorks In-Demand Hot technology ; PTC Creo Parametric
Computer aided manufacturing CAM software	TCadCam Unigraphics; Autodesk PartMaker; Mastercam computer-aided design and manufacturing software In Demand ; Vero Software WorkNC
Electronic mail software	Microsoft Outlook
Enterprise application integration software	Extensible markup language XML Hot technology
Enterprise resource planning ERP software	Aptean Made2Manage; SAP software Hot technology
Object or component oriented development software	G-code In Demand ; M-code
Office suite software	Microsoft Office software In-Demand Hot technology
Presentation software	Microsoft PowerPoint Hot technology
Project management software	Siemens Teamcenter
Spreadsheet software	Microsoft Excel Hot technology
Video conferencing software	FaceTime
Word processing software	Microsoft Word Hot technology

Work activities	
Working with Computers	Using computers and computer systems (including hardware and software) to program, write software, set up functions, enter data, or process information.
Controlling Machines and Processes	Using either control mechanisms or direct physical activity to operate machines or processes (not including computers or vehicles).
Getting Information	Observing, receiving, and otherwise obtaining information from all relevant sources.
Making Decisions and Solving Problems	Analyzing information and evaluating results to choose the best solution and solve problems.
Communicating with Supervisors, Peers, or Subordinates	Providing information to supervisors, co-workers, and subordinates by telephone, in written form, e-mail, or in person.
Inspecting Equipment, Structures, or Materials	Inspecting equipment, structures, or materials to identify the cause of errors or other problems or defects.
Analyzing Data or Information	Identifying the underlying principles, reasons, or facts of information by breaking down information or data into separate parts.
Drafting, Laying Out, and Specifying Technical Devices, Parts, and Equipment	Providing documentation, detailed instructions, drawings, or specifications to tell others about how devices, parts, equipment, or structures are to be fabricated, constructed, assembled, modified, maintained, or used.
Monitoring Processes, Materials, or Surroundings	Monitoring and reviewing information from materials, events, or the environment, to detect or assess problems.
Updating and Using Relevant Knowledge	Keeping up-to-date technically and applying new knowledge to your job.
Organizing, Planning, and Prioritizing Work	Developing specific goals and plans to prioritize, organize, and accomplish your work.
Thinking Creatively	Developing, designing, or creating new applications, ideas, relationships, systems, or products, including artistic contributions.
Processing Information	Compiling, coding, categorizing, calculating, tabulating, auditing, or verifying information or data.
Documenting/Recording Information	Entering, transcribing, recording, storing, or maintaining information in written or electronic/magnetic form.
Identifying Objects, Actions, and Events	Identifying information by categorizing, estimating, recognizing differences or similarities, and detecting changes in circumstances or events.
Judging the Qualities of Objects, Services, or People	Assessing the value, importance, or quality of things or people.
Interpreting the Meaning of Information for Others	Translating or explaining what information means and how it can be used.
Estimating the Quantifiable Characteristics of Products, Events, or Information	Estimating sizes, distances, and quantities; or determining time, costs, resources, or materials needed to perform a work activity.
Evaluating Information to Determine Compliance with Standards	Using relevant information and individual judgment to determine whether events or processes comply with laws, regulations, or standards.

Handling and Moving Objects	Using hands and arms in handling, installing, positioning, and moving materials, and manipulating things.
Scheduling Work and Activities	Scheduling events, programs, and activities, as well as the work of others.
Coordinating the Work and Activities of Others	Getting members of a group to work together to accomplish tasks.
Developing and Building Teams	Encouraging and building mutual trust, respect, and cooperation among team members.
Coaching and Developing Others	Identifying the developmental needs of others and coaching, mentoring, or otherwise helping others to improve their knowledge or skills.
Repairing and Maintaining Mechanical Equipment	Servicing, repairing, adjusting, and testing machines, devices, moving parts, and equipment that operate primarily on the basis of mechanical (not electronic) principles.
Developing Objectives and Strategies	Establishing long-range objectives and specifying the strategies and actions to achieve them.
Training and Teaching Others	Identifying the educational needs of others, developing formal educational or training programs or classes, and teaching or instructing others.
Establishing and Maintaining Interpersonal Relationships	Developing constructive and cooperative working relationships with others, and maintaining them over time.

Structured interviews in Oulu

- Interview for companies based on the vocational qualifications of Finland in the context of EXCEED-project.
- The topics were
 - Sustainable development, advanced manufacturing and digital environments.
- In interview companies answered how highly they appreciate vocational competence requirements in scale 1-4, in which 1= minor significance and 4=great significance.
- Example of vocational qualifications, course *Promoting sustainable development* (the picture on the right). Each bulled point was scored in scale 1-4.

Principles of sustainable development

The student

- knows the main objectives of ecological, financial, social and cultural sustainability in sustainable development and their interconnections
- perceives the role of human activities in climate change
- understands the importance of biodiversity and recognises the necessity of sustainable use of natural resources nationally and globally
- identifies operating methods of sustainable development in their own life and work.

Carbon neutrality and a circular economy

The student

- understands the principles of carbon neutrality and a circular economy
- identifies the energy or material efficiency of a product or a service.

Ethical aspects of operation

The student

- identifies some ethical choices included in the set of tasks
- evaluates their own decisions and those of others ethically.

Interviewed companies, so far

1. International publicly traded company in the field of steel industry.
2. A start-up company that creates injection-molded structural electronics that integrate flexible printed circuitry and discrete electronic components into mass-produced 3D injection-molded plastics.
3. Contract manufacturer in the field of sheet metal, flatbar and busbar mechanics, machining and assembly. In addition, supporting customers in areas such as productization, logistics and product information management.

Results: Company 1

- ▶ Sustainable development and different Advanced manufacturing techniques: in the scale 1-4 all the answers were either 3 or 4 (no 1's or 2's at all).
- ▶ Working in digital environment: 2=14 %, 3=42 % and 4= 42 %.
- ▶ Some comments from company: "The importance of maintenance and forecasting will become more prominent, utilizing digitalization (digital twin).", "The significance of data obtained from the process is important; we utilize artificial intelligence.", "The aim is fossil free production and sustainable development, every employee can contribute."
- ▶ Some comments from company: "The importance of understanding the responsibility in the context of digital tools and information security". "The importance of utilizing up-to-date information seeking (relevant sources)." "Basics of AI".

Results: Company 2

- ▶ Results in questions in the field of Sustainable development and different Advanced manufacturing techniques all answers were 4.
- ▶ Results in the field of Working in digital environment: 3=12 % and 4=88 %
- ▶ Comments from company: "Operators are seen as experts as they know the process best. Operators work in high co-operation with research team (including Ph.D. researchers) of the company. "It is good to have some basic VET, but the most important is the availability to learn new things straight at work."

Results: Company 3

- ▶ Results in questions in the field of Sustainable development and different Advanced manufacturing techniques: 2=30%, 3=55%, 4=15%
- ▶ Results in the field of Working in digital environment: 2=44,4%, 3=44,4%, 5=11,1%.
- ▶ Comments from the company: "Information security is very important."
"Basic professional competence is important and it comes through practical experience."



Thank you

PROJECT TITLE:

**EXCELLENCE IN GREEN
AND DIGITAL
MANUFACTURING**

PRESENTED BY:

Ari Vuokila
Email: Ari.Vuokila@oulu.fi