LCAMP

Learner Centric Advanced Manufacturing Platform

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

D3.2 - M24 - F - French Sub-report

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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
CMQEIf - 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

CONTENT TABLE

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 CMQEIf.

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 focused on French analysis and results.

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.

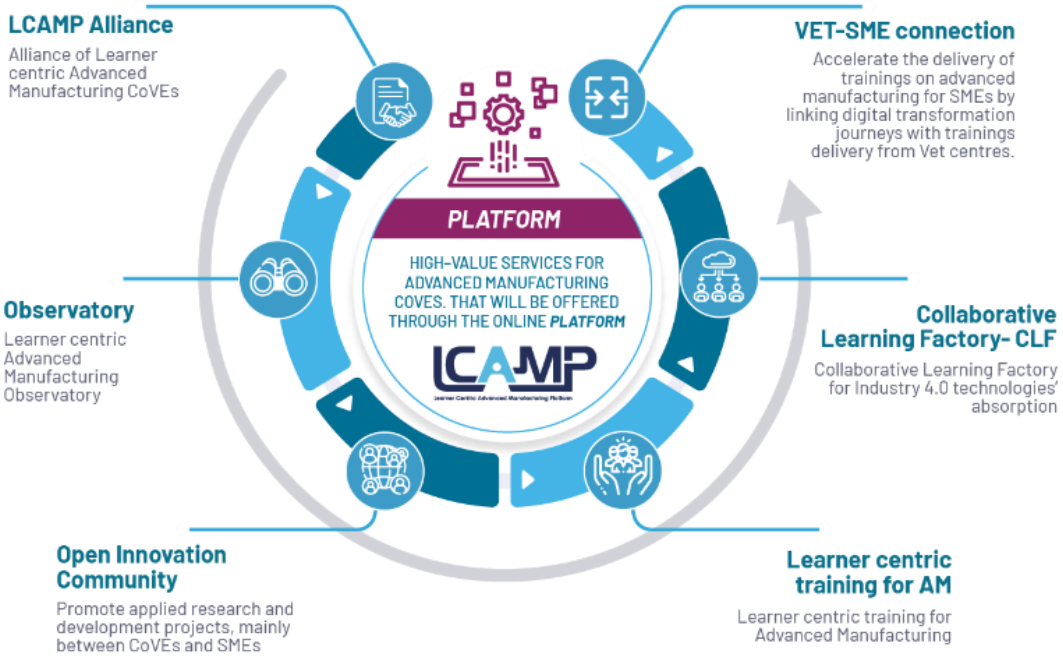

Figure 1 : Outputs and services to be delivered by the LCAMP platform

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 France, 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 experts inputs in the elaboration of the report converges in the detailed description of the 6 selected 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. 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

3. JOB'S IMPACT ANALYSIS

This section deals with the analysis of the selected 6 jobs. As mentioned in the Methodology of the D3.2 M24 Observatory Report (section 3), an analysis of the changes faced by companies is carried out to identify the **levers of those changes** affecting the specific jobs; then, the **changes in skills and knowledges** detected in the analysis, are described.

3.1. LIST OF SELECTED JOBS

Going through the 5 main criteria to evaluate (see chapter “3.1.1 Fields, Areas of observation” in the methodological document), here is after the short list of jobs to be analysed in France:

Table 1 : List of jobs selected

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.
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	Novembre 2023 - France: QA engineer: 1639 job offers https://candidat.pole-emploi.fr/offres/recherche?motsCles=ing%C3%A9nieur+testeur&offresPartenaires=true&range=0-19&rayon=10&tri=0	12 regions among the 21 FR regions consider this generic job among the priorities: FRD1 ; FRE1 ; FRF2 ; FRF3 ; FRG0 ; FRH0 ; FRI3 ; FRJ1 ; FRJ2 ; FRK1 ; FRK2 ; FRL0	EQF 6

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
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:	EQF 5

3.2. INDUSTRIAL ROBOT CONTROLLER

3.2.1. JOB DESCRIPTION AND SCOPE

Job Description

Industrial Robot Controller (ESCO 3139.2) ESCO description: *"Industrial robot controllers operate and monitor industrial robots used in automation processes to perform various manufacturing activities such as lifting, welding and assembling. They ensure that the machines are working correctly and in sync with other industrial robots, maintain and repair defective parts, assess risks and perform tests".* (ESCO, n.d.).

Business Area

This job typically falls within the broader field of automation and robotics engineering. Professionals in this role are responsible for programming, operating, and maintaining industrial robots which are used in a variety of manufacturing and production processes. Here are some of the key industries within scope that employ industrial robot controllers (Bill, n.d.).

- **Automotive Manufacturing:** This industry is one of the largest employers of industrial robot controllers. Robots are used extensively in assembling cars, welding, painting, and handling materials.
- **Electronics and Semiconductors:** Industrial robots are employed for assembling electronic devices, from smartphones to computers and televisions. They are used for tasks that require high precision, such as placing tiny components on circuit boards.
- **Aerospace:** The aerospace industry uses robots for assembling parts of aircraft and spacecraft. This includes drilling, riveting, and welding tasks, all of which require high levels of precision and reliability.
- **Metals and Machinery Manufacturing:** Robots are used in the metal industry for welding, cutting, bending, and assembling metal parts. They are also involved in machinery manufacturing, helping to construct complex machines.
- **Logistics and Warehousing:** Although not manufacturing, this sector increasingly employs robots for picking, packing, and goods. Controllers are needed to manage these robotic systems.

Industrial robot controllers are essential in these industries, ensuring that robots operate efficiently, safely, and effectively. Their work involves programming robots to perform specific tasks, troubleshooting any issues that arise, and performing maintenance to keep robots in optimal condition. As technology advances, the demand for skilled robot controllers is likely to increase across these and other industries (https://www.bls.gov/). (U.S. Bureau of Labor Statistics, 2024)

3.2.2. CONTEXT AND LIMITATIONS

Insights from the Global and European industrial robotics markets can provide useful context to understand the potential demand of industrial robot controllers in France.

The global industrial robotics market is experiencing significant growth, driven by technological advancements and the integration of AI and the Internet of Things (IoT) into robotics. These advancements are enhancing the capabilities of robots, including Selective Compliance Assembly Robot Arm (SCARA) and collaborative robots "cobots", making them more adaptable, efficient, and suitable for a wider range of applications. The increasing adoption of robotics in manufacturing and production processes indicates a growing demand for professionals skilled in controlling and maintaining these systems, including industrial robot controllers.

Furthermore, the robotics market is witnessing a surge in the development and application of collaborative robots designed to work alongside humans. This trend is particularly notable in small and medium-sized enterprises (SMEs) due to cobots' cost-effectiveness and flexibility. The push towards Industry 5.0, which aims to harmonise human creativity and craftsmanship with robotic efficiency, underscores the importance of advanced safety features and human-robot interaction enhancements.

While specific data on France's demand for industrial robot controllers was not directly available, the European robotics market's overall growth trajectory suggests that France, as a significant industrial player in Europe, is likely experiencing similar trends. The robotics industry's expansion in Europe, coupled with initiatives to promote automation and digital transformation within the industrial sector, implies a positive outlook for job opportunities in robotics control and maintenance.

Given the global push towards automation and the strategic importance of robotics in manufacturing and other sectors, professionals with skills in programming, operating, and maintaining industrial robots are likely to find increasing opportunities in France as well. The emphasis on safety, efficiency, and the integration of new technologies into robotics points to a need for skilled controllers to manage these complex systems effectively.

3.2.3. FROM CURRENT SITUATION TO ON-GOING SITUATION

Here after the description of the main tasks impacted by **Digital Technology** and/or **Green transition**, modifications and evolutions of the related needed skills.

Table 2 : Tasks and skills impacted related to Industrial robot controller occupation.

TASK	IMPACTING DIGITAL TECHNOLOGY AND/OR GREEN TRANSITION	IMPACT DESCRIPTION	RELATED NEEDED SKILLS/ KNOWLEDGE IMPACTED	EXPECTED TENDENCY FOR SKILL EVOLUTION	SKILL TYPE	MATURITY LEVEL TO REACH	SKILL ESCO URL	SKILL DESCRIPTION
Operate and Monitor Industrial Robots	**2-1 Virtual and Augmented Reality**	Improve operation efficiency by using VR and AR technology for real-time guidance.	**Growing adoption of VR and AR technologies, for robot simulation, training, and design, enhancing collaboration and improving safety.** **Augmented Reality**	+	**Skill**	L3	**http://data.europa.eu/esco/skill/abdc7ac8-151f-40c6-bc1a-1e9b4b073290**	The process of adding diverse digital content (such as images, 3D objects, etc.) on surfaces that exist in the real world. The user can interact in real-time with the technology by using devices such as mobile phones.
			Growing adoption of VR and AR technologies, for robot simulation, training, and design, enhancing collaboration and improving safety. **Virtual Reality**				**http://data.europa.eu/esco/skill/5da42cfd-1da8-4e4f-b68e-4f821d005fc5**	The process of simulating real-life experiences in a completely immersive digital environment. The user interacts with the virtual reality system via devices such as specifically designed headsets.
	3-1 Cybersecurity	Ensuring secure operations of interconnected robotic systems. Protecting sensitive industrial data and robot control systems from cyber threats.	**Skills in cybersecurity**		**Knowledge**		**http://data.europa.eu/esco/skill/8088750d-8388-4170-a76f-48354c469c44**	The methods that protect ICT systems, networks, computers, devices, services, digital information, and people against illegal or unauthorised use.
	4-4 Digital Twins	Using digital twins for simulation, testing, and optimisation of robotic systems.	**Use of digital twins for optimisation**		**Skill**		**FR01**	Use of digital twins for monitoring optimisation

Optimize industrial robot processes	**4-1 3D Printing/Additive Manufacturing**	Create custom tools and jigs for industrial robots, Produce lightweight and durable tooling for precision manufacturing	**Be aware about 3D printing abilities to propose efficient and flexible solutions in day-to-day Robots usage.**		**Knowledge**		**http://data.europa.eu/esco/skill/2afb2b59-c9a3-4cf3-b1dd-1a2fad51e583**	The process of reproducing 3D objects by using 3D printing technologies.
	5-X All Green Transition Trends / Sustainable Manufacturing	Sustainable manufacturing practices that reduce environmental impact.	**Knowledge of sustainable manufacturing principles, energy efficiency techniques and standards, and their impact on industrial robot processes.**		**Skill**	L4	**FR02**	Ability to optimize industrial robot processes in line with sustainable manufacturing principles, reducing environmental impact and improving resource efficiency.
Participate in robotics strategies development	**5-12 Corporate Social Responsibility (CSR) Initiatives**	Aligning the integration of robots with key CSR objectives, including ensuring that robotic operations meet high safety and quality standards to protect both employees and the public. This involves rigorous testing and compliance with current regulations and standards.	**CSR initiative participation, Ethical operation understanding**		**Knowledge**	L2	**http://data.europa.eu/esco/skill/66db424f-2abe-420d-8e5b-186607266b61**	The handling or managing of business processes in a responsible and ethical manner considering the economic responsibility towards shareholders as equally important as the responsibility towards environmental and social stakeholders.
	5-X All Green Transition Trends / Sustainable Manufacturing	Incorporate Green Transition Trends / Sustainable Manufacturing practices.	**knowledge of Green Transition Trends / Sustainable manufacturing principles**				**FR03**	Understand renewable energy technologies, sustainable manufacturing processes, and robotics programming to take part in development and implementation of integrated automation solutions for these industries
		Increase efficiency of communication and collaboration with Engineering, Technical, and Stakeholder Teams to integrate Digital and Green Transition Trends in efficient and sustainable Manufacturing practices.	**collaborate with all stakeholders' teams**		**Skill**	L3	**http://data.europa.eu/esco/skill/d52382fe-f236-421f-95fe-34fe69d48dbd (à modifier)**	Communicate and collaborate with all stakeholder teams to improve manufacturing processes

Troubleshoot and maintain industrial robots	**1-1 Internet of Things (IoT) / Smart Sensors / 5G technology**	Enhance predictive maintenance capabilities: increase data collection from connected robots - Real-time monitor of robot performance and health.	**Knowledge of IoT device communication.**	**Knowledge**	L4	**http://data.europa.eu/esco/skill/f049d050-12da-4e40-813a-2b5eb6df6b51**	The general principles, categories, requirements, limitations, and vulnerabilities of smart connected devices (most of them with intended internet connectivity).
			Knowledge of sensors technology.			**http://data.europa.eu/esco/skill/70a7b3b3-31ef-4b29-a30f-bb7299dff39b**	Sensors are transducers that can detect or sense characteristics in their environment. They detect changes in the apparatus or environment and provide a corresponding optical or electrical signal. Sensors are commonly divided in six classes: mechanical, electronic, thermal, magnetic, electrochemical, and optical sensors.
	1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics	Use advanced analytics and AI tools for predictive maintenance and fault detection.	**Programming skills - AI concepts**		L3	**http://data.europa.eu/esco/skill/e465a154-93f7-4973-9ce1-31659fe16dd2**	The artificial intelligence theories, applied principles, architectures, and systems, such as intelligent agents, multi-agent systems, expert systems, rule-based systems, neural networks, ontologies, and cognition theories.
			Programming skills - machine learning concepts			**http://data.europa.eu/esco/skill/3a2d5b45-56e4-4f5a-a55a-4a4a65afdc43**	The principles, methods and algorithms of machine learning, a subfield of artificial intelligence. Common machine learning models such as supervised or unsupervised models, semi- supervised models and reinforcement learning models.
			Technical skills - analyse big data		L4	**http://data.europa.eu/esco/skill/47a49cd6-097d-457a-9f7b-c290c14930d5**	Collect and evaluate numerical data in large quantities, especially for the purpose of identifying patterns between the data.
	4-6 Predictive Maintenance	Use predictive analytics for timely maintenance and reducing downtime.	**Understand predictive maintenance principles, data analysis, and their application in industrial automation.**			**http://data.europa.eu/esco/skill/7d913551-e17a-40ba-baf7-48d0c3b12e50**	The use of data analytics and mathematical calculation to manage and monitor the conditions of machines and production processes.
Learn and simulate maintenance procedures	**2-1 Virtual and Augmented Reality**	Improve training and maintenance simulation by using VR and AR technology.	**Growing adoption of VR and AR technologies, for robot simulation, training, and design, enhancing collaboration and improving safety.**	**Skill**		**FR04**	

3.2.4. IMPACTS ON SKILLS

Here after the description of new skills identified, following ESCO format “ESCO template for new Skill description”

Table 3 : Industrial robot controller’s impact on skills

SKILL REFERENCE (LOCAL CODIFICATION)	CONCEPT NAME	DESCRIPTION	ALTERNATIVE LABELS/ SYNONYMS	SKILL TYPE	SKILLS REUSABILITY LEVEL	ESSENTIAL SKILL OF	OPTIONAL SKILL OF	HIERARCHY
FR01	Digital Twin Monitoring Optimisation	Use of digital twins for monitoring optimisation	Twin Monitoring Improvement Digital Replica Optimisation	S	Cross-sectoral	Industrial Engineers Manufacturing Engineers Process Engineers Automation Engineers Data Analysts/Scientists in Manufacturing	Operations Managers Production Supervisors Quality Control Inspectors Logistics Coordinators Maintenance Technicians	
FR02	Sustainable Industrial Robot Process Optimisation	Ability to optimize industrial robot processes in line with sustainable manufacturing principles, reducing environmental impact and improving resource efficiency.	Sustainable Robotics Improvement Green Process Optimisation	S	Sector specific	Robotics Engineers Manufacturing Engineers Process Engineers Industrial Engineers Sustainability Engineers	Safety Coordinators Manufacturing Technicians	
FR03	Renewable Energy Automation Integration	Understand renewable energy technologies, sustainable manufacturing processes, and robotics programming to take part in development and implementation of integrated automation solutions for these industries	Renewable Energy Integration Green Automation Incorporation	S	Sector specific	Renewable Energy Engineers Automation Engineers Electrical Engineers specializing in renewable energy systems Control Systems Engineers Energy Systems Analysts Sustainability Managers	Renewable Energy Project Managers Energy Consultants	

FR04	VR/AR Robot technologie**s**	Growing adoption of VR and AR technologies, for robot simulation, training, and design, enhancing collaboration and improving safety.	Virtual / Augmented Reality Robotics Immersive Robotics	S	Cross-sectoral	Robotics Engineers Virtual Reality (VR) Engineers Augmented Reality (AR) Engineers Software Developers specializing in VR/AR Robotics Programmers Simulation Engineers Human-Computer Interaction (HCI) Specialists	Graphic Designers	

3.3. PRODUCT QUALITY CONTROLLER

3.3.1. JOB DESCRIPTION AND SCOPE

Job Description

Product Quality Controller (https://www.aia-aerospace.org/) (ESCO 7543.9): "*Product quality controllers check the quality of manufactured products. They work in manufacturing facilities where they perform basic inspection and evaluation of products before, during or after the production process"* (ESCO, n.d.). They track production problems and send inferior or malfunctioning items back for repair (Aerospace Industries Association, 2023).

Business Area

The role of Product Quality Controller is critical across various industries where maintaining high standards of product quality is essential. These professionals are responsible for inspecting and testing products to ensure they meet established quality standards, regulatory compliance, and customer satisfaction. Here are some of the key industries (https://www.ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview) within scope that employ Product Quality Controllers (Aerospace Industries Association, 2023):

- **Manufacturing:** This is one of the largest sectors employing Product Quality Controllers. They work in different manufacturing industries, including automotive, electronics, consumer goods, textiles, and machinery, ensuring products are manufactured to specifications and quality standards.
- **Aerospace and Defence:** Given the critical nature of products in the aerospace and defence industry, Product Quality Controllers ensure that components, systems, and final products meet strict quality and safety standards.
- **Construction Materials:** In the construction industry, Product Quality Controllers ensure that materials like cement, steel, and glass meet required quality standards and specifications for safety and durability.
- **Technology and Electronics:** Product Quality Controllers in the technology sector work with electronic devices, software, and hardware products to ensure they meet quality standards, functionality, and user experience requirements.

Across these industries, Product Quality Controllers use a variety of tests and inspection methods to ensure products meet quality standards, including visual inspections, performance tests, durability tests, and regulatory compliance checks. Their work is essential for protecting consumers, maintaining brand reputation, and ensuring the long-term success of products in the market.

3.3.2. CONTEXT AND LIMITATIONS

The general trends and importance of quality control and assurance roles across various industries provide useful insights. Quality controllers ensure products meet specifications and quality standards, a critical function in manufacturing and production processes. Their roles encompass monitoring manufacturing processes, ensuring compliance with standards, maintaining quality documentation, evaluating and maintaining quality management systems, and more.

The skillset for quality control roles has evolved, with an increased emphasis on technical skills, problem-solving, and familiarity with industry standards like ISO and IEC deliverables. Demonstrating precision, consistency, analytical skills, and a practical approach to problem-solving is essential. These trends suggest a growing need for skilled professionals in quality control and assurance, reflecting the broader demand for roles that support operational excellence and product integrity.

Related skills and roles of “Product Quality Controller” in industrial sectors indicate the importance of quality control functions. These sectors are significant employers of quality control expertise to maintain product standards and compliance. Thus, individuals with experience in quality control and a deep understanding of industry-specific regulations are likely to find opportunities in France's diverse industrial landscape.

3.3.3. FROM CURRENT SITUATION TO ONGOING SITUATION

Here after the description of the main tasks impacted by **Digital Technology** and/or **Green transition**, modifications and evolutions of the related needed skills.

Table 4 : Tasks and skills impacted related to Product Quality Controller occupation.

TASK	IMPACTING DIGITAL TECHNOLOGY AND/OR GREEN TRANSITION	IMPACT DESCRIPTION	RELATED NEEDED SKILLS/ KNOWLEDGE IMPACTED	EXPECTED TENDENCY FOR SKILL EVOLUTION	SKILL TYPE	MATURITY LEVEL TO REACH	SKILL ESCO URL	SKILL DESCRIPTION
Analyze product performance data from sensors	**1-1 Internet of Things (IoT) / Smart Sensors / 5G technology**	Integration of sensors into products for real-time performance monitoring and quality control, providing insights beyond traditional inspections.	**Understand sensor data, data analysis techniques, and quality control principles in industrial contexts.**	+	**Skill**	L4	**FR13**	Ability to analyze industrial sensor data related to product performance and identify quality issues.
Perform destructive and non-destructive testing	**4-2 Robotics and Automation**	Automation of repetitive, hazardous, or high-volume testing procedures using robots, improving efficiency and consistency.	**Understand robotic systems, industrial testing procedures, and quality control standards.**				**FR14**	Ability to operate and utilize robotic systems for industrial product testing and quality control.
Maintain accurate and complete quality control records	**3-1 Cybersecurity**	Implementation of robust cybersecurity measures to protect sensitive quality control data, including production information and intellectual property.	**Cybersecurity principles - Vulnerability assessment and penetration testing skills - Network security protocols, standards, and best practices**		**Knowledge**	L3	**http://data.europa.eu/esco/skill/8088750d-8388-4170-a76f-48354c469c44**	The methods that protect ICT systems, networks, computers, devices, services, digital information, and people against illegal or unauthorised use.

Perform Visual Inspection	**1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics**	Automatize visual inspections using image and video analysis for defect detection with high accuracy and speed.	**Understand AI principles, image/video analysis techniques, and quality control standards.**		**Skill**		**FR15**	
Perform Non-destructive Testing		AI analysis of X-ray or other non-destructive testing data for internal defect identification.	**Understand AI principles, data analysis techniques, and non-destructive testing methods and standards.**				**FR16**	
Perform Surface Quality Inspection		AI-powered analysis of surface images for scratch, crack, or imperfection detection.	**Understand AI principles, image analysis techniques, and surface quality standards.**				**FR17**	
Perform Inspect products for visual and dimensional defects	**2-2 3D scanning**	Use of 3D scanning for automated, high-precision inspection and defect detection, including complex geometries.	**Understand new tools of 3D scanning technology, data analysis, and defect identification in industrial settings.**			L4	**FR18**	Ability to use 3D scanners for industrial product inspection, analyze data, and identify defects.
Assess product customisation and personalisation	**4-1 3D Printing/Additive Manufacturing**	Adapt quality control practices to evaluate variations and ensure quality in customized and personalized 3D printed products.	**Understand of 3D printing principles, design for additive manufacturing (DfAM) guidelines, and customized product quality standards.**		**Knowledge**		**http://data.europa.eu/esco/skill/2afb2b59-c9a3-4cf3-b1dd-1a2fad51e583**	The process of reproducing 3D objects by using 3D printing technologies.
Conduct advanced testing with 3D-printed tools		Think, ask, and Integrate 3D-printed jigs, fixtures, and testing tools for specialized and efficient quality control procedures.	**Understand 3D printing capabilities for creating custom testing tools, knowledge of relevant testing procedures, and data analysis skills.**			L2	**FR19**	

Analyze manufacturing processes performance data from sensors	**1-1 Internet of Things (IoT) / Smart Sensors / 5G technology**	Integrate sensors into production tools for real-time performance monitoring, improving process control through predictive maintenance and quality defect detection, reducing waste, and increasing efficiency.	**Understand sensor data, data analysis techniques, and quality control principles in industrial contexts.**		**Skill**	L4	**FR12**	Ability to analyze industrial sensor data related to product performance and identify quality issues.
	1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics		**Understand AI principles, data analysis techniques, and non-destructive testing methods.**				**FR11**	Ability to analyze industrial sensor data related to product performance and identify quality issues.

3.3.4. IMPACTS ON SKILLS

Here after the description of new skills identified, following ESCO format “ESCO template for new Skill description”

Table 5 : Product Quality Controller’s impact on skills

SKILL REFERENCE (LOCAL CODIFICATION)	CONCEPT NAME	DESCRIPTION	ALTERNATIVE LABELS/SYNONYMS	SKILL TYPE	SKILLS REUSABILITY LEVEL	ESSENTIAL SKILL OF	OPTIONAL SKILL OF	HIERARCHY
FR10	Sustainable Automation Development	Understand renewable energy technologies, sustainable manufacturing processes, and robotics programming to take part in development and implementation of integrated automation solutions for these industries	Sustainable Automation Progress Eco-Friendly Automation	S	Sector specific	Sustainability Engineers Automation Engineers Industrial Engineers Manufacturing Engineers Process Engineers	Energy Consultants Operations Analysts	

3.4. 3D PRINTING TECHNICIAN

3.4.1. JOB DESCRIPTION AND SCOPE

Job Description

3D Printing Technician (Prior, 2023), (ESCO 3118.1) ESCO description: *"3D printing technicians assist in the designing and programming of products, ranging from prosthetic products to 3D miniatures. They may also provide 3D printing maintenance, check 3D renders for customers and run 3D printing tests. 3D printing technicians can also repair, maintain and clean 3D printers"* (ESCO, n.d.).

LCAMP job description: 3D printing technicians, also known as additive manufacturing technicians or specialists, are responsible for operating and maintaining 3D printing equipment and processes to create three-dimensional objects from digital models.

Here after the ***ESCO table for reviewing an existing Occupation*** filled to propose a change on the description:

Table 6 : 3D Printing technician occupation definition

OCCUPATION URI	OCCUPATION TITLE	COMMENTS ON THE PREFERRED TERM	NEW DESCRIPTION OF AN EXISTING OCCUPATION	ALTERNATIVE LABELS TO BE REMOVED/MODIFIED	ESSENTIAL SKILLS AND KNOWLEDGE CONCEPTS TO ADD/REMOVE	OPTIONAL SKILLS AND KNOWLEDGE CONCEPTS TO ADD/REMOVE
3118.1 **http://data.europa.eu/esco/occupation/4cf7be91-fed9-47a7-9ca9-e74c7eb6becb**	3D printing technician	Description ESCO should now contain "operating 3D printers"	3D printing technician is now part of serial production processes, not only focused on design phase and prototype production	N/A	N/A	N/A

Business Area

Hereafter are the industries engaging in this role:

The business area of a 3D print operator can vary widely, depending on whether the focus is on business-to-consumer (B2C) or business-to-business (B2B) markets. In a B2C context, 3D printing can be used to create customised products like collectibles, fashion items, or even personalised earbuds. This area is appealing because it allows for the creation of unique, tailored items that cater to individual consumer preferences.

On the other hand, in a B2B setting, 3D printing services are often geared towards industrial clients and can involve producing prototypes, parts for manufacturing processes, and even

functional products in various industries like engineering, automotive, aerospace, and medical. In this area, the focus is more on providing solutions that meet specific industrial needs, such as creating prototypes for testing or producing specialised components that might be too complex or costly to manufacture using traditional methods.

In both B2C and B2B contexts, the ability to customise and rapidly prototype offers significant advantages. However, the level of investment, the type of 3D printers needed, and the business model can differ substantially between these two approaches. For instance, B2C might require less initial investment and can be started even with more affordable desktop 3D printers, whereas B2B services often demand higher-end equipment, more significant investment, and a deeper understanding of industrial requirements.

Thus, the business area for a 3D print operator can range from consumer-focused product creation to providing specialized manufacturing and prototyping services for various industries. The choice of area depends largely on the target market, the level of investment, and the specific expertise and capabilities of the operator.

In the Business-to-Business (B2B) sector, 3D printing operators can explore several areas, including:

- **Engineering and Manufacturing:** Providing prototypes and parts for various engineering and manufacturing processes. This includes creating components for machinery, automotive parts, or other manufacturing tools.
- **Medical Industry:** Production of prosthetics, orthotics, and medical implants. The medical field often requires highly customised parts, which is a key strength of 3D printing.
- **Aerospace Industry:** In the aerospace sector, 3D printing is used for creating lightweight components and parts that need to meet precise specifications.
- **Automotive Industry:** 3D printing is used for both prototyping and the production of final parts in the automotive industry, especially for custom or specialized vehicles.
- **Consumer Goods and Electronics:** Customised components for consumer goods, electronics, and household items.
- **Education and Research:** Providing models and experimental designs for educational purposes and research projects.
- **Tooling and Fixtures:** Producing jigs, fixtures, and other tools that are used in various manufacturing processes.
- **Customised Machinery Parts:** Tailoring parts for specific machinery that might be too expensive or time-consuming to manufacture using traditional methods.
- **Spare parts:** Reproduction of components from old machines or products for which tooling is no longer available. Keeping equipment operational, reducing the resources used to produce new replacement machines, reducing environmental impact.

3.4.2. CONTEXT AND LIMITATIONS

Key Figures

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. The data indicates a significant demand for technical profiles in the 3D printing sector, particularly in industrial fields such as aerospace, automotive, and medical. These sectors are increasingly integrating additive manufacturing into their value chains, showing a growing market and interest in 3D printing skills.

As of 2022 and moving into 2023, the role of a 3D printing technician in the industry has evolved significantly, indicating a shift from a predominantly research-focused phase to an increasingly applied and "live" industry role.

The 3D printing job market in 2022 saw a growing demand for technical roles, with a focus on design, development, production, and methods. This demand reflects the ongoing integration of additive manufacturing into various industrial sectors, such as aerospace, automotive, and medical. The fact that 76% of the job offers in the 3D printing domain were for permanent contracts also underscores a long-term investment in these technologies and confidence in their sustainability and growth within the industry. This transition from research to industry application is evident in the increasing recruitment by large manufacturing companies specializing in these sectors, looking for experts in additive manufacturing to maximise the technology's benefits.

The trend for 2023 continues to show an expansion of 3D printing into mainstream manufacturing processes, with an emphasis on overcoming previous challenges like supply chain issues and the need for more efficient manufacturing processes. There's a strong focus on the development of new technologies, systems, and materials to drive the adoption of additive manufacturing. One notable aspect is the diversification of applications across different sectors, including healthcare and dental, which are particularly well-suited to the benefits of 3D printing.

However, there are challenges that remain, such as concerns about capital budgets for customers, questions about the use of existing systems, and economic factors like inflation. These issues might influence the pace of adoption and integration of 3D printing technologies in various sectors.

Overall, the role of a 3D print technician has firmly established itself in the industry, with significant growth and application across various sectors. The ongoing developments and challenges highlight an industry that is increasingly moving beyond research and prototyping to become a key part of mainstream manufacturing and production processes.

3.4.3. FROM CURRENT SITUATION TO ON-GOING SITUATION

Here after the description of the main tasks impacted by **Digital Technology** and/or **Green transition**, modifications and evolutions of the related needed skills.

Table 7 : Tasks and skills impacted related to 3D Printing technician occupation.

TASK	IMPACTING DIGITAL TECHNOLOGY AND/OR GREEN TRANSITION	IMPACT DESCRIPTION	RELATED NEEDED SKILLS/ KNOWLEDGE IMPACTED	EXPECTED TENDENCY FOR SKILL EVOLUTION	SKILL TYPE	MATURITY LEVEL TO REACH	SKILL ESCO URL	SKILL DESCRIPTION
Ensuring Reliability and Cybersecurity	**3-1 Cybersecurity**	Protect sensitive data and systems from cyber threats	**Cybersecurity**	+	**Knowledge**	L3	**http://data.europa.eu/esco/skill/8088750d-8388-4170-a76f-48354c469c44**	The methods that protect ICT systems, networks, computers, devices, services, digital information, and people against illegal or unauthorised use.
Collaborate in Design	**4-1 3D Printing/Additive Manufacturing**	Integrate 3D Printing Technology in Product Design	**collaborate with designer**		**Skill**		**http://data.europa.eu/esco/skill/d52382fe-f236-421f-95fe-34fe69d48dbd**	Communicate and collaborate with fellow designers to coordinate new products and designs
Operate 3D Printers		Enhance flexibility, precision, sustainability, and reliability in production processes.	**Knowledge of 3D printing technologies, materials, and processes.**		**Knowledge**	L4	**http://data.europa.eu/esco/skill/2afb2b59-c9a3-4cf3-b1dd-1a2fad51e583**	The process of reproducing 3D objects by using 3D printing technologies.

Operate and monitor	**4-4 Digital Twins**	Improve oversight and efficiency in 3D printing operations	**Internet of Things**			L3	**http://data.europa.eu/esco/skill/f049d050-12da-4e40-813a-2b5eb6df6b51**	The general principles, categories, requirements, limitations, and vulnerabilities of smart connected devices (most of them with intended internet connectivity).
Maintain 3D Printers	**4-6 Predictive Maintenance**	Anticipate maintenance failure, reducing downtime.	**predictive maintenance**			L4	**http://data.europa.eu/esco/skill/7d913551-e17a-40ba-baf7-48d0c3b12e50**	The use of data analytics and mathematical calculation to manage and monitor the conditions of machines and production processes.
Implement Sustainability Practices	**5-3 Energy Efficiency**	Reduce waste and energy consumption	**advise on sustainability solutions**		**Skill**	L3	**http://data.europa.eu/esco/skill/dbef5042-4b99-4e6f-b2ed-1d33b07b3ed6**	Advise companies on solutions to develop sustainable production processes, improve material efficiency and reuse and reduce carbon footprint.
Handle Material	**5-6 Sustainable Material Innovation**	Use sustainable materials and components	**Knowledge of sustainable materials, environmental impact assessment**				**http://data.europa.eu/esco/skill/73576419-31c2-4e45-8e30-ab1afec3db4e**	Identify, select environmentally friendly materials and components. Decide on the substitution of certain materials by the one that are environmentally friendly, maintaining the same level of functionality and other characteristics of the product.

3.5. PREDICTIVE MAINTENANCE EXPERT

3.5.1. JOB DESCRIPTION AND SCOPE

Job Description

Predictive Maintenance Expert (ESCO 2152.1.13) ESCO description: *"Predictive maintenance experts analyse data collected from sensors located in factories, machineries, cars, railroads and others to monitor their conditions in order to keep users informed and eventually notify the need to perform maintenance"* (ESCO, n.d.) (Next Move Strategy Consulting, 2024).

Business Area

Predictive Maintenance Technicians play a crucial role in industries that prioritise equipment reliability to enhance operational efficiency, reduce downtime, and optimise maintenance schedules. Their primary responsibility is to use diagnostic tools and data analysis to predict when equipment might fail and to conduct maintenance to prevent such failures. Here are some key industries that employ Predictive Maintenance Technicians within our scope:

- **Manufacturing:** In manufacturing plants, predictive maintenance is essential for minimizing downtime and ensuring that production lines run smoothly. Technicians monitor machinery and equipment using sensors and data analytics to predict and prevent failures.
- **Logistics:** Shipping, and logistics operations use predictive maintenance to monitor the health of engines, vehicles, and other critical infrastructure. This helps in avoiding delays and reducing maintenance costs.
- **Construction and Heavy Machinery:** Predictive maintenance is critical for monitoring construction equipment and heavy machinery to prevent unexpected breakdowns that can delay projects and increase costs.

These industries value the role of Predictive Maintenance Technicians because they help in reducing operational costs, improving safety, and increasing the lifespan of equipment through timely and data-driven maintenance decisions.

3.5.2. CONTEXT AND LIMITATIONS

The demand for predictive maintenance technicians in France is part of a global trend, towards integrating advanced technologies like IoT and AI for maintenance strategies, significantly impacting various industries. This approach not only enhances operational efficiency but also contributes to cost savings by minimizing unplanned downtime and extending equipment lifespan. While specific figures for France weren't available, the global predictive maintenance market, which France is a part of, is expected to grow substantially, indicating a strong demand for these skills across industries.

3.5.3. FROM CURRENT SITUATION TO ON-GOING SITUATION

Here after the description of the main tasks impacted by **Digital Technology** and/or **Green transition**, modifications and evolutions of the related needed skills.

Table 8 : Tasks and skills impacted related to Preventive maintenance expert occupation.

TASK	IMPACTING DIGITAL TECHNOLOGY AND/OR GREEN TRANSITION	IMPACT DESCRIPTION	RELATED NEEDED SKILLS/ KNOWLEDGE IMPACTED	EXPECTED TENDENCY FOR SKILL EVOLUTION	SKILL TYPE	MATURITY LEVEL TO REACH	SKILL ESCO URL	SKILL DESCRIPTION
Collect and monitor equipment data in Real-Time and/or delayed for health Equipment analysis	**1-1 Internet of Things (IoT) / Smart Sensors / 5G technology**	Enhance real-time and/or delayed data collection and analysis. Need to understand the general principles, categories, requirements, limitations, and vulnerabilities of smart connected devices.	**Knowledge of IoT device communication.**	+	**Know-ledge**	L3	**http://data.europa.eu/esco/skill/f049d050-12da-4e40-813a-2b5eb6df6b51**	The general principles, categories, requirements, limitations, and vulnerabilities of smart connected devices (most of them with intended internet connectivity).
		Enhance real-time and/or delayed data collection and analysis. Need to understand the general principles, categories, requirements, limitations, and vulnerabilities of sensors technology.	**Knowledge of sensors technology.**				**http://data.europa.eu/esco/skill/70a7b3b3-31ef-4b29-a30f-bb7299dff39b**	Sensors are transducers that can detect or sense characteristics in their environment. They detect changes in the apparatus or environment and provide a corresponding optical or electrical signal. Sensors are commonly divided in six classes: mechanical, electronic, thermal, magnetic, electrochemical, and optical sensors.

	1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics	Improve prediction accuracy and optimized maintenance schedules. Need to understand the artificial intelligence theories, applied principles, architectures, and systems.	**Programming skills - AI concepts**		**Skill**		**http://data.europa.eu/esco/skill/e465a154-93f7-4973-9ce1-31659fe16dd2**	The artificial intelligence theories, applied principles, architectures, and systems, such as intelligent agents, multi-agent systems, expert systems, rule-based systems, neural networks, ontologies, and cognition theories.
Virtual Training for Maintenance Teams	**2-1 Virtual and Augmented Reality**	Enhanced training experiences with VR/AR	**AR development training design**				**http://data.europa.eu/esco/skill/abdc7ac8-151f-40c6-bc1a-1e9b4b073290**	The process of adding diverse digital content (such as images, 3D objects, etc.) on surfaces that exist in the real world. The user can interact in real-time with the technology by using devices such as mobile phones.
		Increase efficiency of communication and collaboration with VR/AR programmers to enhanced training experiences with VR/AR.	**collaborate with all stakeholder teams**				**http://data.europa.eu/esco/skill/d52382fe-f236-421f-95fe-34fe69d48dbd (à modifier)**	Communicate and collaborate with all stakeholder teams to improve manufacturing processes/maintenance activities.
Improve identification of dimensional wear in equipment	**2-2 3D scanning**	Use of 3D scanning for automated, high-precision inspection and defect detection, including complex geometries.	**Understand new tools of 3D scanning technology, data analysis, and defect identification in industrial settings.**			L4	**FR20**	Ability to use 3D scanners for industrial product inspection, analyze data, and identify defects.

Improve data securisation	**3-1 Cybersecurity**	Protect of sensitive maintenance data: need to understand cybersecurity concepts.	**Cybersecurity principles - Vulnerability assessment and penetration testing skills - Network security protocols and best practices**		**Know-ledge**		**http://data.europa.eu/esco/skill/8088750d-8388-4170-a76f-48354c469c44**	The methods that protect ICT systems, networks, computers, devices, services, digital information, and people against illegal or unauthorised use.
Sustainable Equipment Lifecycle Management	**5-2 Circular Economy**	Promotion of equipment reuse and recycling.	**Lifecycle assessment, circular economy strategies**			L3	**http://data.europa.eu/esco/skill/22c45bf7-e52b-475f-847b-c32a87f65a5d**	The circular economy aims to keep materials and products in use for as long as possible, extracting the maximum value from them while in use and recycling them at the end of their life cycle. It improves resource efficiency and helps to reduce the demand for virgin materials.

3.5.4. IMPACTS ON SKILLS

Here after the description of new skills identified, following ESCO format “ESCO template for new Skill description”

Table 9 : Preventive maintenance experts impacts on Skills

SKILL REFERENCE (LOCAL CODIFICATION)	CONCEPT NAME	DESCRIPTION	ALTERNATIVE LABELS/ SYNONYMS	SKILL TYPE	SKILLS REUSABILITY LEVEL	ESSENTIAL SKILL OF	OPTIONAL SKILL OF	HIERARCHY
FR10	Sustainable Automation Development	Understand renewable energy technologies, sustainable manufacturing processes, and robotics programming to take part in development and implementation of integrated automation solutions for these industries	Sustainable Automation Progress Eco-Friendly Automation	S	Sector specific	Sustainability Engineers Automation Engineers Industrial Engineers Manufacturing Engineers Process Engineers	Energy Consultants Operations Analysts	

3.6. INDUSTRIAL DESIGNER

3.6.1. JOB DESCRIPTION AND SCOPE

Job Description

Industrial Designer (ESCO 2163.1) ESCO description: *"Industrial designers work out ideas and develop them into designs and concepts for a wide variety of manufactured products. They integrate creativity, aesthetics, production feasibility, and market relevance in the design of new products"* (ESCO, n.d.) (World Economic Forum, 2023).

Business Area

Industrial designer technicians and technologists find employment across a range of sectors, mainly focusing on manufacturing and related fields where their skills in design, efficiency improvements, and production optimisation are highly valued.

The largest sectors in scope employing Industrial designer technicians and technologists include:

- **Manufacturing:** This sector is the most significant employer, engaging a considerable portion of professionals in roles that focus on enhancing manufacturing processes, product quality, and production efficiency. They might work on planning, testing, and custom-making industrial products to improve manufacturing outcomes.
- **Computer and Electronic Product Manufacturing:** Here, technicians and technologists contribute to the development and production of electronic goods, playing crucial roles in designing workflows, machinery layouts, and improving production methods.
- **Transportation Equipment Manufacturing:** In this sector, professionals may work on designing and improving the manufacturing process of transportation equipment, ensuring products meet quality and efficiency standards.
- **Professional, Scientific, and Technical Services:** This broad category includes firms providing advice and assistance in areas such as engineering, design services, and other technical disciplines, where industrial design skills can be applied to a variety of projects.
- **Machinery Manufacturing:** Professionals in this sector work on designing, improving, and optimising the production of various machinery and equipment, ensuring they meet specified standards and efficiency levels.

These sectors highlight the diversity of opportunities available to industrial designer technicians and technologists, reflecting their critical role in enhancing production processes, product quality, and overall efficiency in a wide array of manufacturing environments. Their work often involves collaboration with engineers and other professionals to solve complex problems and implement effective solutions.

3.6.2. CONTEXT AND LIMITATIONS

While specific data on the demand for industrial designer technicians in France was not directly available, insights into the broader field of power engineering and industrial design in France might offer some context for the job market and educational opportunities in related fields. France is recognised for its advanced power engineering sector, hosting nearly 500 power engineering companies and employing over 30,000 engineers and technicians. This indicates a robust engineering sector that could have parallel demand in areas like industrial design.

For those interested in the field of industrial design, France offers a variety of educational programs in industrial design at both undergraduate and postgraduate levels. These programs cover a wide range of topics including design management, engineering design, and sustainable industrial design, preparing graduates for diverse career opportunities in the design field.

Given France's strong emphasis on engineering, design, and innovation, coupled with the presence of specialised design agencies and educational programs, it seems there could be opportunities for industrial designer technicians, albeit indirectly indicated. Those interested in this career path might benefit from focusing on skill development in CAD, product design, and innovation to align with the demands of French industries.

For a more targeted search into the job market or educational programs, visiting specific company websites or educational institution portals could provide further insights into current opportunities and requirements in France.

3.6.3. FROM CURRENT SITUATION TO ON-GOING SITUATION

Here after the description of the main tasks impacted by **Digital Technology** and/or **Green Transition**, modifications and evolutions of the related needed skills.

Table 10 : Tasks and skills impacted related to Industrial designer occupation.

TASK	IMPACTING DIGITAL TECHNOLOGY AND/OR GREEN TRANSITION	IMPACT DESCRIPTION	RELATED NEEDED SKILLS/ KNOWLEDGE IMPACTED	EXPECTED TENDENCY FOR SKILL EVOLUTION	SKILL TYPE	MATURITY LEVEL TO REACH	SKILL ESCO URL	SKILL DESCRIPTION
Conceptualize and design new products	**1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics**	AI assists in automating routine tasks, enhancing detail and realism, optimizing designs, speeding up prototyping, predictive modeling, customisation, and error detection in 3D model creation.	**AI proficiency for 3D modeling**	+	**Skill**	L4	**FR06**	Utilize AI tools for enhancing efficiency and precision in 3D model creation.
							FR09	Utilize AI tools for enhancing efficiency and precision in 3D model creation.
	2-1 Virtual and Augmented Reality	Use of VR and AR for product prototyping facilitates design collaboration, and user experience testing.	**Understand VR and AR technologies, their applications in industrial design, and their integration with design tools.**			L3	**http://data.europa.eu/esco/skill/5da42cfd-1da8-4e4f-b68e-4f821d005fc5**	The process of simulating real-life experiences in a completely immersive digital environment. The user interacts with the virtual reality system via devices such as specifically designed headsets.
	2-2 3D scanning	Use of 3D scanning to capture real-world objects for accurate model reproduction. Reverse engineering tool can convert	**Proficiency in 3D scanning technology and software**		**Knowledge**	L4	**FR07**	Skills in operating and interpreting 3D scanning technology

		object scanned into usable object in the CAD tool,	**Proficiency in reverse engineering tool**				**FR08**	Skills in using reverse engineering tool
	4-1 3D Printing/Additive Manufacturing	Use of 3D printing allows for greater design freedom and complexity, rapid prototyping allowing several loops with low costs and time investment.	**Knowledge of 3D printing technologies, materials, and processes.**			L3	**http://data.europa.eu/esco/skill/2afb2b59-c9a3-4cf3-b1dd-1a2fad51e583**	The process of reproducing 3D objects by using 3D printing technologies.
			Collaborate with Machines Operators		**Skill**	L4	**FR05**	Communicate and collaborate with Machines Operators to integrate technologies constraints and possibilities in product designs
	5-2 Circular Economy	Design products for disassembly, reuse, and recycling.	**Understanding of circular design principles**		**Knowledge**		**http://data.europa.eu/esco/skill/22c45bf7-e52b-475f-847b-c32a87f65a5d**	The circular economy aims to keep materials and products in use for as long as possible, extracting the maximum value from them while in use and recycling them at the end of their life cycle. It improves resource efficiency and helps to reduce the demand for virgin materials.
Develop sustainable product designs	**5-6 Sustainable Material Innovation**	Use of sustainable materials, and design principles and standards to reduce the environmental impact of products.	**Knowledge of sustainable materials, design principles, standards, and their application in product design.**		**Skill**		**http://data.europa.eu/esco/skill/73576419-31c2-4e45-8e30-ab1afec3db4e**	Identify, select environmentally friendly materials and components. Decide on the substitution of certain materials by the one that are environmentally friendly, maintaining the same level of functionality and other characteristics of the product.

3.6.4. IMPACTS ON SKILLS

Here after the description of new skills identified, following ESCO format “ESCO template for new Skill description”

Table 11 : Industrial designer’s impact on skills

SKILL REFERENCE (LOCAL CODIFICATION)	CONCEPT NAME	DESCRIPTION	ALTERNATIVE LABELS/ SYNONYMS	SKILL TYPE	SKILLS REUSABILITY LEVEL	ESSENTIAL SKILL OF	OPTIONAL SKILL OF	HIERARCHY
FR05	Communication and Collaboration in Product Design	Communicate and collaborate with Machines Operators to integrate technologies constraints and possibilities in product designs	Product Design Cooperation Collaborative Design Communication	S	Sector specific	Product Designers Industrial Designers Design Engineers Project Managers User Experience (UX) Designers User Interface (UI) Designers Design Managers	Manufacturing Technicians Technical Support Technicians	
FR06	AI-Powered 3D Modeling	Utilize AI tools for enhancing efficiency and precision in 3D model creation.	AI 3D Modeling Automated 3D Design	S	Cross-sectoral	3D Modelers CAD Designers Industrial Designers Product Engineers Software Developers specializing in AI and 3D modeling Research Scientists in Computer Vision and Machine Learning Gaming Developers	Product Design Technicians	
FR07	3D Scanning Operation and Interpretation	Skills in operating and interpreting 3D scanning technology	3D Scan Operation Analysis Scan Interpretation Handling	S	Sector specific	3D Scanning Technicians Quality Control Inspectors Metrology Technicians Manufacturing Engineers Reverse Engineers	Manufacturing Technicians Quality Control Inspectors	

FR08	Reverse engineering	Skills in using reverse engineering tool	Product Analysis Retro-Engineering	S	Cross-sectoral	Product Engineers Manufacturing Engineers Design Engineers Quality Control Engineers Industrial Designers Mechanical Engineers Aerospace Engineers	Quality Control Inspectors Manufacturing Technicians Research Scientists	
FR09	AI-Powered 3D Modeling	Utilize AI tools for enhancing efficiency and precision in 3D model creation.	AI 3D Modeling Automated 3D Design	S	Cross-sectoral	3D Modelers CAD Designers Industrial Designers Product Engineers Software Developers specializing in AI and 3D modeling Research Scientists in Computer Vision and Machine Learning	Product Design Technicians	

3.7. SENSOR ENGINEERING TECHNICIAN

3.7.1. JOB DESCRIPTION AND SCOPE

Job Description

Sensor Engineering Technician (ESCO 3114.1.10) ESCO description: *"Sensor engineering technicians collaborate with sensor engineers in the development of sensors, sensor systems, and products that are equipped with sensors. Their role is to build, test, maintain, and repair the sensor equipment"* (ESCO, n.d.) (U.S. Bureau of Labor Statistics, 2023).

Business area

Sensor engineering technicians, falling broadly under the categories of electrical and electronic engineering technologists and technicians, find employment across several key industries. These include engineering services, semiconductor and other electronic component manufacturing, navigational, measuring, electromedical, and control instruments manufacturing, as well as utilities. These professionals play crucial roles in designing, developing, testing, and repairing equipment that is powered by electricity or electric current.

3.7.2. CONTEXT AND LIMITATIONS

While a sensor engineering technician role may involve a significant amount of hands-on work with sensors and related equipment, it may not require the same depth of technical expertise as a sensor engineer or scientist, typically working under the guidance of engineers, often working closely with them, they may have limitations in terms of decision-making authority or responsibility for designing new sensor technologies.

Sensor engineering technicians' responsibilities may include setting up experiments, collecting data, analysing results, and making recommendations for improvements based on their findings, but also installing sensors in various environments and ensuring they are properly maintained and functioning correctly.

Sensor engineering technicians may also need to adhere to strict safety protocols and regulatory requirements. But, they may have limited influence over strategic decisions or broader project goals. Their focus is typically on executing tasks within the parameters set by engineers and project managers.

For a more targeted search into the job market or educational programs, visiting specific company websites or educational institution portals could provide further insights into current opportunities and requirements in France.

3.7.3. FROM CURRENT SITUATION TO ON-GOING SITUATION

Here after the description of the main tasks impacted by **Digital Technology** and/or **Green transition**, modifications and evolutions of the related needed skills.

Table 12 : Tasks and skills impacted related to Sensor engineering technician occupation.

TASK	IMPACTING DIGITAL TECHNOLOGY AND/OR GREEN TRANSITION	IMPACT DESCRIPTION	RELATED NEEDED SKILLS/ KNOWLEDGE IMPACTED	EXPECTED TENDENCY FOR SKILL EVOLUTION	SKILL TYPE	MATURITY LEVEL TO REACH	SKILL ESCO URL	SKILL DESCRIPTION
Calibrate, test sensors, Troubleshoot and diagnose sensor malfunctions	**1-1 Internet of Things (IoT) / Smart Sensors / 5G technology**	Increased use of advanced sensors with complex calibration procedures requiring understanding of data protocols and network connectivity.	**Internet of Things**	+	**Knowledge**	L3	**http://data.europa.eu/esco/skill/f049d050-12da-4e40-813a-2b5eb6df6b51**	The general principles, categories, requirements, limitations, and vulnerabilities of smart connected devices (most of them with intended internet connectivity).
			Understanding of sensor calibration principles, communication protocols, and data analysis.	=	**Skill**	L4	**http://data.europa.eu/esco/skill/6e34b68e-0d61-49f2-bc4d-571c0326d857**	Test sensors using appropriate equipment. Gather and analyse data. Monitor and evaluate system performance and take action if needed.
		Use of 5G for faster data transmission; implementation of edge computing for localized data processing.	**Understanding of sensor calibration principles, standards, communication protocols, and data analysis.**		**Knowledge**	L3	**http://data.europa.eu/esco/skill/70a7b3b3-31ef-4b29-a30f-bb7299dff39b**	Sensors are transducers that can detect or sense characteristics in their environment. They detect changes in the apparatus or environment and provide a corresponding optical or electrical signal. Sensors are commonly divided in six classes: mechanical, electronic, thermal, magnetic,

								electrochemical, and optical sensors.
	1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics	Integration with AI systems for real-time data analysis and adaptive control using sensor data.	**Understanding of AI principles.**	+	**Skill**		**http://data.europa.eu/esco/skill/e465a154-93f7-4973-9ce1-31659fe16dd2**	The artificial intelligence theories, applied principles, architectures, and systems, such as intelligent agents, multi-agent systems, expert systems, rule-based systems, neural networks, ontologies, and cognition theories.
			machine learning concepts				**http://data.europa.eu/esco/skill/3a2d5b45-56e4-4f5a-a55a-4a4a65afdc43**	The principles, methods and algorithms of machine learning, a subfield of artificial intelligence. Common machine learning models such as supervised or unsupervised models, semi-supervised models and reinforcement learning models.
	4-6 Predictive Maintenance	Implementation of predictive maintenance techniques using sensor data to anticipate and prevent sensor failures.	**Understand predictive maintenance principles, data analysis, and their application in industrial automation.**		**Knowledge**	L4	**http://data.europa.eu/esco/skill/7d913551-e17a-40ba-baf7-48d0c3b12e50**	The use of data analytics and mathematical calculation to manage and monitor the conditions of machines and production processes.

Implement sustainable sensor deployment practices	**5-X All Green Transition Trends / Sustainable Manufacturing**	Incorporate Green Transition Trends / Sustainable Manufacturing practices. integration of renewable energy sources for power.	**knowledge of Green Transition Trends / Sustainable manufacturing principles**			L3	**FR10**	Understand renewable energy technologies, sustainable manufacturing processes, and robotics programming to take part in development and implementation of integrated automation solutions for these industries
Manage sensor data security and privacy	**3-1 Cybersecurity**	Cybersecurity concerns related to sensor data collection, transmission, and storage.	**Understanding of cybersecurity principles, standards, and best practices for protecting sensor data from Cyber threats.**				**http://data.europa.eu/esco/skill/8088750d-8388-4170-a76f-48354c469c44**	The methods that protect ICT systems, networks, computers, devices, services, digital information, and people against illegal or unauthorised use.

3.7.4. IMPACTS ON SKILLS

Here after the description of new skills identified, following ESCO format “ESCO template for new Skill description”

Table 13 : Sensor engineering technician’s impacts on skills

SKILL REFERENCE (LOCAL CODIFICATION)	CONCEPT NAME	DESCRIPTION	ALTERNATIVE LABELS/SYNONYMS	SKILL TYPE	SKILLS REUSABILITY LEVEL	ESSENTIAL SKILL OF	OPTIONAL SKILL OF	HIERARCHY
FR10	Sustainable Automation Development	Understand renewable energy technologies, sustainable manufacturing processes, and robotics programming to take part in development and implementation of integrated automation solutions for these industries	Sustainable Automation Progress Eco-Friendly Automation	S	Sector specific	Sustainability Engineers Automation Engineers Industrial Engineers Manufacturing Engineers Process Engineers	Energy Consultants Operations Analysts	

4. RESULTS, STATISTICS AND EXPERTS' COMMENTS

Thanks to these impacts analysis, statistics have been built, based on:

- Per job, the list of impacting trends and number of tasks impacted.
- From trends impacts, related needed skills to support the changes are identified.

4.1. NUMBER OF TASKS IMPACTED PER JOB

The number of tasks impacted per trend are identified below, per occupation.

This table provides a sum-up, per job, of trends which have been identified as impacting, and an idea of number of tasks impacted within jobs.

Table 14 : Number of tasks impacted per job.

OCCUPATION TITLE	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	2-2 3D SCANNING	3-1 CYBERS ECURITY	4-1 3D PRINTING/ ADDITIVE MANUFACTURING	4-2 ROBOTICS AND AUTOMATION	4-4 DIGITAL TWINS	4-6 PREDICTIVE MAINTENANCE	5-12 CORPORATE SOCIAL RESPONSIBILITY (CSR) INITIATIVES	5-2 CIRCULAR ECONOMY	5-3 ENERGY EFFICIENCY	5-6 SUSTAINABLE MATERIAL INNOVATION	5-X ALL GREEN TRANSITION TRENDS / SUSTAINABLE MANUFACTURING
Predictive maintenance expert	2	1	2	1	1						1			
Industrial designer		2	1	2		2					1		1	

Sensor engineering technician	3	2			1				1					1
3D printing Technician					1	2		1	1			1	1	
Industrial robot controller	2	3	3		1	1		1	1	1				3
Product quality controller	2	4		1	1	2	1							

4.2. FROM TRENDS IMPACTS TO RELATED NEEDED SKILLS

From trends impacts, related needed skills are identified to support the changes. In order to simplify the analysis, all needed skills identified in 7 groups. Here after are the needed type of skills, are grouped, to support trends impacts.

Table 15 : Needed type of skills, allowing to support trends impacts.

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 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	1	1					
	5-2 Circular Economy						1	
	5-6 Sustainable Material Innovation						1	
sensor engineering technician	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	3-1 Cybersecurity			1				
	4-1 3D Printing/Additive Manufacturing	1	1					
	4-4 Digital Twins			1				
	4-6 Predictive Maintenance					1		
	5-3 Energy Efficiency						1	
	5-6 Sustainable Material Innovation						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				2			
	1-2 Artificial Intelligence (AI) / Machine learning / Big Data Analytics					4		
	2-2 3D scanning		1					
	3-1 Cybersecurity			1				
	4-1 3D Printing/Additive Manufacturing		2					
	4-2 Robotics and Automation		1					

The gathering of skills per type of skills is available in Annex 10.1. Gathering of Skills per Type of Skills.

4.3. EXPERTS' COMMENT

The results of the French report were approved by a panel of French experts composed of:

- **Matthieu Merciecca**: French Ministry of Education, Head of Mission Economy-Education Campus.
- **Landry Bourguignon**: French Ministry of Education, Academy Inspector and Regional Education Inspector.
- **David Krupka**: AFNOR (French association for standardisation), "Engineering, Equipment, Materials and Industry 4.0" Development Manager.
- **Eric Fernandez** : Effi'Cairn, Manager.
- **Pierre Carillo**: IUT du Limousin, Head of Business Partnerships, Mechanical and Production Engineering Department.
- **Stephane Blanchard**: Agence Ad'occ (Economic development agency for the Occitanie region),
- **Ali Guerroui:** AFDET (French Association for the Development of Technical Education), Board Member.

Hereafter the results of a survey shared with participants involved during the LCAMP Conference in Aalen (Germany, May 2024). It corresponds to a sample of 30 people composed of:

- 40% (12) are VET's experts
- 30% (9) are Learners
- 23% (7) are industrial's experts
- 7% (2) are from Governments

In the following scheme, these people evaluated the impact of each digital trend on jobs, and the number of skills involved:

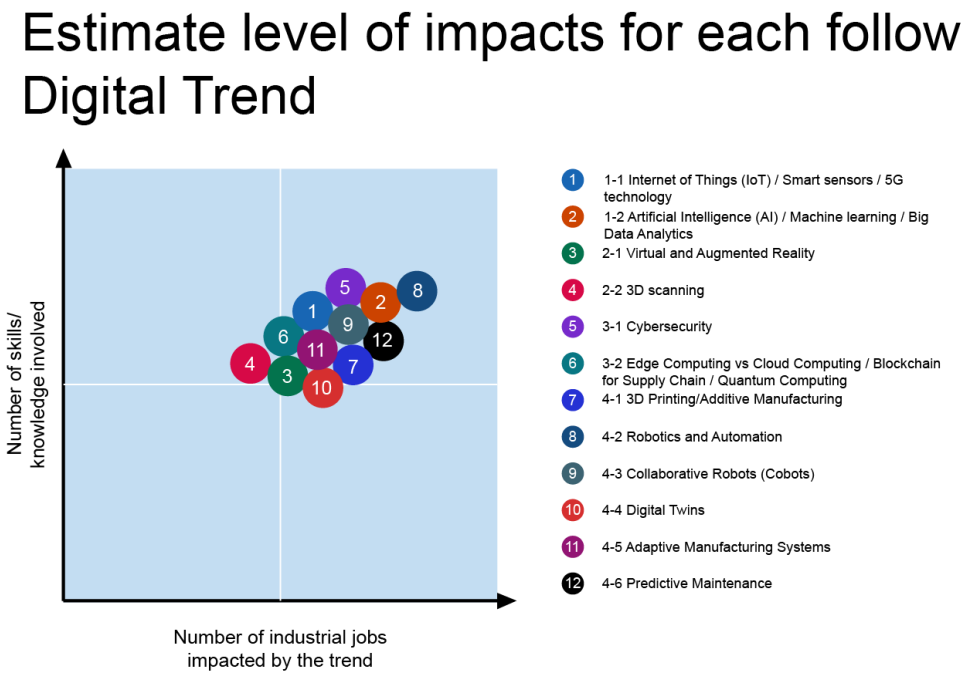

Figure 2 : Estimated level of impacts for each following Digital Trend

In the following scheme, they evaluated the impact of each green transition trend on jobs, and the number of skills involved:

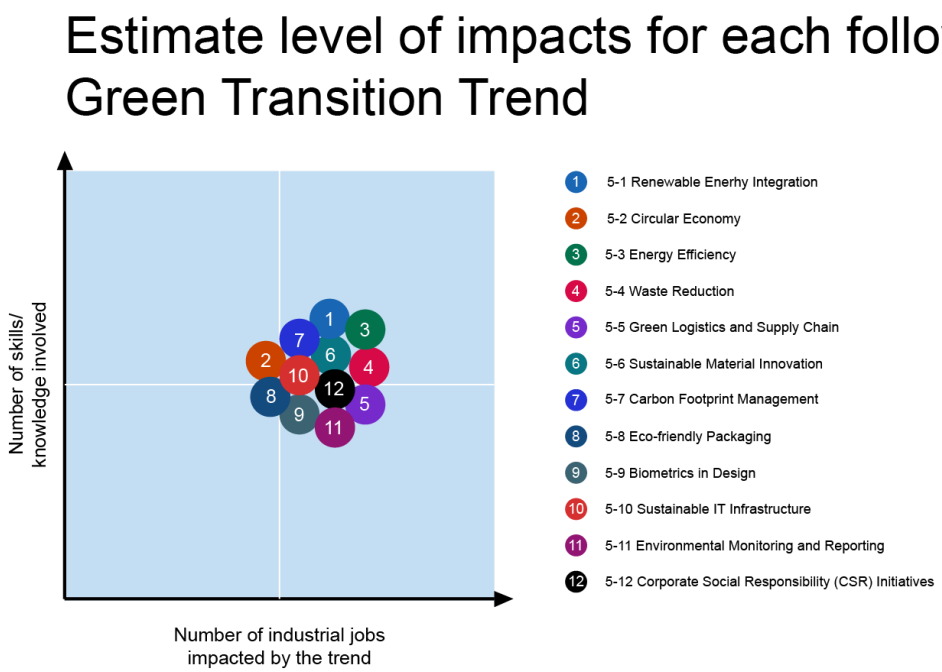

Figure 3 : Estimated level of impacts for each following Green Transition Trend

In the following scheme, these people evaluated which digital and green transition trend are impacting Product Quality Controller occupation:

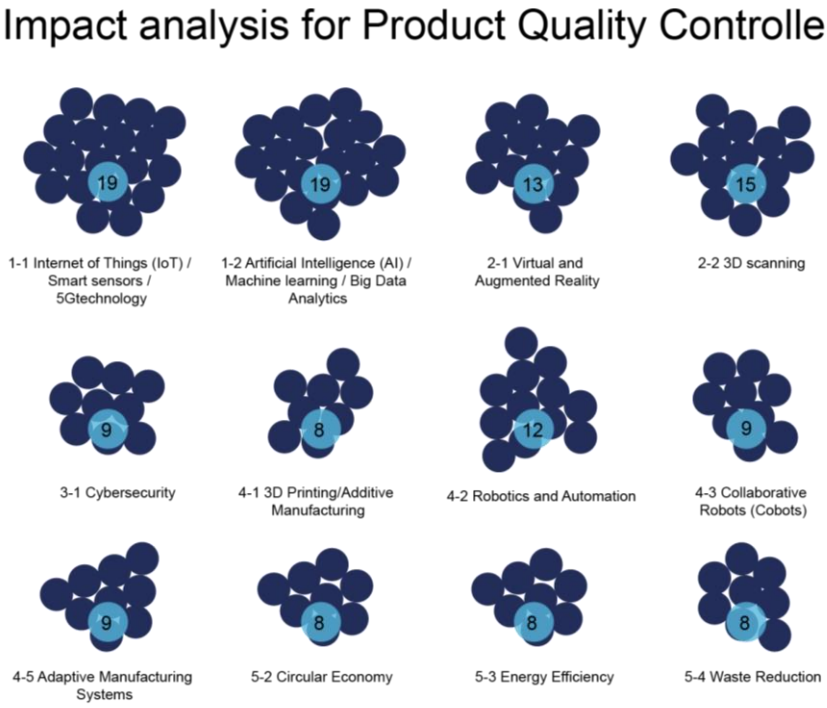

Figure 4 : Impact analysis for Product Quality Controller

Discrepancies can be easily seen between this survey and the deep factual impact analysis performed and presented in this report which can be sum-up as following:

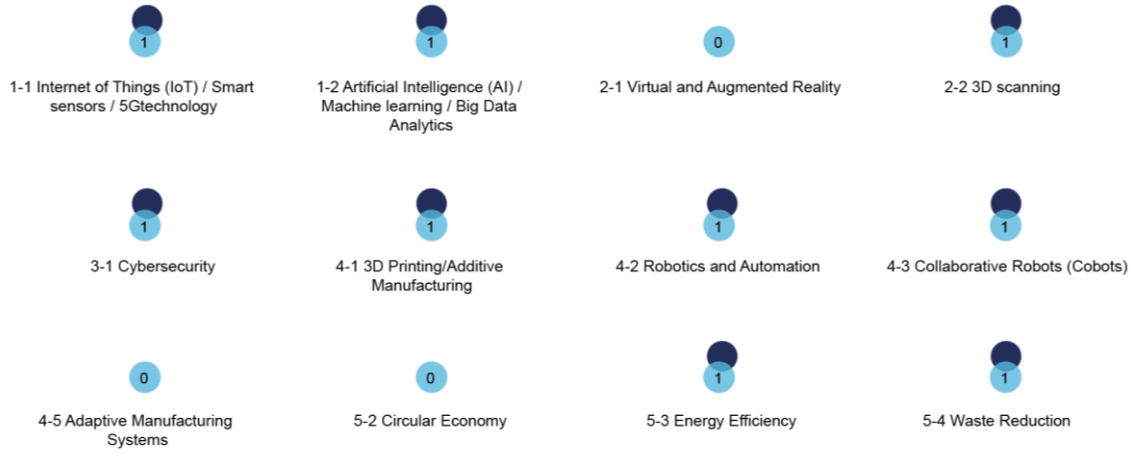

Figure 5 : Sum-up of the impact analysis

5. CONCLUSION AND OUTLOOKS

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.

The expert review indicated that the number of experts in each country or region is insufficient to provide a unified and comprehensive assessment of the findings. Instead, they offered individual expert opinions as documented in the sub-reports. A notable point of discussion among some experts is the perceived impact of Artificial Intelligence (AI) on design. While some experts currently see no significant effects or consider it a low priority, AI is already influencing the creation and control of 3D models. A thorough understanding of AI tools is essential for bringing industrial designers up to speed.

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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8. INDEX OF ILLUSTRATIONS

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10. ANNEX

10.1. GATHERING OF SKILLS PER TYPE OF SKILLS

Here after the gathering skills/type:

Table 16: 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 not indicate skill name**	If Skill available in ESCO data base: ESCO Skill name. If not indicate skill name
Inter-disciplinary Cooperation And Project Management	collaborate with all staakeholder 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

LCAMP

Learner Centric Advanced Manufacturing Platform

Co-funded by the European Union