



Learner Centric Advanced Manufacturing Platform



D3.2 - M24 - Analysis of the Impacts and Evolution of jobs in Advanced Manufacturing

D3.2 - M24 - S - Synthesis of all D3.2 - M24 Sub-reports



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ACRONYMS

AFDET - French Association for the Development of Technical Education
AFNOR - French association for standardisation
AI - Artificial Intelligence
AR - Augmented Reality
AGV - Automated Guided Vehicles
B2B - Business to Business
B2C - Business to Consumer
CMQEI - Campus des Métiers et des Qualifications d'Excellence Industrie du futur
CNC - Computer Numerical Control
EQF - European Qualification Framework
ERP - Enterprise Resource Planning
ESCO - European Skills, Competences, Qualifications and Occupations
FDM - Fused Deposition Modelling
FEM - Finite Element Method
HMI - Human Machine Interfaces
HVET - Higher Vocational Education and Training
IoT - Internet of Things
IT - Information Technology
IUT - University Institute of Technology
LCAMP - Learner-Centric Advanced Manufacturing Platform
M2M - Machine to Machine Communications
MV - *Mecanic Vallée*
SME - Small and Medium-sized Enterprises
VR - Virtual Reality
WP - Work Package



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EXECUTIVE SUMMARY

The LCAMP (Learner-Centric Advanced Manufacturing Platform) project under the CoVE initiative aims to enhance regional skill ecosystems in Advanced Manufacturing.

LCAMP plans to establish a European Platform of Vocational Excellence for Advanced Manufacturing, promoting resilience and innovation across regions through collaboration.

This report is a result of the LCAMP Observatory, which is one of the services the LCAMP platform will make available for the final users. The Observatory is led by the French cluster *Mecanic Vallée* and the French VET centre CMQElf.

During this second year of work, the Observatory Work Package 3 launched an analysis on the impacts of digital and green transitions trends on jobs and skills of the workforce in the advanced manufacturing industry. The analysis focused on a selection of jobs occupied mainly by people qualified by European Qualification Framework (EQF) 3-6 studies.

These analyses are detailed in each regional / national sub-reports written by five countries (the Basque Country, France, Germany, Italy and Turkey) on 28 jobs in the advanced manufacturing industry.

Despite some variations in study methods and presentation of results, this year has established a shared methodological approach and a standardised format for reporting findings, paving the way for further progress.

Drawing from literature review and interviews conducted with companies in the field, several key findings have emerged.

This report is the synthesis of all sub-reports.

In terms of Collaborative Work Process:

- **Methodology:** Each country relied on its own network of experts, with their differences in terms of areas of expertise and availability.
- **Frame:** A detailed presentation, described within a structured database, allows quick cross analysis, based on different axis: trends, skills, jobs/tasks.
- **Results:** Major tendencies of digital and green transition trends, impact on jobs, and required skills have been identified as a result of this analysis.
- **Year 3:** To obtain complete, usable, and certified results going forward, it will be necessary to combine efforts on common analyses. This could result in analysing the impacts of common jobs and reporting in a harmonized framework.



In terms of Impact Analysis and Job Evolutions:

- **Dynamic Job Landscape:** Jobs in advanced manufacturing are undergoing significant transformations due to the digital and green transitions within companies.
- **Influence of Industrial Context:** The evolution of jobs is intricately linked to various factors including company size, digital maturity, production types, business strategies, organisational culture, and regulations.
- **Variability in Job Evolution:** The evolution of specific jobs varies significantly depending on the individual company, highlighting the nuanced nature of workforce changes.
- **Digital Transformation Focus:** Digital transformation initiatives primarily aim at enhancing company performance, with less emphasis placed on individual well-being as the primary driver of change.
- **Versatile Workforce Requirements:** Companies prioritise versatile workers with a flexible mindset towards change, a keen interest in learning, effective communication skills, and problem-solving abilities.
- **Limited Identification of New Jobs:** Few new job roles have been identified, with data analytics positions being predominantly mentioned, particularly in larger companies.
- **Changes in Specific Roles:** Maintenance, Technical Assistance Services (TAS), and automation roles have undergone significant changes in certain cases.
- **Climate Emergency Measures:** Larger companies are more actively implementing climate emergency measures, such as automating carbon footprint calculations and enhancing energy efficiency. However, this process is still in its nascent stages.
- **Specialised Profile Demands:** Companies seek highly specialised profiles tailored to their manufacturing processes. This specialisation is often developed through in-house training and work experience, complementing foundational knowledge acquired from VET schools.
- **Call for Proficiency in Transversal Skills:** VET profiles are expected to possess a solid understanding of fundamentals, proficiency in IT/digital skills and languages, along with holistic transversal skills to meet the demands of advanced manufacturing occupations.

In conclusion, the report underscores the dynamic nature of jobs in advanced manufacturing, driven by digitalisation, greening, and industrial contexts. Companies are increasingly seeking versatile, specialised, and proficient individuals equipped with a blend of technical and transversal skills to thrive in this evolving landscape.

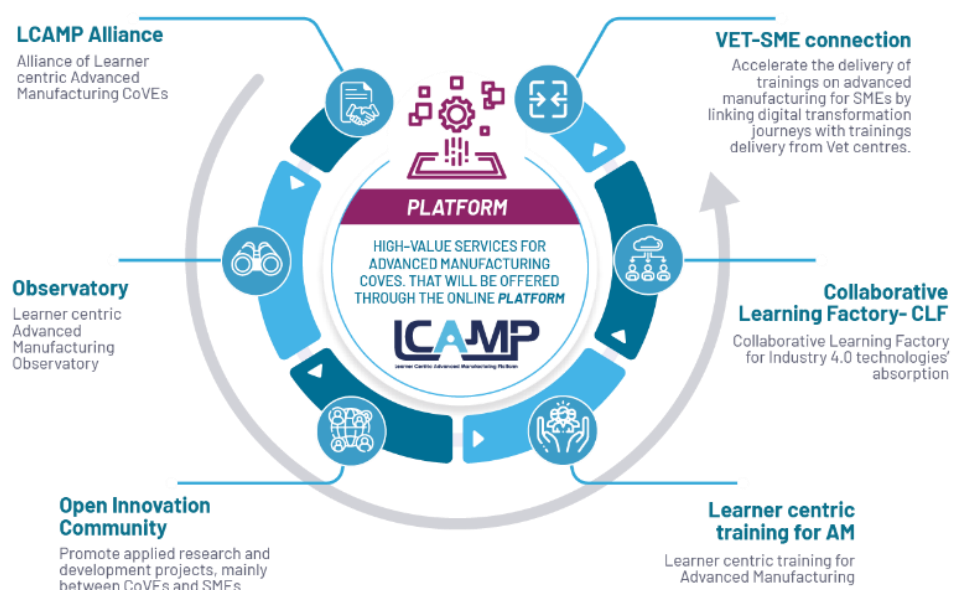


Figure 1 : Outputs and services to be delivered by the LCAMP platform



1. INTRODUCTION

The LCAMP Observatory will serve as an easily accessible source of information for VET centres, authorities in charge of curricula, companies, clusters and other associations through a digital platform. Throughout the LCAMP project, the Observatory will issue periodic reports covering technology trends, labour market changes, skill requirements, and occupations in Advanced Manufacturing.

The following publication of yearly reports is expected:

- Report 1: June 2023, D3.2 – M12
- Report 2: June 2024, D3.2 – M24 (this year's focus)
- Report 3: June 2025, D3.2 – M36

These reports are complemented with regional and national sub reports that will be periodically distributed in the platform and by conventional dissemination channels.

Each of these conclusions are described within all written sub-reports.

In this report, the Observatory work package analyses the impact of digital and green transitions on the competences of the workforce in the advanced manufacturing industry.

It focuses on a selection of jobs occupied mainly by people qualified by European Qualification Framework (EQF) levels 3-6 studies, that make up a significant part of the current demand in industrial companies located in the Autonomous Community of the Basque Country (ACBC), France, Italy, Germany and Turkey, impacted by the digital and green transition (see job selection criteria in section “**Erreur ! Source du renvoi introuvable. Erreur ! Source du renvoi introuvable.**”).

The information gathered and the conclusions reached are the basis for the development of other activities under the LCAMP Project (<https://lcamp.eu/>). In addition, the contents of this report may be analytical material for some stakeholders to develop activities in their respective fields, such as VET Centres, clusters and business associations, companies, etc. These stakeholders will find basic information for the development of activities such as the integration of technology in VET centres, the revision of content (curriculum) and learning methodologies, the updating of continuous training, the design of VET specialties, among others.

The combination of desk (analysis of reports published on the subject in the last years) and field (direct analysis of the job positions selected, conducted through interviews with managers of companies) research activities followed in the elaboration of the report converges in the detailed description of the 28 selected jobs. The elements derived from the general analysis have been combined with elements conditioned by the context of companies, revealing specific results in relation to the 28 jobs.

In term of project management and collaborative work, this year aimed to validate how to describe a job's impact and related skills and validate the frame to allow other work packages to use such Observatory results.



2. OUTCOMES

Year 2 study delivery is constituted by the sub-reports below:

Table 1 : List of sub-reports

WRITER	SUB-REPORT REFERENCE	SUB-REPORT SCOPE	CONCAT	OBJECTIVES
FR	D3.2 - M24 - A	Methodological sub-report	D3.2 - M24 - A Methodological sub-report	Describe objectives, outcomes, scope, and the methodology to produce Sub-reports.
BC	D3.2 - M24 - B	Basque Country sub-report	D3.2 - M24 - B Basque Country sub-report	The purpose of each sub-report is to present how jobs selected, tasks and related skills are impacted by Advanced Manufacturing Digital Technologies and the Green Transition.
FR	D3.2 - M24 - F	French sub-report	D3.2 - M24 - F French sub-report	
GE	D3.2 - M24 - G	Germany sub-report	D3.2 - M24 - G Germany sub-report	
IT	D3.2 - M24 - I	Italy sub-report	D3.2 - M24 - I Italy sub-report	
TR	D3.2 - M24 - T	Turkey sub-report	D3.2 - M24 - T Turkey sub-report	
FR	D3.2 - M24 - S	Synthesis of all D3.2 - M24 sub-reports.	D3.2 - M24 - S Synthesis of all D3.2 - M24 sub-reports.	Provides a synthesis of all D3.2 - M24 reports.
FR	D3.2 - M24 - C	Consolidated report	D3.2 - M24 - C - Consolidated report	Gathering of all sub-report

D3.2 outcomes are the inputs of other LCAMP services, mainly:

- Learner Centric Training for Advanced Manufacturing WP5, which manages skills and curricula data base.
- LCAMP Platform (n.d.) WP8 and Impact Assessment (WP8 which develops the Platform).

These Sub-reports' list in table 1 was defined following to the first stage of the methodology described here after.



3. METHODOLOGIES

The **D3-2-M24-Observatory Methodology** (Pichoutou, 2024) document describes methodology to produce this **Sub-Report**. It includes:

- The methodology to select jobs to analyse
- The methodology to analyse the impacts
- The methodology to validate the Sub-Report

4. SYNTHESIS OF ALL JOB'S IMPACT ANALYSIS

This section deals with the analysis of the selected 16 jobs. As mentioned in the methodology (chapter 3), it was started analysing the changes faced by companies and identifying the **levers of those changes** affecting the specific jobs; then, it was described the **changes in skills and knowledges** detected in the analysis.



4.1. LIST OF SELECTED JOBS

Going through the 5 main criteria that WP3 decided to evaluate, here after the short list of jobs analysed by the 4 countries France, Turkey, Italy and Germany for which detailed data analysis are available:

Table 2 : synthesis of all jobs selected

COUNTRY	ESCO CODE	ESCO OCCUPATION	1 - INDUSTRY SECTORS	2 - DIGITAL AND GREEN TRANSITIONS NEW TRENDS IMPACTING	3 - EMPLOYABILITY	4.RELEVANCE FOR THE SMART SPECIALISATION STRATEGY – AT REGIONAL/COUNTRY?	5 - EDUCATION LEVEL.
FR	2152.1 .13	Predictive Maintenance Expert	Machine tools (Mechanical Engineering), Automotive, Aerospace, Transport, Electric and electronic Industries, Maritime	1-1 Internet of Things (IoT) / Smart Sensors / 5G technology, 1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics, 2-2 3D scanning, 3-1 Cybersecurity, 5-2 Circular Economy		13 regions among the 21 FR regions consider this generic job among the priorities: FRC2; FRD1; FRD2; FRE1; FRE2; FRF1; FRF3; FRG0; FRH0; FRJ2; FRK1; FRK2; FRL0	EQF 6
	2163.1	Industrial Designer	Machine tools (Mechanical Engineering), Automotive, Aerospace, Electric and electronic Industries	1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics, 2-1 Virtual and Augmented Reality, 2-2 3D scanning, 3-1 Cybersecurity, 4-1 3D Printing/Additive Manufacturing, 4-6 Predictive Maintenance, 5-2 Circular Economy, 5-4 Waste Reduction, 5-6 Sustainable Material Innovation	November 2023 - France: 17852 job offers - Product designer: 712 offers (4%) https://www.glassdoor.fr/Emploi/france-product-designer-emplois-SRCH_IL.0,6_IN86_KO7,23.htm	18 regions among the 21 FR regions consider this generic job among the priorities: FR10; FRC2; FRD1; FRD2; FRE1; FRE2; FRF1; FRF2; FRF3; FRG0; FRH0; FRI2; FRI3; FRJ1; FRJ2; FRK1; FRK2; FRL0	EQF 6



3114.1 .10	Sensor Engineering Technician	Machine tools (Mechanical Engineering), Automotive, Aerospace, Electric and electronic Industries, Transport, Maritime	1-1 Internet of Things (IoT) / Smart Sensors / 5G technology, 1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics, 3-1 Cybersecurity, 4-1 3D Printing/Additive Manufacturing, 4-6 Predictive Maintenance, 5-3 Energy Efficiency, 5-10 Sustainable IT Infrastructure, 5-11 Environmental Monitoring and Reporting		18 regions among the 21 FR regions consider this generic job among the priorities:	EQF5
3118.1	3D Printing Technician	Maritime, Electric and electronic Industries, Aerospace, Automotive, Transport	3-1 Cybersecurity, 4-1 3D Printing/Additive Manufacturing, 4-4 Digital Twins, 4-6 Predictive Maintenance, 5-3 Energy Efficiency, 5-4 Waste Reduction, 5-6 Sustainable Material Innovation	In 2022, more than 900 job offers for 3D printing roles were published across the French, English, Spanish, Italian, and German sites of 3Dnatives. This number represents more than double the offers published in the previous year.	10 regions among the 21 FR regions consider this generic job among the priorities: FRC2; FRE1; FRF1; FRF2; FRF3; FRG0; FRH0; FRI2; FRJ2; FRK1	EQF 5
3139.2	Industrial Robot Controller	Machine tools (Mechanical Engineering), Automotive, Aerospace, Electric and electronic Industries, Maritime	1-1 Internet of Things (IoT) / Smart Sensors / 5G technology, 1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics, 2-1 Virtual and Augmented Reality, 3-1 Cybersecurity, 4-1 3D Printing/Additive Manufacturing, 4-4 Digital Twins, 4-6 Predictive Maintenance, 5-12 Corporate Social Responsibility (CSR) Initiatives	November 2023 - France: Robotics technician: 3090 job offers https://candidat.pole-emploi.fr/offres/recherche?motsCles=technicien+robotique&offresPartenaires=true&range=0-19&rayon=10&tri=0	10 regions among the 21 FR regions consider this generic job among the priorities: FR10; FRC2; FRD1; FRF3; FRG0; FRH0; FRJ2; FRK1; FRK2; FRL0	EQF6
7543.9	Product Quality Controller	Machine tools (Mechanical Engineering), Automotive, Aerospace, Electric and electronic Industries	1-1 Internet of Things (IoT) / Smart Sensors / 5G technology, 1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics, 2-2 3D scanning, 3-1 Cybersecurity, 4-1 3D Printing/Additive Manufacturing, 4-2 Robotics and Automation	November 2023 - France: QA engineer: 1639 job offers https://candidat.pole-emploi.fr/offres/recherche?motsCles=ing%C3%A9nieur+testeur&offresPartenaire=true&range=0-19&rayon=10&tri=0	12 regions among the 21 FR regions consider this generic job among the priorities: FRC2; FRD1; FRD2; FRE1; FRF2; FRF3; FRG0; FRH0; FRJ2; FRK1; FRK2; FRL0	EQF 6



TR	7223.4	Computer Numerical Control Machine Operator	Machine tools (Mechanical Engineering), Automotive, Aerospace	"1-1 Internet of Things (IoT) / Smart Sensors / 5G technology, 1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics, 4-2 Robotics and Automation, 4-3 Collaborative Robots (Cobots), 4-6 Predictive Maintenance, 5-3 Energy Efficiency, 5-6 Sustainable Material Innovation"	April 2024 - Türkiye: CNC Operator: 64 job offers (İŞKUR) 373 job offers (kariyer.net) Sources: İŞKUR - Bilgisayarlı Makine (CNC Operatörü) https://esube.iskur.gov.tr/Istihdam/AcikIsIlanAra.aspx https://www.kariyer.net/is-ilanlari/cnc-operatoru?pst=4150&pkw=cnc%20operat%C3%B6r%C3%BC	Aligns with the S3 priorities of "Automotive plastics" and "Power units" https://s3platform.jrc.ec.europa.eu/region-page-test/-/regions/TR42	EQF Level 4
	7543.9	Product Quality Controller	Automotive, Aerospace, Electric and electronic Industries, Machine tools (Mechanical Engineering)	"1-1 Internet of Things (IoT) / Smart Sensors / 5G technology, 2-2 3D scanning, 3-1 Cybersecurity, 4-2 Robotics and Automation, 4-3 Collaborative Robots (Cobots), 5-3 Energy Efficiency, 5-4 Waste Reduction"	April 2024 - Türkiye: Quality Controller: 222 job offers (İŞKUR) 514 job offers (kariyer.net) Sources: İŞKUR - Kalite Kontrolcü https://esube.iskur.gov.tr/Istihdam/AcikIsIlanAra.aspx https://www.kariyer.net/is-ilanlari/kalite-kontrol+elemani?pst=960&pkw=kalite%20kontrol%20eleman%C4%B1	Aligns with most of the S3 priorities given for TR42 region. https://s3platform.jrc.ec.europa.eu/region-page-test/-/regions/TR42	EQF Level 6
	2529.8	ICT Security Manager	Transport, Electric and electronic Industries, Aerospace, Automotive	"1-1 Internet of Things (IoT) / Smart Sensors / 5G technology, 1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics, 3-1 Cybersecurity, 5-10 Sustainable IT Infrastructure, 5-12 Corporate Social Responsibility (CSR) Initiatives"	April 2024 - Türkiye: ICT Security Specialist: 28 job offers (kariyer.net) https://www.kariyer.net/is-ilanlari/it-guvenlik+uzmani?pst=4558&pkw=%C4%B1t%20g%C3%BCvenlik%20uzman%C4%B1	Although not directly addressed under S3, it is relevant to all businesses, especially ones affected more by the digital transition trends.	EQF Level 5



	1213.8	Sustainability Manager	Machine tools (Mechanical Engineering), Automotive, Aerospace, Electric and electronic Industries, Transport, Maritime	"1-1 Internet of Things (IoT) / Smart Sensors / 5G technology, 1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics, 5-1 Renewable Energy Integration, 5-3 Energy Efficiency, 5-4 Waste Reduction, 5-5 Green Logistics and Supply Chain, 5-6 Sustainable Material Innovation, 5-7 Carbon Footprint Management, 5-11 Environmental Monitoring and Reporting, 5-12 Corporate Social Responsibility (CSR) Initiatives"	April 2024 - Türkiye: Sustainability Manager: 2 job offers (kariyer.net) https://www.kariyer.net/is-ilanlari?pst=12185&pkw=s%C3%BCrd%C3%BCr%C3%BClebilirlik%20m%C3%BCd%C3%BCr%C3%BC	Although not directly addressed under S3, it is relevant to all businesses, especially ones affected more by the green transition trends.	EQF Level 6
	3139.1	Automated Assembly Line Operator	Automotive, Aerospace, Electric and electronic Industries	"1-1 Internet of Things (IoT) / Smart Sensors / 5G technology, 4-2 Robotics and Automation, 4-3 Collaborative Robots (Cobots), 4-6 Predictive Maintenance, 5-6 Sustainable Material Innovation"	This occupation is not directly listed in career sites, instead they are listed under assembly line operators for different types of sectors.	Aligns with the S3 priority of "Automotive plastics" https://s3platform.jrc.ec.europa.eu/regi-on-page-test/-/regions/TR42	EQF Level 3
IT	2511.3	Data Analyst	Machine tools (Mechanical Engineering), Automotive, Aerospace, Electric and electronic Industries, Transport, Maritime	1-1 Internet of Things (IoT) / Smart Sensors / 5G technology, 1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics, 5-5 Green Logistics and Supply Chain, 5-3 Energy Efficiency, 2-1 Virtual and Augmented Reality, 3-1 Cybersecurity	High difficulty in finding	Lombardy Region and Piedmont Region consider Advanced Manufacturing as one of the priorities in their S3	In Italy, courses and programs for Data Engineers often fall within EQF (European Qualifications Framework) levels 6 to 8, which correspond to undergraduate and postgraduate levels.6, such as bachelor courses in Data Science or Statistics.



2141.4 .2.1	Automation Engineer	Automotive, Machine tools (Mechanical Engineering)	1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics, 1-1 Internet of Things (IoT) / Smart Sensors / 5G technology, 2-1 Virtual and Augmented Reality, 5-3 Energy Efficiency	Average difficulty in finding: 61%	Lombardy Region and Piedmont Region consider Advanced Manufacturing as one of the priorities in their S3	In Italy, courses and programs for Automation Engineer often fall within EQF (European Qualifications Framework) levels 6 to 8, which correspond to undergraduate and postgraduate levels.6, such as bachelor's degree in Automation Engineering or Robotics.
2529.4	Ethical Hackers (Main Title Of ESCO Occupation)/Cybersecurity Specialist (Alternative Label Put On The ESCO Occupation)	Electric and electronic Industries, Transport, Maritime	1-1 Internet of Things (IoT) / Smart Sensors / 5G technology, 3-2 Edge Computing vs Cloud Computing / Blockchain for Supply Chain / Quantum Computing, 4-4 Digital Twins, 5-2 Circular Economy, 5-4 Waste Reduction	Average difficulty in finding: 50 %	Lombardy Region and Piedmont Region consider Advanced Manufacturing as one of the priorities in their S3	In Italy, courses and programs for Cybersecurity Specialist often fall within EQF (European Qualifications Framework) levels 6 to 8, which correspond to undergraduate and postgraduate levels.6, such as bachelor's degree in computer science.



GERMANY	3118.1	3D Printing Technician	Automotive, Aerospace, Electric and electronic Industries, Machine tools (Mechanical Engineering), Maritime	1-1 Internet of Things (IoT) / Smart Sensors / 5G technology, 1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics, 2-2 3D scanning, 4-1 3D Printing/Additive Manufacturing, 4-2 Robotics and Automation, 4-4 Digital Twins, 4-5 Adaptive Manufacturing Systems, 4-6 Predictive Maintenance, 5-4 Waste Reduction, 5-2 Circular Economy, 5-3 Energy Efficiency, 5-6 Sustainable Material Innovation, 5-11 Environmental Monitoring and Reporting	<p>Employability in 2024: The rapid adoption of additive manufacturing in aerospace, automotive, healthcare, and consumer goods is driving demand for skilled operators. Additive manufacturing's benefits, like reduced lead times and design flexibility, boost job opportunities across sectors. High demand exists for operators skilled in managing Advanced Manufacturing equipment, preparing digital models, post-processing, and quality control.</p> <p>Employability in 5 Years (2029): Technological advancements require operators to update their skills to enhance speed, accuracy, and material diversity. More integrated roles in hybrid manufacturing settings create additional jobs, blending traditional and additive manufacturing skills. Specialisation in specific types of additive manufacturing, such as metal or polymer printing, offer new career paths.</p> <p>Employability in 10 Years (2034): Seasoned operators find opportunities in leadership, training, or entrepreneurial roles within the industry. Full integration with Industry 4.0 necessitates a deep understanding of digital technologies and data analytics. Staying competitive require continuous learning and adaptability to new technologies and market demands.</p> <p>Conclusion: Promising employability prospects exist for Additive Manufacturing Operators, with strong growth expected in this sector.</p>	The Region of Baden-Württemberg considers Advanced Manufacturing as one of the priorities in its S3. https://ec.europa.eu/regional_policy/as-sets/s3-observatory/regions/de1.html	EQF Level 4 (trained skilled worker or equivalent): Operators undertake corresponding tasks, potentially with supervisory roles, troubleshooting, and process optimisation.
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	7223.4	Computer Numerical Control Machine Operator	Machine tools (Mechanical Engineering), Automotive, Aerospace, Maritime, Electric and electronic Industries	<p>1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics,</p> <p>3-1 Cybersecurity,</p> <p>4-2 Robotics and Automation,</p> <p>4-3 Collaborative Robots (Cobots),</p> <p>4-4 Digital Twins,</p> <p>4-5 Adaptive Manufacturing Systems,</p> <p>1-1 Internet of Things (IoT) / Smart Sensors / 5G technology,</p> <p>5-3 Energy Efficiency,</p> <p>5-4 Waste Reduction</p>	<p>Current Factors (2024):</p> <p>CNC machining is crucial in industries like aerospace, automotive, electronics, and medical devices, ensuring steady demand for skilled operators. Technological advancements in automation, precision, and efficiency require highly skilled operators. Integration of robotics and CAM software boosts efficiency, increasing the need for proficient operators. A skill shortage has created a competitive job market with ample opportunities for qualified individuals.</p> <p>Employability in 5 Years (2029):</p> <p>Increased automation and robotics integration sustain high demand for adaptable CNC operators. Advanced digital skills, including proficiency in CAD/CAM software and CNC programming, are essential. Specialisation in areas like additive manufacturing, multi-axis, or high-speed machining could offer new career paths based on industry needs.</p> <p>Employability in 10 Years (2034):</p> <p>CNC machining remains vital to manufacturing, ensuring continued demand for skilled operators. Engaging with emerging technologies such as nanotechnology, advanced materials, and digital twins are crucial, necessitating ongoing learning. Global economic and industry trends influence employability, emphasizing flexibility and adaptability in skills and practices.</p> <p>Conclusion:</p> <p>CNC operators who continuously update their skills and adapt to new technologies and industry trends can expect to remain highly employable, supporting the hypothesis provided.</p>	<p>The Region of Baden-Württemberg considers Advanced Manufacturing as one of the priorities in its S3. https://ec.europa.eu/regional_policy/as-sets/s3-observatory/regions/de1.html</p>	<p>EQF Level 5 (technician or equivalent):</p> <p>CNC-Technicians at this level have advanced CNC skills, capable of programming complex operations, proficient in multi-axis machining, adaptive control, and integrated CAD/CAM systems optimizing tool paths, and conducting comprehensive troubleshooting. They also manage less experienced operators and contribute to process improvements.</p>
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4.2. RESULTS AND STATISTICS

Here after the synthesis of the 16 jobs analysed per country:

Table 3 : Synthesis of the jobs analysed per country.

OCCUPATION REF	OCCUPATION TITLE	FR	GE	IT	TR
2152.1.13	Predictive maintenance expert	8			
2163.1	industrial designer	9			
3114.1.10	sensor engineering technician	8			
3118.1	3D printing Technician	7	11		
3139.2	Industrial robot controller	16			
7543.9	product quality controller	11			10
7223.4	Computer Numerical Control machine operator		12		10
2511.3	Data Analyst			6	
2141.4.2.1	Automation Engineer			5	
2529.4	Ethical Hackers			5	
1213.8	Sustainability Manager				17
2529.8	ICT Security Manager				12
2152.1	Electronics Engineer				11
3139.1	Automated Assembly Line Operator				7

4.2.1. JOBS IMPACTED BY TRENDS

Below, it is presented a table which summarises jobs considered as impacted by each trend (list of trends detailed in chapter 3.1.1 Fields, Areas of observation). Details of the analysis are available in the corresponding sub-reports.

Table 4 : Jobs impacted by trends.

IMPACTING DIGITAL TECHNOLOGY AND/OR GREEN TRANSITION	OCCUPATION REF.	OCCUPATION TITLE	FR	GE	IT	TR
1-1 Internet of Things (IoT) / Smart Sensors / 5G technology	2152.1.13	Predictive maintenance expert	2			
	3114.1.10	sensor engineering technician	3			
	3118.1	3D printing Technician		1		
	3139.2	Industrial robot controller	2			
	7543.9	product quality controller	2			1



	7223.4	Computer Numerical Control machine operator				2
	2511.3	Data Analyst			1	
	2141.4.2.1	Automation Engineer			1	
	2529.4	Ethical Hackers			1	
	1213.8	Sustainability Manager				3
	2529.8	ICT Security Manager				2
	3139.1	Automated Assembly Line Operator				1
1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics	2152.1.13	Predictive maintenance expert	1			
	2163.1	industrial designer	2			
	3114.1.10	sensor engineering technician	2			
	3118.1	3D printing Technician		2		
	3139.2	Industrial robot controller	3			
	7543.9	product quality controller	4			
	7223.4	Computer Numerical Control machine operator		3		3
	2511.3	Data Analyst			1	
	2141.4.2.1	Automation Engineer			2	
	1213.8	Sustainability Manager				2
	2529.8	ICT Security Manager				2
2-1 Virtual and Augmented Reality	2152.1.13	Predictive maintenance expert	2			
	2163.1	industrial designer	1			
	3139.2	Industrial robot controller	3			
	2511.3	Data Analyst			1	
	2141.4.2.1	Automation Engineer			1	
2-2 3D scanning	2152.1.13	Predictive maintenance expert	1			
	2163.1	industrial designer	2			
	7543.9	product quality controller	1			1
3-1 Cybersecurity	2152.1.13	Predictive maintenance expert	1			
	3114.1.10	sensor engineering technician	1			



	3118.1	3D printing Technician	1	1		
	3139.2	Industrial robot controller	1			
	7543.9	product quality controller	1			1
	7223.4	Computer Numerical Control machine operator		1		
	2511.3	Data Analyst			1	
	2529.8	ICT Security Manager				5
3-2 Edge Computing vs Cloud Computing / Blockchain for Supply Chain / Quantum Computing	2529.4	Ethical Hackers			1	
4-1 3D Printing/Additive Manufacturing	2163.1	industrial designer	2			
	3118.1	3D printing Technician	2	2		
	3139.2	Industrial robot controller	1			
	7543.9	product quality controller	2			
4-2 Robotics and Automation	7543.9	product quality controller	1			2
	7223.4	Computer Numerical Control machine operator		2		1
	3139.1	Automated Assembly Line Operator				2
4-3 Collaborative Robots (Cobots)	7543.9	product quality controller				1
	7223.4	Computer Numerical Control machine operator				1
	3139.1	Automated Assembly Line Operator				1
4-4 Digital Twins	3118.1	3D printing Technician	1			
	3139.2	Industrial robot controller	1			
	2529.4	Ethical Hackers			1	
4-5 Adaptive Manufacturing Systems	7223.4	Computer Numerical Control machine operator		1		
4-6 Predictive Maintenance	3114.1.10	sensor engineering technician	1			
	3118.1	3D printing Technician	1	3		
	3139.2	Industrial robot controller	1			
	7223.4	Computer Numerical Control machine operator		3		1
	3139.1	Automated Assembly Line Operator				1



5-1 Renewable Energy Integration	1213.8	Sustainability Manager				1
5-10 Sustainable IT Infrastructure	2529.8	ICT Security Manager				1
5-11 Environmental Monitoring and Reporting	1213.8	Sustainability Manager				2
5-12 Corporate Social Responsibility (CSR) Initiatives	3139.2	Industrial robot controller	1			
	7223.4	Computer Numerical Control machine operator		2		
	1213.8	Sustainability Manager				3
	2529.8	ICT Security Manager				2
5-2 Circular Economy	2152.1.13	Predictive maintenance expert	1			
	2163.1	industrial designer	1			
	2529.4	Ethical Hackers			1	
5-3 Energy Efficiency	3118.1	3D printing Technician	1			
	7543.9	product quality controller				2
	7223.4	Computer Numerical Control machine operator				1
	2511.3	Data Analyst			1	
	2141.4.2.1	Automation Engineer			1	
	1213.8	Sustainability Manager				1
5-4 Waste Reduction	7543.9	product quality controller				2
	2529.4	Ethical Hackers			1	
	1213.8	Sustainability Manager				1
5-5 Green Logistics and Supply Chain	2511.3	Data Analyst			1	
	1213.8	Sustainability Manager				1
5-6 Sustainable Material Innovation	2163.1	industrial designer	1			
	3118.1	3D printing Technician	1	2		
	7223.4	Computer Numerical Control machine operator				1
	1213.8	Sustainability Manager				2
	3139.1	Automated Assembly Line Operator				2
5-7 Carbon Footprint Management	1213.8	Sustainability Manager				1
5-X All Green Transition Trends / Sustainable Manufacturing	3114.1.10	sensor engineering technician	1			
	3139.2	Industrial robot controller	3			



4.2.2. TRENDS IMPACTING JOBS

Below, it is presented a table which lists trends which are considered as impacting jobs (list of trends detailed in chapter 3.1.1 Fields, Areas of observation). Details of the analysis are available in the corresponding sub-reports.

When several countries analysed the same occupation, it is easy to identify when the results are not always the same. This is the case for instance for 3D printing technician analysed by France and Germany.

Table 5 : Trends impacting jobs

OCCUPATION REF	OCCUPATION TITLE	IMPACTING DIGITAL TECHNOLOGY AND/OR GREEN TRANSITION	FR	GE	IT	TR
2152.1.13	Predictive maintenance expert	1-1 Internet of Things (IoT) / Smart Sensors / 5G technology	2			
		1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics	1			
		2-1 Virtual and Augmented Reality	2			
		2-2 3D scanning	1			
		3-1 Cybersecurity	1			
		5-2 Circular Economy	1			
2163.1	industrial designer	1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics	2			
		2-1 Virtual and Augmented Reality	1			
		2-2 3D scanning	2			
		4-1 3D Printing/Additive Manufacturing	2			
		5-2 Circular Economy	1			
		5-6 Sustainable Material Innovation	1			
3114.1.10	sensor engineering technician	1-1 Internet of Things (IoT) / Smart Sensors / 5G technology	3			
		1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics	2			
		3-1 Cybersecurity	1			
		4-6 Predictive Maintenance	1			
		5-X All Green Transition Trends / Sustainable Manufacturing	1			
3118.1	3D printing Technician	1-1 Internet of Things (IoT) / Smart Sensors / 5G technology		1		
		1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics		2		



		3-1 Cybersecurity	1	1		
		4-1 3D Printing/Additive Manufacturing	2	2		
		4-4 Digital Twins	1			
		4-6 Predictive Maintenance	1	3		
		5-3 Energy Efficiency	1			
		5-6 Sustainable Material Innovation	1	2		
3139.2	Industrial robot controller	1-1 Internet of Things (IoT) / Smart Sensors / 5G technology	2			
		1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics	3			
		2-1 Virtual and Augmented Reality	3			
		3-1 Cybersecurity	1			
		4-1 3D Printing/Additive Manufacturing	1			
		4-4 Digital Twins	1			
		4-6 Predictive Maintenance	1			
		5-12 Corporate Social Responsibility (CSR) Initiatives	1			
		5-X All Green Transition Trends / Sustainable Manufacturing	3			
7543.9	product quality controller	1-1 Internet of Things (IoT) / Smart Sensors / 5G technology	2			1
		1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics	4			
		2-2 3D scanning	1			1
		3-1 Cybersecurity	1			1
		4-1 3D Printing/Additive Manufacturing	2			
		4-2 Robotics and Automation	1			2
		4-3 Collaborative Robots (Cobots)				1
		5-3 Energy Efficiency				2
		5-4 Waste Reduction				2
7223.4	Computer Numerical Control machine operator	1-1 Internet of Things (IoT) / Smart Sensors / 5G technology				2
		1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics		3		3



		3-1 Cybersecurity		1		
		4-2 Robotics and Automation		2		1
		4-3 Collaborative Robots (Cobots)				1
		4-5 Adaptive Manufacturing Systems		1		
		4-6 Predictive Maintenance		3		1
		5-12 Corporate Social Responsibility (CSR) Initiatives		2		
		5-3 Energy Efficiency				1
		5-6 Sustainable Material Innovation				1
2511.3	Data Analyst	1-1 Internet of Things (IoT) / Smart Sensors / 5G technology			1	
		1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics			1	
		2-1 Virtual and Augmented Reality			1	
		3-1 Cybersecurity			1	
		5-3 Energy Efficiency			1	
		5-5 Green Logistics and Supply Chain			1	
2141.4.2.1	Automation Engineer	1-1 Internet of Things (IoT) / Smart Sensors / 5G technology			1	
		1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics			2	
		2-1 Virtual and Augmented Reality			1	
		5-3 Energy Efficiency			1	
2529.4	Ethical Hackers	1-1 Internet of Things (IoT) / Smart Sensors / 5G technology			1	
		3-2 Edge Computing vs Cloud Computing / Blockchain for Supply Chain / Quantum Computing			1	
		4-4 Digital Twins			1	
		5-2 Circular Economy			1	
		5-4 Waste Reduction			1	
1213.8	Sustainability Manager	1-1 Internet of Things (IoT) / Smart Sensors / 5G technology				3
		1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics				2



		5-1 Renewable Energy Integration			1
		5-11 Environmental Monitoring and Reporting			2
		5-12 Corporate Social Responsibility (CSR) Initiatives			3
		5-3 Energy Efficiency			1
		5-4 Waste Reduction			1
		5-5 Green Logistics and Supply Chain			1
		5-6 Sustainable Material Innovation			2
		5-7 Carbon Footprint Management			1
2529.8	ICT Security Manager	1-1 Internet of Things (IoT) / Smart Sensors / 5G technology			2
		1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics			2
		3-1 Cybersecurity			5
		5-10 Sustainable IT Infrastructure			1
		5-12 Corporate Social Responsibility (CSR) Initiatives			2
2152.1	Electronics Engineer	1-1 Internet of Things (IoT) / Smart Sensors / 5G technology			4
		4-1 3D Printing/Additive Manufacturing			3
		5-1 Renewable Energy Integration			3
		5-3 Energy Efficiency			1
3139.1	Automated Assembly Line Operator	1-1 Internet of Things (IoT) / Smart Sensors / 5G technology			1
		4-2 Robotics and Automation			2
		4-3 Collaborative Robots (Cobots)			1
		4-6 Predictive Maintenance			1
		5-6 Sustainable Material Innovation			2



4.2.3. JOBS – TRENDS IMPACT – SKILLS NEEDED

From trends impacts, it is identified related needed skills to support the changes. To simplify the analysis, all needed skills identified in 7 groups are grouped Here after, are the needed type of skills, allowing to support trends impacts, per occupation and trend. To sum up, 165 skills are identified which are involved by these trends' impacts.

Table 6 : Needed type of skills

OCCUPATION TITLE	IMPACTING DIGITAL TECHNOLOGY AND/OR GREEN TRANSITION	INTER-DISCIPLINARY COOPERATION AND PROJECT MANAGEMENT	PRODUCTION AND MANUFACTURING TECHNOLOGIES	DIGITALISATION AND IT SECURITY	TECHNOLOGICAL CORE COMPETENCES	DATA ANALYSIS AND ARTIFICIAL INTELLIGENCE	SUSTAINABILITY AND ENVIRONMENTAL MANAGEMENT	VIRTUAL AND AUGMENTED REALITY
Predictive Maintenance Expert	1-1 Internet of Things (IoT) / Smart Sensors / 5G technology			2				
	1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics					1		
	2-1 Virtual and Augmented Reality	1						1
	2-2 3D scanning		1					
	3-1 Cybersecurity			1				
	5-2 Circular Economy						1	
Industrial Designers	1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics					2		
	2-1 Virtual and Augmented Reality							1
	2-2 3D scanning		2					
	4-1 3D Printing/Additive Manufacturing	1	1					
	5-2 Circular Economy						1	



	5-6 Sustainable Material Innovation						1	
Sensor Engineering Technicians	1-1 Internet of Things (IoT) / Smart Sensors / 5G technology			2	1			
	1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics					2		
	3-1 Cybersecurity			1				
	4-6 Predictive Maintenance					1		
	5-X All Green Transition Trends / Sustainable Manufacturing						1	
3D printing Technician	1-1 Internet of Things (IoT) / Smart Sensors / 5G technology			1				
	1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics					2		
	3-1 Cybersecurity			2				
	4-1 3D Printing/Additive Manufacturing	2	1	1				
	4-4 Digital Twins			1				
	4-6 Predictive Maintenance	1				3		
	5-3 Energy Efficiency						1	
	5-6 Sustainable Material Innovation				1	1	1	
Industrial Robot Controller	1-1 Internet of Things (IoT) / Smart Sensors / 5G technology			2				
	1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics					3		
	2-1 Virtual and Augmented Reality							3
	3-1 Cybersecurity			1				
	4-1 3D Printing/Additive Manufacturing		1					
	4-4 Digital Twins		1					
	4-6 Predictive Maintenance					1		
	5-12 Corporate Social Responsibility (CSR) Initiatives						1	



	5-X All Green Transition Trends / Sustainable Manufacturing	1					2	
Product Quality Controller	1-1 Internet of Things (IoT) / Smart Sensors / 5G technology				3			
	1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics					4		
	2-2 3D scanning		1					1
	3-1 Cybersecurity			2				
	4-1 3D Printing/Additive Manufacturing		2					
	4-2 Robotics and Automation		3					
	4-3 Collaborative Robots (Cobots)		1					
	5-3 Energy Efficiency	1				1		
	5-4 Waste Reduction	1				1		
Computer Numerical Control Machine Operator	1-1 Internet of Things (IoT) / Smart Sensors / 5G technology			1	1			
	1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics					5		
	3-1 Cybersecurity			1				
	4-2 Robotics and Automation		2			1		
	4-3 Collaborative Robots (Cobots)		1					
	4-5 Adaptive Manufacturing Systems	1						
	4-6 Predictive Maintenance					4		
	5-12 Corporate Social Responsibility (CSR) Initiatives	2						
	5-3 Energy Efficiency						1	
	5-6 Sustainable Material Innovation						1	
Data Analyst	1-1 Internet of Things (IoT) / Smart Sensors / 5G technology			1				
	1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics					1		
	2-1 Virtual and Augmented Reality							1
	3-1 Cybersecurity			1				
	5-3 Energy Efficiency	1						



	5-5 Green Logistics and Supply Chain	1						
Automation Engineer	1-1 Internet of Things (IoT) / Smart Sensors / 5G technology			1				
	1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics					2		
	2-1 Virtual and Augmented Reality							1
	5-3 Energy Efficiency				1			
Ethical Hackers	1-1 Internet of Things (IoT) / Smart Sensors / 5G technology			1				
	3-2 Edge Computing vs Cloud Computing / Blockchain for Supply Chain / Quantum Computing			1				
	4-4 Digital Twins			1				
	5-2 Circular Economy	1						
	5-4 Waste Reduction						1	
Sustainability Manager	1-1 Internet of Things (IoT) / Smart Sensors / 5G technology						3	
	1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics						2	
	5-1 Renewable Energy Integration						1	
	5-11 Environmental Monitoring and Reporting						2	
	5-12 Corporate Social Responsibility (CSR) Initiatives	3						
	5-3 Energy Efficiency						1	
	5-4 Waste Reduction						1	
	5-5 Green Logistics and Supply Chain						1	
	5-6 Sustainable Material Innovation						2	
	5-7 Carbon Footprint Management						1	
ICT Security Manager	1-1 Internet of Things (IoT) / Smart Sensors / 5G technology			1	1			
	1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics					2		
	3-1 Cybersecurity			5				
	5-10 Sustainable IT Infrastructure			1				
	5-12 Corporate Social Responsibility (CSR) Initiatives	1		1				



Electronics Engineer	1-1 Internet of Things (IoT) / Smart Sensors / 5G technology			2	2			
	4-1 3D Printing/Additive Manufacturing		1	1	1			
	5-1 Renewable Energy Integration				1		2	
	5-3 Energy Efficiency						1	
Automated Assembly Line Operator	1-1 Internet of Things (IoT) / Smart Sensors / 5G technology				1			
	4-2 Robotics and Automation		2					
	4-3 Collaborative Robots (Cobots)		1					
	4-6 Predictive Maintenance					1		
	5-6 Sustainable Material Innovation						2	

The gathering of skills per type of skills is available in Annex 8.1. Gathering of Skills per Type of Skills.



4.2.1. JOBS / SKILLS IMPACTS BY DIGITAL TRENDS

All these results can be visualised and classified, allowing to identify the “level” of digital trends’ impacts related to number of jobs impacted (horizontal axis) and related number of skills involved (vertical axis) as shown in figure 20.

It is identified for instance the two main trends considered as the most impacting in regards of these two axes:

- **The ability to gather information from the shop floor:** 1-1 Internet of things, smart sensors, 5G technology
- **The ability to analyse these data:** 1-2 Artificial Intelligence (AI) / Machine learning, Big Data Analytics.

- 1 1-1 Internet of Things (IoT) / Smart sensors / 5G technology
- 2 1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics
- 3 2-1 Virtual and Augmented Reality
- 4 2-2 3D scanning
- 5 3-1 Cybersecurity
- 6 3-2 Edge Computing vs Cloud Computing / Blockchain for Supply Chain / Quantum Computing
- 7 4-1 3D Printing/Additive Manufacturing
- 8 4-2 Robotics and Automation
- 9 4-3 Collaborative Robots (Cobots)
- 10 4-4 Digital Twins
- 11 4-5 Adaptive Manufacturing Systems
- 12 4-6 Predictive Maintenance

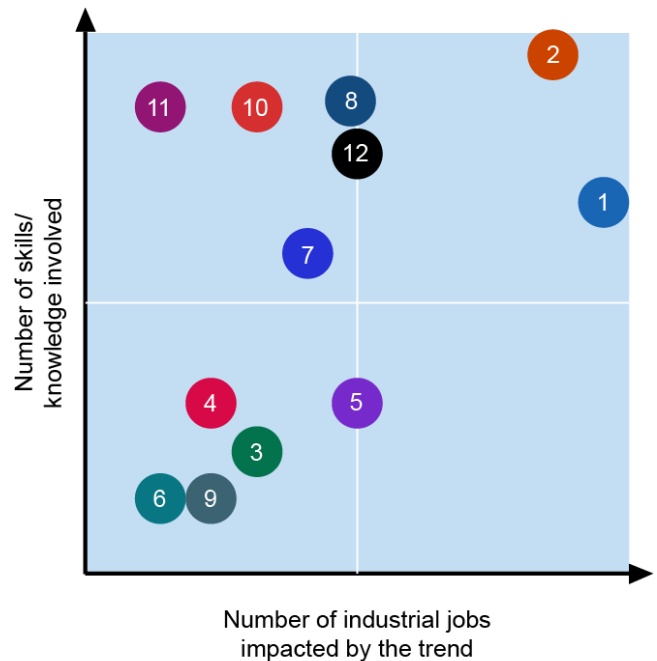


Figure 2 : Trends

Figure 3 : Level of Digital trends' impacts related to jobs impacted



4.2.2. JOBS/SKILLS IMPACTS BY GREEN TRANSITION TRENDS

The presentation and classification can be carried out in the same manner, facilitating the identification of the "level" of impact from Green transition trends, as depicted in Figure 22.

This summarised analysis of impacts suggests that Green transition trends are not significantly affecting the 16 selected jobs.

- 1 5-1 Renewable Energy Integration
- 2 5-2 Circular Economy
- 3 5-3 Energy Efficiency
- 4 5-4 Waste Reduction
- 5 5-5 Green Logistics and Supply Chain
- 6 5-6 Sustainable Material Innovation
- 7 5-7 Carbon Footprint Management
- 8 5-8 Eco-friendly Packaging
- 9 5-9 Biometrics in Design
- 10 5-10 Sustainable IT Infrastructure
- 11 5-11 Environmental Monitoring and Reporting
- 12 5-12 Corporate Social Responsibility (CSR) Initiatives

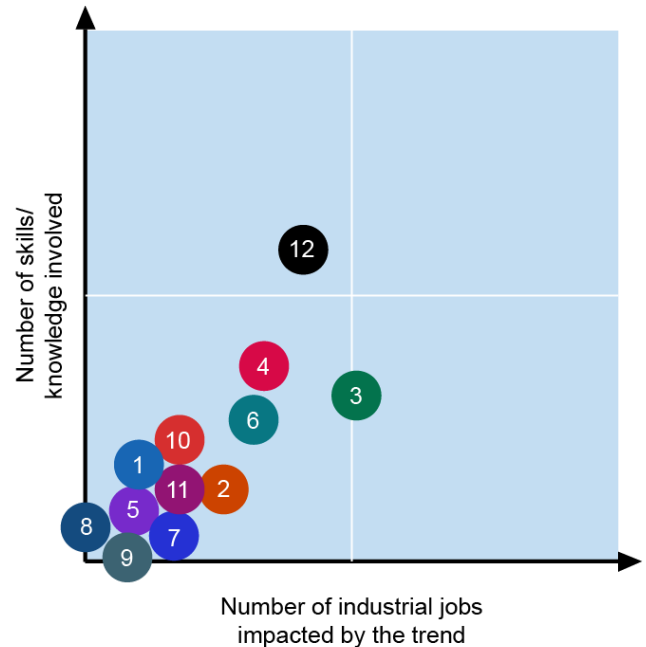


Figure 4 : Green transition trends

Figure 5 : Level of Green transition trends' impacts

The question which raises, thanks to this presentation is: did impacts well identified on jobs regarding green transition trends?

Indeed, in accordance with [World Economic Forum \(https://www.weforum.org/agenda/2024/01/green-transition-skilled-workforce-manpowergroup/\)](https://www.weforum.org/agenda/2024/01/green-transition-skilled-workforce-manpowergroup/) (Prising, 2022), the green transition is anticipated to create up to 30 million new jobs by 2030, yet 75% of employers struggle to find skilled talent, and 94% lack the skills needed to meet their ESG (Environmental, Social, and Governance criteria) goals, emphasizing the necessity for substantial upskilling and reskilling efforts. This transition is particularly impactful within highly technical industries like renewable energy and automotive, where specific green skills are in short supply and urgently needed to meet the growing demand.

If we do consider the following figure, the impact of the green transition will be more focused on the greening of existing jobs versus entirely new jobs.

However, 75% of employers report difficulties in finding skilled talent, and 94% of them are lacking the necessary skills to meet their Environmental, Social, and Governance (ESG) objectives. This underscores a significant need for comprehensive upskilling and reskilling, particularly in highly technical industries such as renewable energy and automotive, where there is a critical shortage of specific green skills required to meet increasing demands. Considering the subsequent figure, the influence of the green transition appears to be more about enhancing the green capabilities of existing jobs rather than creating entirely new positions.



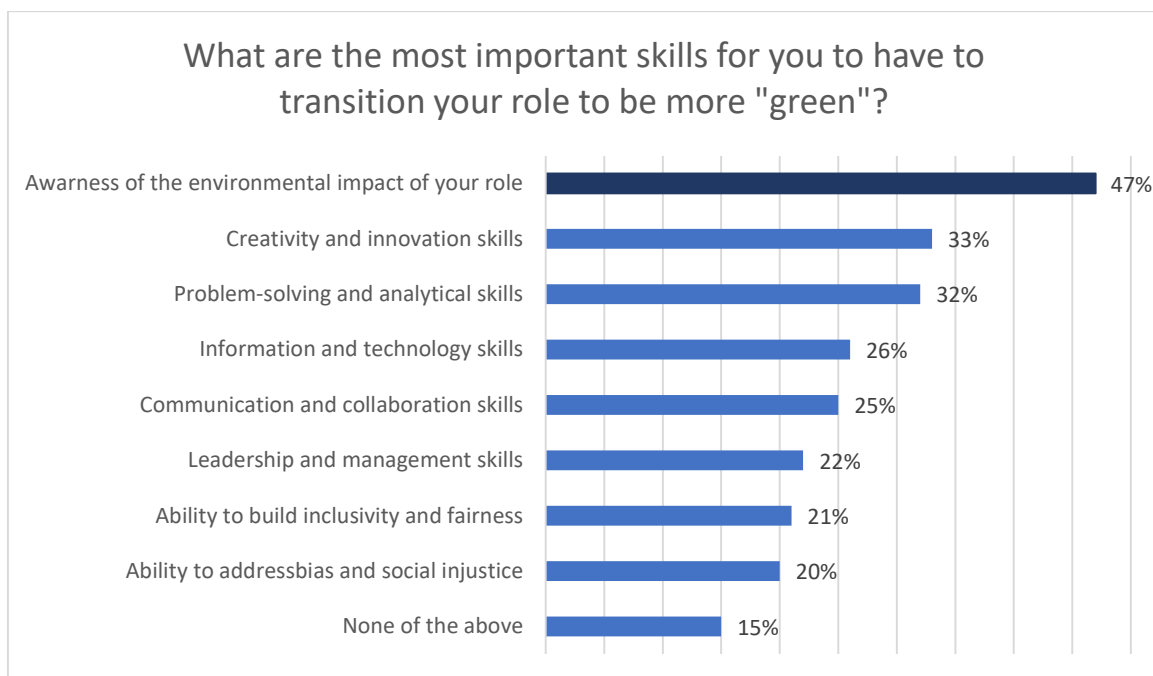


Figure 6: the most important skills to have to transition roles to be more "green"

These statements are confirmed in this [this publication](https://economy-finance.ec.europa.eu/system/files/2022-12/dp176_en_green%20transition%20labour.pdf) (https://economy-finance.ec.europa.eu/system/files/2022-12/dp176_en_green%20transition%20labour.pdf) from Europe (Vandeplas, 2022).



5. CONCLUSION AND OUTLOOKS

The study has established a robust methodology and framework for analysing the impact of digital and green trends on jobs, allowing for accurate identification of regional discrepancies and guiding the analysis roadmap. The framework has proven useful, comprehensive and usable data to fill the future LCAMP Platform. It will provide valuable insights for trainers and teachers to modify curricula and create new micro-credentials.

The primary objective being to gather sufficient data to propose clear and valuable data for European and National Advanced Manufacturing curricula, this year of work sets the stage for further analysis and data collection, supporting the workforce's adaptation to these significant shifts.

This sub-report, marking the second year, is inherently an intermediate update, reflecting two years of work and collaboration among all partners and experts. The French team, for instance, convened three times to review work and analyse results.

Further, more in-depth studies are necessary to analyse the green and digital impacts on Advanced Manufacturing jobs. This research will provide trainers and teachers with valuable data to revise current courses, develop new micro-credentials, and facilitate comparisons of results across different countries and regions. The aim is to enhance the quality of deliverables in the coming years.

The ultimate goal is to gather sufficient data on a substantial number of jobs affected by green and digital trends. This will enable the provision of clear, valuable data for trainers and teachers to effectively update European and National Advanced Manufacturing curricula.



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9. ANNEX

9.1. GATHERING OF SKILLS PER TYPE OF SKILLS

Here after the gathering skills/type:

Table 7: Gathering of skills per type of skills

RELATED NEEDED SKILLS/KNOWLEDGE IMPACTED - HARMONIZED	RELATED NEEDED SKILLS/KNOWLEDGE IMPACTED
If Skill available in ESCO data base: ESCO Skill name.	If Skill available in ESCO data base: ESCO Skill name.
If not indicate skill name	If not indicate skill name
Inter-disciplinary Cooperation And Project Management	collaborate with all stakeholder teams
	collaborate with designer
	Collaborate with Machines Operators
Production And Manu-facturing Technologies	3D printing technologies, materials, and processes
	Be aware about 3D printing abilities to propose efficient and flexible solutions in day-to-day Robots usage
	Knowledge of 3D printing technologies, materials, and processes
	Proficiency in 3D scanning technology and software
	Proficiency in reverse engineering tool
	Understand 3D printing capabilities for creating custom testing tools, knowledge of relevant testing procedures, and data analysis skills
	Understand new tools of 3D scanning technology, data analysis, and defect identification in industrial settings
	Understand of 3D printing principles, design for additive manufacturing (DfAM) guidelines, and customized product quality standards
	Understand robotic systems, industrial testing procedures, and quality control standards
	Use of digital twins for optimisation
Digitalisation and IT Security	Cybersecurity
	Cybersecurity principles - Vulnerability assessment and penetration testing skills - Network security protocols and best practices
	Internet of things



	Knowledge of IoT device communication
	Knowledge of sensors technology
	Skills in cybersecurity
	Understanding of 5G communication protocols, and data analysis
	Understanding of cybersecurity principles and best practices for protecting sensor data from Cyber threats
Technological Core Competences	Understand sensor data, data analysis techniques, and quality control principles in industrial contexts
	Understanding of sensor calibration principles, communication protocols, and data analysis
Data Analysis And Artificial Intelligence	AI proficiency for 3D modeling
	machine learning concepts
	predictive maintenance
	Programming skills - AI concepts
	Programming skills - machine learning concepts
	Technical skills - analyse big data
	Understand AI principles, data analysis techniques, and non-destructive testing methods
	Understand AI principles, image analysis techniques, and surface quality standards
	Understand AI principles, image/video analysis techniques, and quality control standards
	Understand predictive maintenance principles, data analysis, and their application in industrial automation
	Understanding of AI principles
Sustainability and Environmental Management	advise on sustainability solutions
	CSR initiative participation, Ethical operation understanding
	knowledge of Green Transition Trends / Sustainable manufacturing principles
	Knowledge of sustainable manufacturing principles, energy efficiency techniques, and their impact on industrial robot processes
	Knowledge of sustainable materials, design principles, and their application in product design
	Knowledge of sustainable materials, environmental impact assessment
	Lifecycle assessment, circular economy strategies
	Understanding of circular design principles
Virtual And Augmented Reality	AR development training design



	Growing adoption of VR and AR technologies, for robot simulation, training, and design, enhancing collaboration and improving safety
	Growing adoption of VR and AR technologies, for robot simulation, training, and design, enhancing collaboration and improving safety. Augmented Reality
	Growing adoption of VR and AR technologies, for robot simulation, training, and design, enhancing collaboration and improving safety. Virtual Reality





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