Learner Centric Advanced Manufacturing Platform

Impact of AI and IoT on industry and training needs

WP3 – Observatory - D3.2 – M48 - Impact of AI and IoT in industry and training needs

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Co-funded by
the European Union

Funded by the European Union. Views and opinions expressed are, however, those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

LCAMP partners:

TKNIKA – Basque VET Applied Research Centre, CIFP Miguel Altuna LHII, DHBW Heilbronn – Duale Hochschule, Baden-Württemberg, Curt Nicolin High School, AFM – Spanish Association of Machine Tool Industries, EARLALL – European Association of Regional & Local Authorities for Lifelong Learning, FORCAM, CMQE: Association campus des métiers et des qualifications industrie du future, MV: Mecanic Vallée, KIC: Knowledge Innovation Centre, MADE Competence Centre Industria 4.0; AFIL: Associazione Fabbrica Intelligente Lombardia, SIMUMATIK AB; Association HVC Association of Slovene Higher Vocational Colleges; TSCMB:Tehniški šolski center Maribor, KPDoNE: Kocaeli Directorate Of National Education; GEBKİM OIZ and CAMOSUN college.

Document summary

Document type:	Public Report
Title	Impact of AI and IoT in industry and training needs
Author	Pascal Pichoutou
Co-authors	Camille Leonard
Reviewer	Hervé Danton
Date	February 2026
Document status	1.0
Document description	This document describes the main impacts of connected objects and AI in industry and on related training courses.
Cite this deliverable as:	Pichoutou - D3.2 - M36 – Impacts of connected objects and AI in industry and related training courses
Document level	Public

GLOSSARY AND/OR ACRONYMS

AFNOR - French association for standardisation
AIOPS - Artificial Intelligence for IT Operations
AIoT - Artificial Intelligence & Internet of Things
AMI - Call for Expressions of Interest
AMI CMA - Call for Expressions of Interest - Future Skills and Professions
BTS - Brevet de Technicien Supérieur
CAGR/TCAC - Compound Annual Growth Rate
CoVE - Centres of Vocational Excellence
EQF - European Qualification Framework
ERP - Enterprise Resource Planning
AI - Artificial Intelligence
IEC - International Electrotechnical Commission
IIoT - Industrial Internet of Things
IoT - Internet of Things
IS/SI - Information System
ISO - International Organisation for Standardisation
IT / ICT - Information Technology
IUT - University Institute of Technology
LCAMP - Learner-centric advanced manufacturing platform
LLM - Large Language Model
LPWAN - Low Power Wide Area Network
MES - Manufacturing Execution System
ML - Machine Learning
MLOps - Machine Learning Operations
NLP - Natural Language Processing
OT - Operational Technology
PdM - Predictive Maintenance
RGPD - General Data Protection Regulation
HR - Human Resources
ROI - Return on Investment
SCADA - Supervisory Control and Data Acquisition
SME/SME - Small and Medium-sized Enterprises
TKNIKA - Centre for Applied Research in Vocational Training in the Basque Country.
TPM - Total Productive Maintenance
UNM - French Mechanical Standardization Union

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The LCAMP (Learner-Centric Advanced Manufacturing Platform) project, part of the CoVE initiative, aims to strengthen regional skills ecosystems in the field of advanced manufacturing through collaboration, resilience and innovation.

This report analyses the impact of AI/IoT technologies on industrial professions and the associated industrial training needs.

Produced by the LCAMP Observatory, led by the French cluster *Mecanic Vallée* in collaboration with the Campus des Métiers et des Qualifications Industrie du Futur, the report aims to provide strategic information to SMEs, vocational training centres and policy makers to help align industrial transformation with education and skills development.

European industry is undergoing a phase of rapid transformation driven by the convergence of Artificial Intelligence (AI) and the Internet of Things (IoT), a hybridisation that heralds the era of AIoT. This convergence is profoundly changing the way companies oversee their operations, exploit data, automate processes and reorganise their businesses.

However, the study, based on articles published between 2019 and 2025, shows a persistent gap between the potential of these technologies and their actual adoption, particularly in SMEs.

This observation is reinforced by the results of a survey conducted among industrial companies, with only 35% of respondents reporting that they use IoT solutions and 25% having implemented AI applications, mainly in administrative or support functions.

Advanced industrial applications – predictive maintenance, embedded AI, automatic optimisation – remain marginal, revealing a still limited level of adoption.

This gap can be explained mainly by a lack of operational skills and technological integration. Companies express strong needs in five key areas:

- AI applied to industrial processes (vision, optimisation, automation).
- Management and exploitation of IoT data (collection, pipelines, MLOps-Industrialisation of Machine Learning).
- Cybersecurity for OT (Operational Technology) environments.
- IT/OT integration and IIoT (Industrial Internet of Things) architectures.
- Change management and human-machine collaboration.

These needs are largely concentrated at EQF levels 5 and 6, which are essential for industrialising AI and IoT.

At the same time, training centres are keen to ramp up their efforts but remain limited by a lack of equipment, specialised trainers, pedagogical maturity in AI/IoT and modularity in curricula.

A cross-analysis of more than 60 European publications and reports and the two surveys highlights a profound transformation in the professions. Operators are moving towards augmented supervision roles, technicians towards analysis and integration functions, engineer-towards hybrid system design responsibilities, and managers are becoming true "cognitive interfaces" between humans and AI. New profiles are emerging around data, OT cybersecurity, IT/OT integration and AI.

In light of these developments, four major challenges are emerging for the industrial and educational ecosystem:

- Rapidly adapting skills to application uses
- Structure an agile, modular and updatable training offering
- Strengthen the technical capabilities of training centres
- Develop close collaboration between companies, training organisations
- public institutions and technology providers.

The report's recommendations focus on four areas:

- **For companies**: professionalise IT/OT and AI integration, structure skills development, anticipate organisational impacts and invest in change management
- **For training centres**: modernise content, deploy IoT/AI platforms, train trainers and align courses with EQF levels 5 and 6
- **For institutions**: finance infrastructure, promote the pooling of resources, and integrate European regulatory frameworks (AI Act, IEC 62443, ISO/IEC 23894) into training programmes
- **For the SME/VET ecosystem**: strengthen cooperation to co-develop models focused on real industrial applications, initiate applied projects and short workshops, develop shared technical platforms, and align industrial needs and educational content through ongoing dialogue.

All of these actions aim to:

- Strengthen the **relevance of curricula** through co-construction
- **Supporting trainer training** through feedback from the field
- **Create co-training spaces** where companies and trainers work together to **keep pace with technological developments**
- **Develop work-study programmes** and hybrid educational environments.

In summary, the convergence of AI and IoT opens up a major strategic opportunity for European industry. Its success will depend on the collective ability to bridge skills gaps, accelerate technology adoption and build a learning, ethical and secure industry. Recent advances in generative AI further reinforce this potential by enabling the exploitation of previously difficult-to-use data, thereby reducing one of the historical barriers to the industrialisation of AI. Skills development is now the key driver of competitiveness, sustainability and industrial sovereignty for the coming decade.

1. INTRODUCTION

1.1. PURPOSE OF THE REPORT

In the face of the accelerating digital and ecological transition, structured analysis of the IoT–AI field of observation is a strategic issue: it enables us to understand the industrial changes underway, assess their implications for professions and guide training and innovation policies.

The field of observation selected in this report is based on work carried out as part of the LCAMP project(*Home - LCAMP*, n.d.) , particularly within working group 7 (WP7), through the implementation of "360° company scans" and the development of transformation plans. This work has made it possible to identify the nature of needs as well as the dynamics of use and convergence of IoT and AI.

1.1.1. CONTEXT

Industry is currently undergoing a dual transformation – digital and ecological – driven by the growing adoption of so-called advanced technologies, among which the Internet of Things (IoT) and Artificial Intelligence (AI) occupy a central place. These technologies are set to profoundly redefine production processes, maintenance models, quality management and global supply chains, promoting data-driven decision-making.

Market projections confirm the scale of this dynamic: the industrial IoT is expected to reach **$263.4 billion by 2030**, with a compound annual growth rate (CAGR) of **13.8%**, while AI applied to industry is growing even faster (**CAGR of 21.4%),** with an estimated value of **$92.7 billion in 203**1.

These developments are part of the overall trajectory of Industry 4.0, whose adoption is accelerating: **66% of French manufacturers** already report using related solutions (Sirteq, 2024) , and **77%** have deployed industrial IoT (Aurélie Chandeze, 2020).

1.1.2. OBJECTIVES AND SCOPE

This report aims to:

- Identify and understand the technological impacts of IoT and AI on industrial professions
- Analyse the changing needs for technical and cross-functional skills
- Assess the match between current training provision and future needs
- Formulate recommendations for companies, training centres and institutions.

The analysis focuses on the manufacturing industry, including production, maintenance, quality and support functions directly related to operations. It is part of the digital and green transition, in line with European policy (LCAMP, Skills Pact, etc.) and the relevant regulatory and normative framework.

1.2. METHODOLOGY

The methodology applied in preparing this report follows the structured framework of **the LCAMP Observatory**, as defined in the **Observatory Process Cycle** (D3.1), which aims to identify, analyse and validate emerging professional fields in the context of advanced manufacturing.

1.2.1. SOURCES AND DATA USED

To ensure the robustness and reliability of the conclusions, this report is based on a structured set of **60 specialised sources, more than half of which are directly referenced** (sector reports, market studies, specialised articles, normative and regulatory framework) and analyses of the data collected to identify convergences and divergences.

1.2.2. PRIMARY DATA COLLECTION: TWO COMPLEMENTARY SURVEYS

In order to complement the documentary analysis and provide an accurate picture of current practices and needs in the field, two targeted surveys were conducted among industrial companies and training centres, enabling the collection of primary data essential for identifying uses, expectations and deployment capacities related to the IoT, AI and skills development.

Survey of industrial companies in the sectors mentioned above (detailed results are available in Appendix 2):

- 20 respondents out of a panel of 119
- Breakdown: 47% small (10–49), 32% medium (50–249), 10.5% micro (1–9), 10.5% large (250+)
- Dominant sectors: Machinery & Equipment (7/20) and Aeronautics & Defence (5/20). Other more specific sectors: construction, maintenance, metallurgy, medical, machining/boiler making
- Respondents' roles: mainly executives/CEOs and operational managers (production/maintenance, IT), providing a field perspective
- Objectives - to assess their:
  - Current and future uses of IoT/AI
  - Perception of the impact on professions and skills
  - Training needs for employees and recent graduates (EQF levels 3-6).

Survey of training centres: (detailed results are available in Appendix 3)**:**

- 10 respondents out of a panel of 17
- Breakdown by size: 5 centres with 500 to 900 learners, 3 with over 1,000 and 2 smaller centres (1-99 and 300-499 learners)
- Types of establishments: Technical and vocational secondary schools, apprentice training centres and university technology institutes
- Respondents' roles: 60% teachers/trainers, 30% directors of vocational and technical training, 10% school principals
- Dominant sectors: Mechanical engineering - Production - Design and IT/Cybersecurity Other sectors: Electrical engineering - Automation and Maintenance
- Objectives - to evaluate their:
  - Existing and planned training programmes
  - Adaptations to the needs expressed by companies
  - Capacities and constraints for deployment.

1.2.3. INVOLVEMENT OF EXPERTS

This year, the panel of experts was mobilised from the validation phase of the scope of observation and the structure of the final report. This methodological change is in line with the recommendations made during the interim review (M36). It allows the results of ongoing studies, some of which have not yet been published, to be incorporated and ensures that the scope of the analysis is relevant to all stakeholders. The panel brings together representatives from industry, the French Ministry of Education, standardisation bodies, and national and regional institutions involved in innovation, technological research and training.

1.2.4. APPROACH AND LIMITATIONS

The combination of these three sources of information – literature review, field surveys and institutional expertise – makes it possible to cross-reference the views of manufacturers, training organisations and analyses from the specialist literature. This methodological triangulation provides a contextualised and operational view of the dynamics at work, while facilitating the identification of convergences, divergences and emerging opportunities in terms of skills and the transformation of professions.

However, the scope of interpretation remains limited to the manufacturing sector, with a particular focus on the French context and issues related to Industry 4.0 and the digital and green transition. The results should therefore be understood as representative of a limited but significant group of players, and not as an exhaustive snapshot of the entire European industrial fabric.

1.2.5. USE OF AI AS A DOCUMENTARY AND EDITORIAL ASSISTANCE TOOL

Artificial intelligence was used as an assistance tool for documentary research, source consolidation and preliminary analysis of scientific and professional literature. It also helped to structure and accelerate certain writing phases.

However, all content – analysis, interpretation, structuring and final writing – was entirely supervised, proofread, validated and written by the authors. AI played no decision-making role in methodological or analytical choices, and all arguments, conclusions and recommendations reflect human expertise and synthesis.

2. CONTEXT, EMERGENCE AND CONVERGENCE OF IOT AND AI TECHNOLOGIES

Today's industry is experiencing an unprecedented phase of technological acceleration, marked by the simultaneous rise of the Industrial Internet of Things (IIoT) and Artificial Intelligence (AI). These technologies, which have become pillars of Industry 4.0, are profoundly transforming production processes, organisational models and skills structures. This chapter offers a structured analysis of the current technological context, the mechanisms of convergence between IoT and AI, and the trends, adoption rates and regulatory frameworks that are shaping the digital and ecological transformation of the manufacturing sector.

2.1. REFERENCE REGULATORY AND NORMATIVE FRAMEWORK

As these technologies rely on the collection and processing of large amounts of data, their deployment in industry must necessarily be governed by a constantly evolving regulatory and normative framework, which is essential to ensure the trustworthiness, security and accountability of the systems:

- **The AI Act** (Rules for Trustworthy Artificial Intelligence in the EU, 2024) establishes rules on the development, deployment and use of AI for trustworthy artificial intelligence in the European Union, with direct implications for industrial applications. It defines risk levels and compliance obligations according to the context of use.
- **AI risk management – NF EN ISO/IEC 23894** is a standard that introduces the **steps of AI risk management** that manufacturers must integrate (identification, assessment, treatment and monitoring of risks related to AI systems).
- **Ethical governance – XP Z77-101** is a reference framework that defines **good governance and ethical practices** for AI systems, covering transparency, fairness, accountability and regulatory compliance.
- **Machine Safety & AI – UNM Guide** is a guide that provides training in **risk analysis, validation, documentation and continuous updating** of systems incorporating AI, in line with machine safety directives.

2.2. DEFINITION AND ARTICULATION OF TECHNOLOGIES

Understanding the technologies used in Industry 4.0 is a prerequisite for analysing their impact on organisations: it is therefore necessary to define the key concepts of the Industrial Internet of Things (IIoT), Artificial Intelligence applied to industry, and the mechanisms of their convergence.

- Definition of the concept **of artificial intelligence**:
  - Definition and reference for this document: for the sake of simplicity, we have used the term AI in its broadest sense, without going into the specifics of each application. It may refer to machine learning, symbolic approaches, natural language processing, computer vision or generative AI.
  - Regulation (EU) 2024/1689 of the European Parliament and of the Council of 13 June 2024 laying down harmonised rules on artificial intelligence (Artificial Intelligence Act) -(*Article* 3, 2025).

    - **Summary of the definition logic:**
      An AI system is an automated system designed to operate with varying levels of autonomy and capable of demonstrating adaptability after deployment, which, for

explicit or implicit purposes, generates outputs such as predictions, recommendations or decisions that influence physical or virtual environments.

- International standard adopted in Europe -(*ISO/IEC 22989:2022*, 2022)
  - Artificial intelligence (AI) refers to a scientific and technical field dedicated to the design of computer systems capable of generating outputs such as predictions, recommendations, decisions or content for human-defined purposes. These systems rely on different approaches — machine learning, symbolic approaches, natural language processing, computer vision or generative AI — to represent data, acquire knowledge and perform tasks in a more or less automated manner.

- **The Industrial Internet of Things** (IIoT) refers to a network of connected sensors, equipment and systems that collect and exchange data within the industrial environment. **Industrial Artificial Intelligence** encompasses the algorithms and models that analyse this data to automate decisions, predict events or optimise processes.
- The convergence of these technologies, sometimes referred to as **AIoT** (AI + IoT), represents a key performance driver for industry. According to the Telenor IoT/Omdia report, **more than 48% of companies prioritise AI/ML in their IoT deployments** (Francois Gauthier, 2024). This convergence makes it possible to exploit the massive volumes of data generated by equipment to increase efficiency, quality and productivity.

2.3. DIGITAL AND GREEN TRANSFORMATION OF INDUSTRY

IoT and AI are now major drivers of the dual digital and ecological transition of industry, improving operational visibility, energy efficiency and the agility of production systems in the face of new industrial challenges:

- **Digital transformation:** connected technologies enable real-time visibility into operations, data-driven decision-making and intelligent process automation.
- **Green transformation:** the energy optimisation enabled by these technologies can generate **up to 20% in energy efficiency gains** (AURORE CHATRAS, 2025) , contributing significantly to manufacturers' sustainability objectives.
- As stated in an article by Orange Business, "industrial tools must become more agile, connected and efficient in order to respond to challenges such as production customisation, carbon footprint and supply difficulties" (Sebastien DUDREUILH, n.d..)..

2.4. DEVELOPMENTS AND TRENDS: USE CASES AND ADOPTION RATES

The most widespread uses of IoT and AI in industry today focus on applications with high operational value, deployed to improve the reliability, performance and quality of processes:

- **Predictive maintenance**: this accounts for **more than 50% of IoT use cases** (Lee, 2025) , with an **average reduction of 28% in** factory **downtime** (Pascal Pichoutou et al., 2025)
- **Production optimisation**: **79% of companies** use IIoT to optimise their production (Aurélie Chandeze, 2020)
- **Quality control**: particularly through computer vision, with 97.2% detection accuracy (Lee, 2025)
- **Energy efficiency**: **37% of IoT users** in industry use it to optimise their energy consumption (Nicolas Boudrot (Insee), 2021).

Available data shows a marked acceleration in the adoption of advanced digital technologies worldwide, driven by the widespread use of smart manufacturing and the rapid arrival of generative AI in industrial environments:

- **95% of companies** were using or planned to use smart manufacturing in 2024, compared to 82% in 2023 (Stanley A. Miller, 2024)
- **83% of companies** planned to use generative AI in 2024 (, while **generative AI is rapidly gaining ground, with 38%** of companies surveyed in Omdia's IT Enterprise Insights 2024 study (panel of manufacturers) stating that they have fully adopted it or are in the process of implementing it (Francois Gauthier, 2024)
- **86% of current** IIoT **users** plan to expand its use (Aurélie Chandeze, 2020).

In France and Europe, indicators also show a significant increase in the adoption of IoT and AI technologies, driven by both corporate investment and changes in the industrial job market:

- **10% of French companies** are currently investing in IoT, a figure that is expected **to double to 20% by 2025** (Sebastien DUDREUILH, n.d.)

- Industry, automotive, transport and logistics account for **42% of vertical players in the IoT in France** (Sebastien DUDREUILH, n.d.)
- **3% of industrial executive job offers** mention AI skills, with a **56% increase between 2019 and 2023** (APEC, 2025)
- **Although the proportion of job offers requiring AI skills remains low (3%), 80% come** from the metallurgy sector, with growth of 56% between 2019 and 2023 (APEC, 2025).

Despite this overall momentum, the survey results reveal a significant gap with the reality of the SMEs surveyed, whose levels of IoT and AI adoption remain modest in 2025, with only **35% of respondents reporting that they use connected objects** in their processes and **25% indicating that they use AI**.

3. CURRENT SITUATION, DYNAMICS AND TRANSFORMATION OF INDUSTRIAL PROFESSIONS

The key dynamics that are reshaping practices, professions and skills in industry are now strongly driven by IoT and AI.

3.1. EMERGENCE AND CONVERGENCE OF AI/IOT

The gradual integration of AI and IoT is redefining industrial processes and paving the way for new operating models.

3.1.1.DOMINANT USES

The first concrete effects of this convergence are evident in operational uses focused on reliability, quality and performance, which are structured around three main levers:

- **Supervision:** IoT provides real-time visibility into equipment and processes, while AI analyses this data to detect anomalies or opportunities for optimisation.
- **Maintenance:** Predictive maintenance, which accounts **for more than 50% of IoT use cases** (Lee, 2025)
- **Quality:** AI-assisted quality control, particularly through computer vision, can achieve **97.2% detection accuracy** (Lee, 2025).

3.1.2.LESSONS LEARNED IN THE FIELD: PRAGMATISM AND LIMITATIONS OF ADOPTION

The survey results (Appendix 2) show a more nuanced situation in SMEs, which mainly focus on simple, mature and immediately operational IoT solutions. Strategic uses with a greater impact remain underdeveloped, and AI is mainly used to speed up administrative tasks rather than to transform key industrial processes.

In detail, the results show that:

- **IoT is primarily used to secure operations**: maintenance, equipment monitoring and performance optimisation (energy, automation). These uses are mainly aimed at reducing breakdowns and improving supervision, based on a pragmatic investment approach with a rapid ROI.
- **Advanced IoT uses remain virtually absent**: digital twins, embedded AI, intelligent quality or automated logistics appear only in a few isolated cases.
- **AI is rarely deployed in industrial processes**: only a quarter of respondents say they use it, with a single case in production and none in product design or predictive maintenance.
- **AI is mainly confined to support functions**: preparing quotations, project management and administrative tasks.

These findings show that digital transformation still relies primarily on support and supervisory functions, rather than advanced automation.

They also highlight:

- The increased need for data skills
- The need for profiles capable of translating field requirements into digital applications
- And the urgent need to strengthen IoT/AI integration skills, which are currently very limited in SMEs.

3.2. TRANSFORMATION OF INDUSTRIAL PROFESSIONS

The spread of IoT and AI is leading to a reconfiguration of industrial professions, both in terms of skills and responsibilities.

3.2.1. IT/OT CONVERGENCE: A STRUCTURAL CHALLENGE

The convergence between the IT (Information Technology) and OT (Operational Technology) spheres is an essential condition for the effective deployment of advanced digital technologies.

However, **41%** of companies still operate with separate IT and OT teams (, which is a major obstacle to the industrialisation of IoT/AI applications.

This organisational fragmentation represents a key challenge for manufacturers wishing to accelerate their transformation.

3.2.2. EMERGENCE OF NEW PROFESSIONS

The rise of AI, data and IoT is giving rise to a new generation of specialised professions at the heart of industrial transformation:

- **Data Analyst/Engineer/ML Engineer for manufacturing** (Célia Garcia-Montero, 2023) : essential for leveraging industrial data.
- **IoT/IIoT Engineer and IT/OT Architect** (Viorel, 2024) : key to designing and integrating connected systems.
- **Industrial cybersecurity engineer** (OT) (Célia Garcia-Montero, 2023) : essential in the face of increasing cyber risks.
- **AI technicians and predictive maintenance engineers** (Pesset, 2025) : guarantors of the quality and performance of industrial AI models.

As Orange Business points out, "new jobs focused on data processing and governance are emerging with the implementation of adapted processing platforms" (Sebastien DUDREUILH, n.d..).

3.2.3. TRANSFORMATION OF EXISTING PROFESSIONS

Beyond new roles, traditional professions are undergoing profound changes to integrate intelligent tools and data-based practices:

- **Operators:** are becoming augmented supervisors, focused on added value. (Pesset, 2025). They are concentrating their work on value-added tasks and collaboration with intelligent systems.
- **Maintenance technicians:** move from reactive maintenance to data-driven predictive maintenance
- **Quality engineers:** use AI to analyse defects and optimise processes, combining business expertise and algorithmic analysis
- **Middle managers**: act as a "cognitive interface", arbitrating AI proposals and ensuring human intent.

Industrial IIoT allows "operators to focus on value-added tasks" (Sebastien DUDREUILH, n.d..) , with a redefinition of roles towards human-machine collaboration and proactive problem anticipation.

3.3. HR IMPACTS AND CHALLENGES

These technological transformations raise major challenges for human resources in terms of skills, organisation and attractiveness.

3.3.1. TRAINING, MOBILITY AND RESKILLING CHALLENGES

Companies must adapt their training, retraining and internal mobility strategies to support the skills development required by the IoT and AI.

- **Continuing education** – Employees must continuously develop new skills in order to keep pace with rapidly evolving technologies and uses. Training content and methods must be updated regularly.
- **Internal mobility** – Transformations open up opportunities for retraining in new professions (data, AI, OT cybersecurity, IT/OT). This mobility makes it possible to leverage existing experience while developing new skills.
- **Attractiveness and recruitment** – In a context of talent shortages, particularly in the fields of AI and OT cybersecurity, manufacturers must strengthen their employer brand to attract these highly sought-after profiles.

Retraining and reskilling – Reskilling programmes are becoming essential and require progressive, structured training tailored to the needs of the field (Célia Garcia-Montero, 2023) **:**

  - Operators and technicians moving into robotics/IIoT,
  - IT personnel towards OT/cyber,
  - Assembly and adjustment technicians towards connected maintenance.

3.3.2. JOB RETENTION AND CREATION

Contrary to the concerns often associated with automation, data shows that digital technologies tend to transform jobs rather than replace them.

94% of companies involved in Industry 4.0 plan to maintain or increase their workforce (Sirteq, 2024).

This dynamic reflects a shift in roles rather than job losses, and highlights the importance of support, training and upskilling to ensure a successful transition.

4. TRAINING NEEDS AND GAPS

The rise of AIoT is profoundly transforming industrial professions and creating major needs for technical, cross-functional and organisational skills. A cross-analysis of surveys of companies (Appendix 2) and training centres (Appendix 3) reveals high expectations, a still limited supply capacity and significant gaps to be filled.

4.1. PRIORITY TECHNICAL SKILLS REQUIRED

The rapid evolution of industrial technologies is accompanied by new needs for advanced skills. Three dimensions structure this analysis: company expectations, the current offering of training centres, and the alignment of these needs with EQF levels.

4.1.1. SUMMARY OF THE NEEDS EXPRESSED BY COMPANIES (APPENDIX 2)

Companies identify three priority categories of technical skills needed to exploit IoT and AI in production:

- **Cybersecurity of connected systems**, a major challenge and the most frequently mentioned area
- **Integration of AI into industrial processes**: deployment, adaptation, data-based automation
- **Analysis, interpretation and exploitation of industrial data** from sensors, dashboards or AI systems.

These needs reflect a growing maturity: SMEs now have a clear understanding of the skills that are essential for moving from experimentation to operational use.

EQF5 (BTS/DUT) and EQF6 (Licence/BUT) qualification levels account for most of the needs for all skills related to AI and IoT:

- EQF5 dominates the needs for **programming, IoT/automation integration and data analysis**
- EQF6 takes precedence for **AI skills, advanced cybersecurity, and integration of AI models into processes**.

Initial EQF3 and EQF4 training courses are rarely promoted and are limited to simple tasks (basic cybersecurity, data awareness).

4.1.2. SUMMARY OF THE CURRENT CAPABILITIES OF TRAINING CENTRES (APPENDIX 3)

To address these challenges, although the results of the survey sent to training centres (Appendix 3) show that nearly 82% of centres already include IoT content, only slightly more than half have dedicated equipment.

In addition, nearly two-thirds address AI, most often in the form of awareness-raising, but with few applied projects.

This can be explained by the fact that more than 80% of centres do not have trainers specialised in IoT/AI.

However, these same centres agree that there will be strong growth in IoT/AI training needs; 6 out of 11 centres anticipate a "sharp increase in needs linked to digitalisation".

The educational priorities for the future identified by the centres are:

- Project-based and experiential learning: 8 centres
- Modular and adaptive training: 5 centres
- Development of digital training platforms: 4 centres.

This development does not only affect businesses: it also places training centres at the heart of the adaptation process. In this context, levels 4 and 5 of the European Qualification Framework (EQF) appear to be the most targeted for increased training efforts in order to meet the needs of industries in high-demand professions (Hanotaux Pierre et al., 2023) , as they are the ones that most directly respond to the emerging demands and needs of industry. These intermediate levels bring together technical and technological profiles capable of integrating new skills in AI and IoT, making them essential levers for supporting the digital transition of industrial companies.

4.1.3. ALIGNMENT BY QUALIFICATION LEVELS (EQF)

The cross-referencing of responses indicates a clear correspondence between industrial needs and the relevant training levels:

- **EQF 5 (BTS/DUT/BUT1):** highly sought after for programming, IoT/automation integration and data analysis
- **EQF 6 (Bachelor's degree / BUT2–3):** dominant in applied AI, advanced cybersecurity and the integration of AI models into processes
- **EQF 3 and EQF 4:** low demand, skills remain limited to simple tasks (data awareness, basic cybersecurity).

These intermediate levels (EQF 5–6) are at the heart of current needs, as they correspond to technical profiles that can be directly deployed in companies' IoT/AI projects.

These findings converge with analyses from the literature, which highlight the following four families of technical skills that are essential for supporting digital transformation.

4.1.4. DATA MANAGEMENT: COLLECTION, PREPARATION AND GOVERNANCE

Companies must now master the entire data chain:

- **Data collection:** Instrumentation, sensors, communication protocols to feed AI systems.
- **Data preparation:** cleaning, structuring and standardising industrial data remain critical steps for the quality of analyses. With the rise of generative AI, new tools are emerging and must be mastered to overcome these obstacles. As shown in , they make it possible to identify and correct errors, verify the consistency of data sets and automatically enrich metadata. Empirical results indicate a notable improvement in quality: fewer inconsistencies, more complete and better structured data, and a significant reduction in the manual work required.

- **Leveraging unstructured data:** with the rise of generative AI, dependence on perfectly structured data is decreasing. These technologies make it possible to exploit heterogeneous or partially cleaned data. As highlighted in , nearly 90% of the data produced by an organisation is unstructured, and less than half of it has been effectively exploited to date, leaving considerable untapped potential. This data includes, for example, emails, meeting minutes, customer calls, chat logs, contracts, product roadmaps, etc. Knowledge and mastery of these tools opens the door to numerous use cases.
- **Data governance:** data quality, security and compliance policies.

In 2024, 77% of companies reported having mastered data management (+24 points vs. 2023), which marks significant progress but highlights persistent needs (Vincent Moulin, 2024).

4.1.5. APPLIED AI AND SUPERVISION

The implementation of AI models is becoming a key issue:

- **Applied AI:** Machine learning, computer vision, predictive maintenance - capabilities to develop and deploy AI models in an industrial environment.
- **Data quality:** Verification, validation and continuous improvement of training data
- **Model maintenance:** Performance monitoring, retraining, version management
- **Supervision of AI systems:** Detection of deviations, explainability of decisions

The **AI Act** now imposes strict obligations on manufacturers: documentation, risk management, supervision, ethics, RGPD, traceability. This creates an urgent demand for regulatory and ethical training.

4.1.6. CYBERSECURITY: A CRITICAL ISSUE FOR OT

With the increase in industrial connectivity, cybersecurity is becoming a priority area (Directorate-General for Enterprise, 2024) :

- **Network segmentation:** Isolation of critical systems, demilitarised zones
- **Intrusion detection:** Monitoring and management of vulnerabilities specific to industrial environments
- **Compliance with standards:** Notably IEC 62443 for the security of industrial automation and control systems.

Cybersecurity is considered **very or extremely important by 89% of respondents in the industrial sector** (Aurélie Chandeze, 2020) , reflecting the critical nature of this issue in the face of growing risks related to connectivity.

4.1.7. IT/OT PROGRAMMING AND INTEGRATION

The integration of IT and OT technologies requires specialised convergence skills:

- **Industrial protocols:** OPC UA, MQTT, Modbus, Profinet - essential communication standards
- **Edge computing:** processing data as close as possible to the equipment to reduce latency

- **Integration with existing systems:** SCADA, MES, ERP - need to understand legacy ecosystems
- **Industrial networks:** private 5G, LPWAN (LoRaWAN, NB-IoT) - emerging technologies for connectivity
- **MLOps - Industrialisation of Machine Learning:** deployment and management of AI models in production environments - ensuring the continuity and reliability of intelligent systems.

Industrial engineering/IT professions must now embrace **MLOps, containers, and AI deployment in production environments** (Francois Gauthier, 2024) , marking a growing convergence between IT and OT.

4.2. CROSS-FUNCTIONAL AND BEHAVIOURAL SKILLS

Beyond technical skills, digital transformation requires new behavioural and organisational skills that are essential for the adoption of technologies (Emmanuelle Blons, 2024; Haut-Commissariat à la stratégie et au plan, 2025) :

4.2.1. COMMUNICATION AND BUSINESS-TECHNICAL TRANSLATION

Ability to explain, document, coordinate and work with cross-functional teams (IT, OT, production)

4.2.2. PROBLEM SOLVING AND SYSTEMIC ANALYSIS

Systemic failure analysis, data analysis, critical thinking regarding algorithmic recommendations, understanding the limitations of models, complex problem solving.

4.2.3. HUMAN-MACHINE COLLABORATION AND SUPERVISION

Human arbitration, supervision of automated systems, contextual interpretation of information generated by AI, ability to arbitrate, ethics and responsibility.

4.2.4. CHANGE MANAGEMENT AND ACCEPTABILITY

Supporting teams in digital transformation and the adoption of new technologies, managing resistance to change, culture of innovation, agility and adaptability in the face of constantly evolving tools and technologies, curiosity and creativity to identify new industrial uses for AI and improve existing processes.

4.2.5. CENTRAL ROLE OF MIDDLE MANAGERS

Middle managers play a central role as **"cognitive interfaces" between AI and teams**, arbitrating AI proposals to ensure human intent and enhance acceptability. This human dimension is critical to the success of AI and IoT projects, transforming management into a true mediation activity between technical systems and teams (Krim, 2025).

4.3. CROSSING SUPPLY ↔ DEMAND: IDENTIFYING GAPS

Cross-referencing the needs of businesses and the current capacities of training centres reveals several structural gaps.

4.3.1. MAJOR GAPS IDENTIFIED

A cross-analysis of business needs and training provision reveals several significant gaps:

- **Shortage of profiles:** the Grande École du Numérique warns of a shortage of training in IoT and robotics, which has a major impact on industry (Célia Garcia-Montero, 2023).
- **Rapid growth in demand**: job offers mentioning AI skills in industry increased by 56% between 2019 and 2023 (APEC, 2025) , far outstripping the growth in training provision. This dynamic is creating increasing tension in the labour market.
- **Level of expertise:** companies are looking for more experienced data profiles, while training programmes mainly produce junior profiles (Célia Garcia- Montero, 2023) **,** creating a gap between expectations and reality. In addition, a trend is emerging: as companies review their recruitment levels in anticipation of the impact of AI, young graduates are finding themselves faced with fewer opportunities, impacting their ability to gain experience (Tera Allas CBE & Andrew Goodman, 2025).
- **Industrial cloud and OT cybersecurity**: training provision remains poorly aligned with these critical areas (Célia Garcia-Montero, 2023) , creating a particularly problematic deficit in a context of growing threats.
- **Dual technical and telecoms skills**: The rise of private 5G networks requires this dual skill set, which is rarely found in current curricula (Célia Garcia-Montero, 2023).
- **MLOps and AI deployment in production**: These skills, which are essential for the industrialisation of AI, are insufficiently covered by existing training programmes.

4.3.2. CURRENT LIMITATIONS OF TRAINING CENTRES

According to the 10 training centres that responded to the survey, the main difficulties encountered in integrating IoT and AI are:

- Lack of suitable teaching resources: 6 centres
- Lack of training for trainers: 6 centres
- Lack of equipment: 4 centres
- Lack of suitable curricula: 4 centres
- Lack of internal skills: 4 centres
- Lack of industrial partnerships: 2 centres.

Conversely, the forms of support deemed most useful are:

- Ready-to-use teaching resources: 7 centres
- Equipment funding: 6 centres
- Training of trainers: 6 centres
- Shared technical platforms (learning factories, shared IoT/AI platforms): 5 centres
- Stronger partnerships with businesses: 4 centres.

To reduce these gaps, training provision must evolve in several areas:

- **Modularity:** Need to align training provision with new business needs through more flexible formats (micro-certifications (OECD, 2023) , turnkey modular courses, upskilling) tailored to the needs of businesses.
- **Continuing education:** The importance of lifelong learning to keep pace with rapid technological change, with regular content updates (Cécile Derouin, 2024).
- **Hybridisation of skills:** Need for training courses combining technical expertise and business understanding, to train professionals capable of translating between the IT and OT worlds (EMLV, 2019).
- **Training of trainers:** In terms of human resources, the internal capacity of centres to address these issues appears limited:
  - 9 out of 11 centres report that they do not yet have trainers specialising in IoT/AI;
  - Only 2 centres report having one or more dedicated trainers.

- **Shared technical platforms:** it is important to develop shared technical platforms, enabling the pooling of resources and costs, in order to guarantee access to advanced technological equipment.
- **Training specialisation**: There is a need to introduce sector- or profession-specific specialisations within training programmes (cybersecurity, energy, automation, etc.) in order to contextualise technical skills (IoT, AI, data) and strengthen their operational applicability. This approach makes it possible to adapt content to the specific characteristics of different sectors, better meet the expectations of businesses and promote the employability of learners by bringing training closer to practical applications.

5. CHALLENGES AND PROSPECTS

Examining the obstacles that currently hinder the use of IoT and AI, and then looking at the scenarios that are emerging, helps to clarify the transformations to be anticipated and the possible paths of evolution for industrial companies.

5.1. CURRENT OBSTACLES

Several obstacles still hinder the optimal adoption of AI and IoT in industry, requiring strategic attention:

5.1.1. STRUCTURAL OBSTACLE: LACK OF ADVANCED INDUSTRIAL USE

The gap between the potential of these technologies and their actual uses, as described in section 2.1, highlights the limited adoption of the most transformative technologies.

This low level of AIoT adoption in industrial processes can be explained by:

- The **complexity of integrating** AI systems into OT environments.
- The lack of **structured data**, although this obstacle is tending to diminish, as generative AI offers the ability to leverage imperfect or unstructured data (Paula Morton, 2025).
- The lack of **MLOps/IT-OT/AI** skills **applied to production** in SMEs.

5.1.2. TALENT SHORTAGE: THE MAIN OBSTACLE

The talent shortage is identified as the main obstacle to the adoption of AI and automation in industry (Viorel, 2024). This shortage particularly affects profiles combining technical expertise and an understanding of industrial processes, and the increased competition to attract and retain these rare profiles.

5.1.3. INITIAL INVESTMENT AND BUDGET CONSTRAINTS

Initial investment remains a major obstacle, with budget constraints limiting the ability of some companies, particularly SMEs, to adopt these technologies. The costs relate not only to technological infrastructure, but also to training, change management and the human resources dedicated to the transformation.

5.1.4. RESISTANCE TO CHANGE AND INSUFFICIENT DATA CULTURE

Resistance to change and a lack of data culture are significant organisational barriers. The transformation of business lines raises concerns that need to be addressed through appropriate communication and support. Obstacles include:

- Fears about employment and changing roles
- Lack of understanding of the benefits of new technologies

- Reluctance to share data and knowledge
- Absence of a culture of experimentation and learning.

5.1.5. SECURITY: A CRITICAL BARRIER TO IOT ADOPTION

Security remains the main barrier to IoT adoption, cited by 28% of respondents (FRANCETRAVAIL.FR, n.d.). The specific risks associated with OT environments require an appropriate security approach:

- Vulnerabilities of legacy systems not designed for connectivity
- Lack of OT cybersecurity skills
- Complexity of securing heterogeneous networks
- Absence of clear standards and documented best practices.

5.1.6. COMPLEXITY OF INTEGRATION AND SCALABLE SYSTEMS

No less than 80% of IoT projects fail to adapt due to the complexity of integration and the inability to support scalable systems (Viorel, 2024). This complexity is accentuated by:

- The diversity of technologies and industry standards
- The heterogeneity of legacy equipment and systems
- The lack of documentation and standardisation
- The absence of internal skills to manage the continuous evolution of systems.

5.2. PROSPECTIVE SCENARIOS FOR 2030

By 2030, several trends are expected to shape the adoption of AI and IoT in industry, opening up new opportunities:

5.2.1. ACCELERATED AI/IOT CONVERGENCE

AIoT will become the standard, with intelligence embedded as close as possible to the equipment thanks to advances in Edge AI and TinyML (Francois Gauthier, 2024). This evolution means:

- Massive deployment of lightweight algorithms directly on sensors and equipment
- Reduced dependence on cloud connections
- Improved system latency and responsiveness
- Better privacy protection through local data processing.

5.2.2. WIDESPREAD ADOPTION OF INDUSTRIAL 5G

Private 5G networks will be deployed on a massive scale in businesses, providing the connectivity needed for critical real-time applications. This will enable:

- Reliable, ultra-low latency connectivity for critical applications
- The ability to support thousands of sensors simultaneously
- Flexibility to adapt network configurations to operational needs
- Increased resilience to connectivity disruptions.

5.2.3. INCREASING AUTONOMY OF INDUSTRIAL SYSTEMS

Industrial systems will become more autonomous, with an increased ability to:

- Self-optimise based on operational conditions
- Self-repair by detecting and correcting faults
- Adapt dynamically to variations in demand
- Assist decision-makers in complex decision-making.

5.2.4. DEEPENING HUMAN-MACHINE HYBRIDISATION

Collaboration between human operators and intelligent systems will deepen, with:

- More natural and contextual interfaces (augmented reality, voice interaction)
- Better mutual understanding between humans and systems
- Optimised distribution of roles and responsibilities
- An increase in human capabilities through technology.

5.2.5. EUROPEAN TECHNOLOGICAL SOVEREIGNTY

Issues of sovereignty and resilience will drive the development of European solutions in industrial AI and IoT. This evolution reflects:

- The desire for technological independence from global players
- The strengthening of R&D capabilities in Europe
- The development of European standards and open source solutions
- The creation of robust European technological ecosystems

5.2.6. A RISE IN EXPERTISE NEEDED TO INDUSTRIALISE AI AND IOT

The strong demand for EQF5/EQF6 skills described in 3.1.3 indicates that companies are seeking to:

- Internalise the ability to **integrate and maintain** IoT/AI systems
- Secure their IT/OT architecture
- Develop autonomy in **operational data**

- Avoid excessive dependence on external service providers
- Prepare for the arrival of advanced uses (Edge AI, MLOps, digital twins).

The overall increase in the level of qualification among technical teams requires an expanded training offering that incorporates new technical content tailored to emerging industrial uses:

- **Increase training dedicated to IoT/IIoT and robotics** for industry (Célia Garcia-Montero, 2023)
- **Adapting curricula to industrial cloud and OT cybersecurity needs** (IEC 62443, network segmentation) (Célia Garcia-Montero, 2023)
- **Develop dual technical skills in industry and telecoms** for 5G and private networks (Célia Garcia-Montero, 2023)
- **Structure pathways leading to experienced data profiles** (Data/AI for manufacturing, MLOps/edge) (Célia Garcia-Montero, 2023)
- **Strengthen the two-year/three-year degree programmes** for industrial network maintenance and operation (Célia Garcia-Montero, 2023)
- **Develop specialised modules** for sustainable industry, eco-production, green data, energy efficiency in connection with AI and IoT (Russo, 2025).

5.3. VISION OF A 'LEARNING' INDUSTRY

The rapid evolution of technologies and required skills calls for a vision of a "learning" industry, characterised by:

5.3.1. LIFELONG LEARNING: AN ESSENTIAL COMPONENT

Integration of continuous learning as an essential component of professional activity (Cécile Derouin, 2024) , involving:

- Allocation of time and resources for continuing education
- Development of personalised and adaptive training pathways
- Recognition and promotion of formal and informal learning
- Creation of a culture where learning is valued and encouraged

5.3.2. AGILE AND ADAPTABLE ORGANISATIONS

Ability to adapt quickly to technological developments and new business models, through:

- Flexible and modular organisational structures
- Rapid and decentralised decision-making processes
- Ability to pivot quickly in response to market changes
- Continuous investment in innovation and experimentation

5.3.3. COLLABORATIVE AND OPEN ECOSYSTEMS

Stronger partnerships between companies, educational institutions, start-ups and research centres, promoting(*Home - LCAMP*, n.d.) :

- Sharing knowledge and best practices
- Co-creation of innovative solutions
- Access to external resources and expertise
- The creation of synergies and network effects

5.3.4. A CULTURE OF EXPERIMENTATION AND LEARNING

Iterative and learning-based approach to the deployment of new technologies, characterised by:

- Acceptance of risk and failure as sources of learning
- Rapid testing and iteration cycles
- Documentation and sharing of lessons learned
- Continuous improvement based on feedback

5.4. IMPORTANCE OF MULTI-STAKEHOLDER COLLABORATION

The success of the industry's digital transformation will depend on enhanced collaboration between the various stakeholders in the ecosystem:

5.4.1. SHARING, CO-CONSTRUCTION & EDUCATIONAL INSTITUTIONS: AGILE ADAPTATION

Collaboration between training centres and companies is a key lever for adapting curricula to real needs in the field. However, survey results show that these partnerships are still limited and often unstructured.

On **the business side,** the survey (Appendix 2) reveals a partial openness to pedagogical co-construction, with a significant proportion (45.5%) remaining cautious or unavailable and 54.5% showing an interest in pedagogical co-construction. Among those interested:

- **22.7%** would be willing to collaborate **for both audiences**: initial training (EQF 3–6) and continuing training for employees
- **18.2%** are interested only in **continuing education** for current employees
- **13.6%** would accept collaboration for **initial training** for young graduates.

Furthermore, the results of the survey sent to **training centres** reveal that **their ability to meet IoT/AI needs remains limited by** a lack of specialised trainers and the fact that collaboration between training centres and businesses on IoT/AI topics is still in its infancy, limiting the implementation of courses that are truly aligned with industrial needs:

- Only 2 out of 11 centres report already working with companies on IoT/AI-related projects or training courses

- Three centres indicate that this type of collaboration is in the pipeline
- Six centres are not currently conducting any IoT/AI projects with companies.

However, given the rapid pace of technological innovation, curricula must incorporate mechanisms for continuous updating and strengthen the management of risks related to critical skills:

- **Anticipate technological developments** by incorporating emerging trends into curricula
- **Establish mechanisms** for **rapidly updating** training content to remain aligned with market needs
- **Identify vulnerabilities** in critical skills (cybersecurity, MLOps) and address them as a priority.

To respond to this, a restructuring of courses must offer more flexible, modular training tailored to different learner profiles:

- **Clarify full-stack industrial pathways** (MES/SCADA + web/edge) or modularise by stacks to facilitate access and progression (Célia Garcia-Montero, 2023)
- **Develop micro-certifications** that validate specific skill sets and can be quickly updated
- **Create modular pathways** that allow for gradual skill development adapted to the pace of learners
- Offer short workshops
- Organise joint end-of-study projects
- Set up shared modules with SMEs.

All of these actions aim to:

- Strengthen the **relevance of courses** through co-construction
- **Supporting trainer training** through feedback from the field
- **Create co-training spaces** where companies and trainers work together to **keep pace with technological developments**
- **Develop work-study programmes** and hybrid learning environments**.**

5.4.2. GOVERNMENTS: SUPPORT AND A FAVOURABLE FRAMEWORK

Public authorities play a decisive role in accelerating industrial transformation by creating conditions conducive to innovation, skills development and cooperation between stakeholders. This involves, in particular:

- Supporting innovation through funding and incentives
- Investing in training and retraining
- Creating a favourable and predictable regulatory framework
- Promoting technological sovereignty
- Facilitating collaboration between public and private stakeholders.

5.4.3. INNOVATION ECOSYSTEMS: COLLECTIVE ACCELERATION

Innovation progresses faster when technological players cooperate: start-ups, laboratories and large groups form a key ecosystem for disseminating, testing and industrialising IoT/AI uses, in particular by:

- Collaborating to accelerate the adoption of technologies
- Sharing resources and infrastructure
- Developing innovative and scalable solutions
- Creating network effects and positive externalities
- Contributing to collective skills development.

5.4.4. SUMMARY: COLLABORATION AS A FACTOR FOR SUCCESS

Stronger collaboration between all stakeholders is essential for the success of industrial transformation. To produce concrete results, this cooperation must be:

- **Systemic**: involving all stakeholders in the ecosystem
- **Sustainable**: part of a long-term approach
- **Inclusive**: involving SMEs and less advanced businesses
- **Impact-oriented**: aiming for concrete and measurable results.

5.5. ROLE OF PUBLIC POLICY AND EUROPEAN INITIATIVES

Public policies and European initiatives play a crucial role in accelerating the adoption of AI and IoT in industry:

5.5.1. EUROPEAN PROJECTS

European Erasmus+ projects, such as the LCAMP project(*Home - LCAMP*, n.d.) , can promote the adoption of IoT and AI technologies in industry through several concrete levers by:

- Developing training courses, micro-certifications and educational tools dedicated to IoT/AI
- Setting up Learning Factories for practical experimentation and training
- Connecting VET centres, companies and SMEs via an open innovation community
- Aligning emerging skills with real industrial needs (skills observatory)
- Reducing barriers to adoption by providing structured and shared support for businesses.

5.5.2. FUNDING FOR R&D AND INNOVATION

National and European funding programmes stimulate innovation in the fields of industrial AI and IoT through:

- Horizon Europe and its thematic calls for projects
- National funding programmes (France 2030, etc.)
- Regional innovation funds
- Public-private partnerships for technological acceleration.

For example, with **Quatrium**, Cetim and its partners provide companies with transformation and technology experts available throughout the country and around a hundred pieces of equipment to demonstrate the benefits of the technologies with tailor-made support. **Quatrium** was certified in 2021 by the French government as part of the call for projects "Acceleration platforms for the industry of the future" funded by the Future Investment Programme.(*Quatrium, the CETIM support programme*, n.d.)

5.5.3. FAVOURABLE REGULATORY FRAMEWORK

The AI Act (Rules for Trustworthy Artificial Intelligence in the EU, 2024) **and other European regulations are shaping an environment conducive** to the responsible development of these technologies by:

- Establishing clear and predictable rules
- Ensuring data protection and privacy
- Promoting trust in AI systems
- Creating a common basis for European competitiveness.

5.5.4. AMI CMA PROJECT

The winning projects of the Call for Expressions of Interest – Skills for the Future (AMI CMA) – are France 2030 initiatives. Several AMI CMA projects focus on AI, including the MACMIA *project*(project, 2024) , which aims to:

- Meet the skills needs associated with technological, digital and ecological transition.
- Massify and structure innovative and transdisciplinary training programmes in AI
- Create a comprehensive offering ranging from technicians to engineers.
- Accelerate the availability of qualified talent.

6. RECOMMENDATIONS

To fully leverage the potential of AI and IoT, the various stakeholders must now move from analysis to action. The following recommendations aim to bridge the gaps identified, strengthen skills at all levels and accelerate a sustainable and controlled industrial transformation.

6.1. FOR BUSINESSES: TRANSFORMING SKILLS DEVELOPMENT INTO A STRATEGIC ADVANTAGE

For digital and green transformation to deliver concrete results, companies must structure skills development as a strategic lever rather than a one-off action:

6.1.1. STRATEGY AND MANAGEMENT

Digital transformation cannot succeed without structured governance: companies must organise, plan and manage skills development with the same rigour as their technological investments:

- **Integrate skills development as an essential component of the digital transformation strategy.** This means allocating dedicated budgets, human resources and managerial time to training, in the same way as technological investment.
- **Map existing skills and identify gaps in relation to future needs.** This assessment must be carried out regularly and cover all hierarchical and functional levels in order to anticipate needs and plan training actions.
- **Integrate the CDO (Chief Data Officer) into the Information Systems and Operational Technologies departments to link factory data and business objectives** (FRANCETRAVAIL.FR, n.d.). This cross-functional governance ensures alignment between data strategy and operational realities.

6.1.2. TRAINING AND MOBILITY

Skills development requires more fluid pathways and mechanisms for leveraging internal experience:

- **Develop personalised training pathways combining formal training and on-the-job learning.** Blended learning approaches combining theory and practice in a real-world context promote better integration of learning.
- **Encourage internal mobility and retraining for new emerging professions.** This makes it possible to leverage existing experience, reduce external recruitment costs and strengthen team commitment.

6.1.3. MANAGEMENT OF AI AND TECHNOLOGY INVESTMENTS

The performance of AI projects depends as much on investment management as on the quality of their operational implementation:

- **Avoid premature cuts in AI investments: manage ROI with measurable industrial use cases** (quality, maintenance, supply chain) (FRANCETRAVAIL.FR, n.d.). AI projects need time to demonstrate their value; a long-term vision is essential.
- **For agentic architectures, favour incremental approaches and/or rely on partners/publishers rather than 100% in-house development** (FRANCETRAVAIL.FR, n.d.). This reduces technological risks and time to production.
- **Accelerate the adoption of AIOps/MLOps to reduce technological debt and improve IT/OT reliability** (FRANCETRAVAIL.FR, n.d..). These practices enable the operationalisation of AI systems and ensure their maintenance and continuous evolution.

6.1.4. RISK MANAGEMENT

Technological risks must be treated as strategic issues in order to secure transformation and business continuity: **strengthen the management of technological risks (cyber OT, compliance, resilience) to the level of strategic risk** (FRANCETRAVAIL.FR, n.d.). Security and compliance should not be secondary considerations but should be integrated from the design stage of projects.

6.2. FOR TRAINING CENTRES: DEVELOPING AN AGILE AND RELEVANT OFFERING

Training centres must quickly adapt their content and practices to meet the growing needs of businesses for technical, hybrid and cross-functional skills:

6.2.1. MODULARITY AND FLEXIBILITY

Modularity has become essential for offering scalable, customisable courses that can keep pace with innovation:

- **Develop modular training courses that allow for personalised learning paths and rapid adaptation to technological developments.** Modularity allows learners to progress at their own pace and enables centres to update content quickly.
- **Offer hybrid formats combining distance and face-to-face training, theory and practice.** This diversity of formats responds to learners' constraints (geography, schedules, timetables) and improves engagement.
- **Clarify full-stack industrial pathways (MES/SCADA + web/edge) or modularise by** stacks. This clarification makes it easier for learners to navigate and identify prerequisites.

6.2.2. CERTIFICATIONS AND RECOGNITION

Skills recognition must become more granular, faster and aligned with market expectations:

- **Integrate industry-recognised micro-certifications to promote acquired skills.** Micro-certifications enable granular recognition of learning and facilitate continuous progression**.**
- **Develop industry-recognised sectoral certifications for skills in industrial AI and IoT.** These certifications must be co-developed with companies to ensure their relevance and acceptability.

6.2.3. PRIORITY AREAS FOR DEVELOPMENT

Certain technological fields have very strong needs and require a rapid ramp-up of training provision:

- **Increase training dedicated to IoT/IIoT and robotics for industry** (Célia Garcia-Montero, 2023). This field is experiencing high demand and a shortage of supply.
- **Adapting curricula to industrial cloud and OT cybersecurity needs** (IEC 62443, network segmentation) (Célia Garcia-Montero, 2023). OT cybersecurity is a critical and under-covered area.
- **Develop dual technical skills in industry and telecoms for 5G** (private networks) (Célia Garcia-Montero, 2023). This dual skill set is rare and in high demand.
- **Structure pathways leading to experienced data profiles** (Data/AI for manufacturing, MLOps/edge) (Célia Garcia-Montero, 2023). Companies are looking for experienced profiles, not just juniors.
- **Strengthen the range of two- and three-year higher education programmes for the maintenance and operation of industrial networks** (Célia Garcia-Montero, 2023). This level of qualification is often overlooked but represents significant needs.

6.2.4. PARTNERSHIPS AND CO-CONSTRUCTION

Close ties between training centres and businesses are essential to ensure the relevance of content and the adoption of new practices:

- **Strengthen school-industry partnerships to ensure that training courses are tailored to real needs.** These partnerships enable the co-construction of curricula and better integration of technological innovations both within training centres and in industrial processes.

6.3. FOR INSTITUTIONS: CREATING A COHERENT TRAINING ECOSYSTEM

Institutions play a key role in structuring, financing and supporting the development of training provision at regional and sectoral level:

6.3.1. FUNDING AND SUPPORT

Public support is crucial to accelerating skills development and facilitating access to critical training:

- **Strengthen funding mechanisms for continuing education in the fields of industrial AI and IoT.** Continuing education budgets must be increased to support rapid transformation.
- **Facilitate professional retraining for occupations in high demand.** Retraining assistance schemes (allowances, support, funded training) must be put in place.
- **Support the development of shared technology platforms for training and experimentation.** These platforms enable training centres and companies to access expensive technologies without individual investment.

6.3.2. POOLING AND SHARING

Pooling infrastructure and knowledge reduces costs, accelerates innovation and strengthens collective learning:

- **Support the development of shared training platforms between companies and training centres.** Pooling reduces costs and promotes the sharing of best practices.
- **Encourage the creation of shared skills frameworks for emerging professions.** These frameworks facilitate the alignment of training supply and demand.
- **Encourage the sharing of best practices and use cases between industry players.** Communities of practice and forums accelerate collective learning.

6.3.3. CENTRES OF EXCELLENCE AND INFRASTRUCTURE

The development of specialised clusters facilitates access to advanced technologies and creates environments conducive to experimentation:

- **Promote the creation of centres of excellence bringing together companies, training centres and research laboratories.** These centres become hubs of expertise and innovation.
- **Facilitate access for SMEs to AI and IoT resources and skills through appropriate support mechanisms.** SMEs often have limited resources; collective support mechanisms can help them.

6.4. CREDENTIALS AND CERTIFICATIONS: INTEGRATING ETHICS AND RISK MANAGEMENT

Changes in regulatory frameworks, particularly with the AI Act, require strengthening the ethical, security and methodological aspects of certifications :

6.4.1. BASIC STANDARDS AND BENCHMARKS

Standards must incorporate requirements related to ethics, governance and risk management to support the responsible use of AI:

- **Integrate AI ethics and risk management modules in accordance with the AI Act** (Rules for Trustworthy Artificial Intelligence in the EU, 2024) **and associated standards.** These modules must cover:
    - Fundamental ethical principles (fairness, transparency, accountability)
    - The legal and regulatory obligations of the AI Act
    - The stages of AI risk management (NF EN ISO/IEC 23894)
    - Good governance and ethical practices (XP Z77-101).
- **Training in risk analysis, validation, documentation and continuous updating of systems incorporating AI**, in accordance with the UNM Guide on machine safety and AI. These skills cover:
    - Risk identification and assessment
    - Validation of AI systems
    - Documentation of decisions and processes
    - Management of updates and continuous evolution.
- **Integrating good governance and ethical practices as defined by the XP Z77-101 standard.** These good practices cover:
    - Governance of AI systems
    - Ethics and responsibility
    - Transparency and explainability
    - Management of social and environmental impacts.

6.4.2. SECTOR-SPECIFIC CERTIFICATIONS AND RECOGNITIONS

To meet the needs of businesses, specialised certifications must emerge in the most strategic technical fields:

- **Develop industry-recognised sector-specific certifications** for key skills:
    - **IoT/IIoT certifications**: industrial protocols, architecture, security
    - **Applied AI certifications**: machine learning, computer vision, predictive maintenance
    - **OT cybersecurity certifications**: network segmentation, intrusion detection, IEC 62443 compliance
    - **Data management certifications**: collection, quality, governance, RGPD compliance
    - **IT/OT certifications**: integration, edge computing, protocols, architectures.

7. EXPERT EVALUATION

The following experts, all actively involved in training and/or transforming industrial professions, contributed their knowledge and assessments based on their level of experience and involvement.

Hervé Danton	- General Delegate, Mecanic Vallée
Stéphane Blanchard	- Project Manager – Industry 4.0 - AD'OCC
Landry Bourguignon	- Rectorate, Ministry of National Education – Academic Inspector
Thierry Ameye	- Industry 4.0 and transformation of professions – CETIM
David Krupka	- Standards, certifications, training – AFNOR
Pierre Pomeret-Coquot	- Lecturer in Digital Technology and Computer Science - IUT Rodez

The comments gathered from these stakeholders, including industry professionals, training institutions and technical experts, reflect strong and consistent support from industry professionals, training institutions and technical experts.

Each chapter was evaluated qualitatively. Overall, the report is recognised for its relevance, clear structure and strategic value, illustrated with factual data, and is considered useful and usable. Here is a summary of their feedback by chapter:

- **Introduction:** Approved without comment
- **Context:** Approved with a proposal to add the topic of ethical AI: added to the conclusion of the report
- **Current situation, dynamics and transformations in industrial professions:** Approved. Comment: Comprehensive technical aspects
- **Training needs and gaps:** Approved. Comments: Tools exist, but the challenge lies more in RGPD compliance. Part 4 reflects reality.
- **Challenges and prospects:** Approved. Comment: CETIM offers documentation on a platform of use case demonstrators accessible to manufacturers: added to chapter 5.4.3
- **Recommendations:** Approved without comment
- **Conclusion:** Validated without comment.

Cross-cutting comment: It was noted **that there is no clear and consistent definition of the term "AI",** which seems to be used with **varying meanings depending on the chapter**:

- Sometimes limited to generative AI or chatbots
- Sometimes broadened to include optimisation, decision support or data analysis
- Sometimes associated with a **method** (machine learning) rather than a **field of application**.

A clarification has been added to the definition of the term artificial intelligence in 2.2. to explain the scope of the term AI as used in this report.

8. CONCLUSION

The spread of AI and IoT marks a decisive step for industry, transforming both processes and the professions and skills needed to master them. The report's cross-analyses – surveys, literature, technological trends – show that these technologies are no longer a projection, but are becoming central to industrial performance. They offer tangible gains, while revealing significant gaps between the needs on the ground and the current capacity to meet them. At the same time, advances in generative AI are gradually alleviating the constraints associated with data quality, making information that was previously difficult to structure usable.

The key challenge that emerges is the need to support this transformation with an ambitious and coordinated skills development programme to ensure the competitiveness of French and European industry in a rapidly changing technological landscape.

8.1. CROSS-CUTTING SUMMARY

An in-depth analysis of the impact of AI and IoT on industry reveals a **major transformation of industrial processes and related professions**. This transformation is driven by the accelerated convergence of these technologies, with significant and measurable benefits:

- **Significant reduction in unplanned downtime** thanks to predictive maintenance
- **10-20% savings on energy costs** through real-time optimisation
- **97.2% accuracy in** computer vision-assisted **quality control**
- **40% reduction in test cycles** through digital twins.
- At the same time, advances in generative AI are making it **possible to exploit a large portion of unstructured data**, reducing the historical dependence on perfectly prepared data sets.

Professions are undergoing profound changes: new roles are emerging (data engineer, IoT/IIoT engineer, OT cybersecurity, AI technician) and traditional professions are being transformed into supervisory, analytical and assisted decision-making functions. Middle managers are becoming the "cognitive interfaces" between AI and teams, and engineers are becoming complex systems architects.

This evolution is generating significant skills requirements, structured along two dimensions:

- **Technical skills**: data management, applied AI, OT cybersecurity, IT/OT integration, MLOps
- **Cross-functional skills**: communication, problem solving, human-machine collaboration, change management, adaptability.

A cross-analysis of business needs and training provision reveals significant gaps, both quantitative and qualitative:

- **Talent shortage** identified as the main obstacle
- **56% increase in AI job offers** between 2019 and 2023, outpacing the growth in training provision

- **80% of IoT projects fail** due to the complexity of integration
- **Shortage of training in IoT/robotics, OT cybersecurity and MLOps.**

These findings call for **coordinated action by businesses, training centres and institutions** to adapt training provision and strengthen skills.

8.2. STRATEGIC IMPORTANCE OF IOT AND AI FOR INDUSTRY

IoT and AI are becoming strategic levers for business competitiveness, sustainability and resilience.

8.2.1. MARKET DYNAMICS AND GROWTH

The industrial IoT and AI markets are experiencing exponential growth:

- **Industrial IoT market**: $263.4 billion by 2030, CAGR of **13.8%**
- **Industrial AI market**: $92.7 billion by 2031, CAGR of **21.4%.**

This momentum reflects a growing recognition of the transformative potential of these technologies.

8.2.2. COMPETITIVENESS FACTORS

In a context **of increased global competition and ecological transition**, mastery of these technologies is becoming a **differentiating factor** for industrial companies and regions. The challenges include:

- **Productivity and efficiency**: process optimisation, cost reduction
- **Quality and innovation**: continuous improvement, acceleration of development cycles
- **Sustainability**: reduction of carbon footprint, energy efficiency
- **Resilience**: adaptability in the face of disruption, risk prediction
- **Attractiveness**: ability to attract and retain talent
- **Sovereignty**: ability to master critical technologies.

8.2.3. EUROPEAN AND FRENCH POSITIONING

Europe, and France in particular, has significant assets to position itself in these technologies:

- A dense and diversified industrial fabric
- Recognised expertise in automation and robotics
- Significant R&D capabilities (universities, research centres)
- A progressive regulatory framework (AI Act, ethical standards)
- Support initiatives (LCAMP, Skills Pact, France 2030).

Provided that the skills of industrial players are rapidly developed, Europe can build a strong position in IoT/AI technologies and create a sustainable competitive advantage.

8.3. KEY MESSAGE: SUPPORTING AI/IOT CONVERGENCE THROUGH COORDINATED SKILLS DEVELOPMENT

The central message of this report is the **need to support AI/IoT convergence with coordinated skills development**. This skills development must meet four essential criteria:

8.3.1. STRATEGIC: ALIGNMENT WITH TRANSFORMATION

Skills development must be **aligned with** companies' **digital and green transformation objectives**. This means:

- Integrating training into the corporate strategy, not as a peripheral activity
- Allocating budgets and resources commensurate with the challenges
- Defining clear and measurable objectives in terms of skills acquired
- Regularly assessing the match between skills and needs
- Adjusting training programmes in line with technological developments.

8.3.2. SYSTEMIC: MOBILISATION OF THE ENTIRE ECOSYSTEM

Skills development must **involve all players** in the industrial and training ecosystem:

- **Companies**: define needs, invest in training, create pathways
- **Training centres**: adapt provision, develop partnerships, innovate pedagogically and technologically
- **Institutions**: create a favourable environment, provide funding, pool resources
- **Research stakeholders**: anticipate developments, contribute to content
- **Private sector**: share best practices, co-develop solutions

No single actor can meet this challenge alone; systemic collaboration is essential.

8.3.3. AGILE: ABILITY TO ADAPT QUICKLY

Skills development must be **able to adapt quickly to technological developments and market needs**:

- Develop modular training courses that can be updated quickly
- Use hybrid and flexible formats (face-to-face, distance learning, blended)
- Integrate technological innovations into training programmes (generative AI, 5G, edge computing)
- Create mechanisms for feedback between industry and training

- Encourage experimentation and iteration
- Anticipate future needs rather than react to current needs.

8.3.4. INCLUSIVE: ENABLING EVERYONE TO PARTICIPATE

Skills development must **enable all profiles to participate in this transformation**:

- Create accessible pathways for operators, technicians, engineers and managers
- Offer training tailored to different levels (EQF 3-6)
- Encourage the retraining of existing profiles
- Support SMEs with fewer resources
- Ensure equal access to training (gender, geography, economic situation)
- Promote formal and informal learning.

8.4. OUTLOOK AND CALL TO ACTION

The success of this transformation depends on a shared vision and enhanced collaboration between all stakeholders in the industrial and training ecosystem. Critical steps for the coming years include:

8.4.1. SHORT TERM

1. **Companies**: map skills, identify gaps, launch the first training courses
2. **Training** centres: develop modular programmes, strengthen industry partnerships.
3. **Institutions**: launch funding mechanisms, create the first shared reference frameworks
4. **All**: integrate AI ethics and risk management into training programmes.

8.4.2. MEDIUM TERM

1. **Companies**: structure internal mobility pathways, measure the impact of training
2. **Training centres**: roll out sector-specific certifications, strengthen practical laboratories
3. **Institutions**: create centres of excellence, pool technology platforms
4. **Ecosystem**: build a community of practice, share learning.

8.4.3. CALL TO ACTION

Only then will French and European industry be able to fully leverage the potential of AI and IoT to build a smarter, more sustainable and more competitive industry.

This objective will only be achieved if:

- **Companies** agree to invest in training as a key element of their transformation strategy
- **Training centres** innovate pedagogically and adapt nimbly to market needs
- **Institutions** create a favourable environment and allocate the necessary resources

- **All stakeholders** collaborate with transparency and shared commitment.

The time to act is now. IoT and AI are not technologies of the distant future; they are already being deployed on a massive scale in industry. Companies that have anticipated and supported the upskilling of their teams will be the leaders of tomorrow. Those that have waited will face a growing talent shortage and a loss of competitiveness.

9. REFERENCES

APEC. (2025, February 14). *AI training for industry executives: an absolute necessity to meet the challenges of tomorrow*. http://corporate.apec.fr/home/actus-medias/toutes-nos-actualites/la-formation-a-l'ia-des-cadres-de-l'industrie-une-necessite-absolue-pour-repondre-aux-defis-de-demain.html

Article 3: Definitions | EU Artificial Intelligence Act. (2 February 2025). https://artificialintelligenceact.eu/article/3/

Aurélie Chandeze. (28 April 2020). *Industrial IoT widely adopted in French companies*. https://www.cio-online.com/actualites/lire-l-iot-industriel-largement-adopte-dans-les-entreprises-francaises-12162.html

AURORE CHATRAS. (2025, January 2). *Top 5 AI jobs in 2025*. https://www.wildcodeschool.com/blog/top-5-des-métiers-de-lia-en-2025

Azeroual, O. (2024). Can generative AI transform data quality? A critical discussion of ChatGPT's capabilities. *Academia*, *4*. https://doi.org/10.20935/AcadEng7407

BILLAUT Fabrice. (2024, October 17). *Statistics and growth forecasts: IoT AI - www.DEMETER-FB.FR - Fabrice BILLAUT*. https://demeter-fb.fr/statistiques-et-previsions-de-croissance-iot-ia/

Cécile Derouin. (27 August 2024). *Continuous learning: The key to employability | HR Academy*. https://www.academie-rh.com/post/lifelong-learning

Célia Garcia-Montero. (22 June 2023). *The IoT market in France: All the figures*. https://www.journaldunet.fr/web-tech/dictionnaire-de-l-iot/1498593-marche-de-l-iot-en-france-tous-les-chiffres/

Directorate-General for Enterprise. (2024, November 19). *France 2030: Cybersecurity acceleration strategy | Directorate-General for Enterprise*.

https://www.entreprises.gouv.fr/priorites-et-actions/autonomie-strategique/soutenir-linnovation-dans-les-secteurs-strategiques-16

EMLV, E. (2019, March 6). The hybridisation of skills: Towards the creation of new professions combining several fields. *EMLV Business School & Management*. https://www.emlv.fr/hybridation-des-competences-creation-nouveaux-metiers-combinant-plusieurs-domaines/

Emmanuelle Blons. (2024, January 2). *In the face of AI, here are the skills to develop*. Entrepreneurs. https://entrepreneurs.lesechos.fr/ma-vie/developpement-personnel/face-a-lia-voici-les-competences-a-developper-2043902

FRANCETRAVAIL.FR. (n.d.). *Artificial intelligence: Available jobs and training programmes*. Retrieved 8 December 2025, from https://www.francetravail.fr/actualites/le-dossier/les-metiers-de-demain/IA-quels-metiers.html

Francois Gauthier. (2024, January 23). *AIoT will be a key driver of digital transformation in 2024, according to a report by Telenor IoT*. https://lembarque.com/article/laiot-sera-un-moteur-cle-de-la-transformation-numerique-en-2024-selon-un-rapport-de-telenor-iot

Hanotaux Pierre, de, A. C., Berera, F., de, J. D., & Vilboeuf, L. (2023). *Staffing and skills shortages in industry and associated training programmes*.

High Commission for Strategy and Planning. (2025, May 20). *Artificial intelligence and work | High Commission for Strategy and Planning*. https://www.strategie-plan.gouv.fr/publications/intelligence-artificielle-travail

Home—LCAMP. (n.d.). Retrieved 8 December 2025, from https://lcamp.eu/

ISO/IEC 22989:2022. (2022). https://cdn.standards.iteh.ai/samples/74296/c4efbadbf1a146d4af6d62fcad09438f/ISO-IEC-22989-2022.pdf

Krim, M. (2025, 10 September). Working with AI: Managers at the heart of the paradigm shift. *IT SOCIAL*. https://itsocial.fr/intelligence-artificielle/intelligence-artificielle-articles/travailler-avec-lia-les-managers-au-coeur-du-changement-de-paradigme/

Lee, R. A. (2025, May 23). Internet of Things Statistics 2025: Devices, Security, and Adoption. *SQ Magazine*. https://sqmagazine.co.uk/internet-of-things-statistics/

Nicolas Boudrot (INSEE). (2021, 21 April). *Internet of Things, 3D printing, robotics: Technologies used more by large companies—INSEE Première—1854*. https://www.insee.fr/fr/statistiques/5356737

OECD. (2023). *Micro-credentials for lifelong learning and employability: Uses and possibilities* (OECD Education Policy Perspectives No. 66; OECD Education Policy Perspectives, Vol. 66). https://doi.org/10.1787/9c4b7b68-en

Pascal Pichoutou, Ralf Steck, Jesus Rebolledo, & Camille Leonard. (2025, May 25). *Digital Technologies 4.0 and Green Transition Impacts on Predictive Maintenance*.

Paula Morton. (2025, January 23). Unstructured Data and Generative AI: A New Era of Customer Insights. *Bridgepointe Technologies*. https://bridgepointetechnologies.com/customer-experience/unstructured-data-and-generative-ai/

Pesset, I. (2025, July 3). *AI in industry: Towards ever smarter factories | Motilde*. https://motilde.com/ia-dans-lindustrie-vers-des-usines-toujours-plus-intelligentes/

MACMIA Project: Winner of the call for expressions of interest in future skills and professions in AI - IMT. (2024, May 24). https://www.imt.fr/projet-macmia-laureat-de-lappel-a-manifestation-dinteret-competences-et-metiers-davenir-en-ia/

Quatrium, the CETIM support programme. (n.d.). Cetim. Retrieved 29 January 2026, from https://www.cetim.fr/projets-strategiques/quatrium/

Rules for Trustworthy Artificial Intelligence in the EU (2024). https://eur-lex.europa.eu/legal-content/FR/LSU/?uri=CELEX:32024R1689

Russo, I. L. (27 November 2025). AI and ecological transition, already firmly established in industry. *OPCO 2i*. https://www.opco2i.fr/ia-et-transition-ecologique-deja-ancrees-dans-lindustrie/

Sebastien DUDREUILH. (n.d.). *Some key figures on the IoT in the industrial sector | Testimonials on the IoT | IoT Journey*. Retrieved 8 December 2025, from https://iotjourney.orange.com/fr-FR/partenaires/temoignages-sur-l-iot/quelques-chiffres-cles-sur-l%27iot-dans-le-secteur-industriel-1656934255947

Sirteq. (2024). *Industry 4.0 Trends in France in 2024*. https://www.sirteq.org/les-tendances-de-lindustrie-4-0-en-france-en-2024/

Stanley A. Miller. (2024, March 26). *Industry 4.0: French companies on the right track | Rockwell Automation*. https://www.rockwellautomation.com/fr-be/company/news/press-releases/new-study-finds-genAI-as-top-tech-investment-for-manufacturers.html

Tera Allas CBE, & Andrew Goodman. (2025, July 14). *Not yet productive, already disruptive: AI's uneven effects on UK jobs and talent*. https://www.mckinsey.com/uk/our-insights/the-mckinsey-uk-blog/ai-uneven-effects-on-uk-jobs-and-talent

Vincent Moulin. (2024, November 24). Industry 4.0 Barometer 2024. *Wavestone*. https://www.wavestone.com/fr/insight/barometre-industrie-4-0-2024/

Viorel, P. (2024, January 23). [Survey Results] Building Industrial IoT Systems in 2024. *IIoT World*. https://www.iiot-world.com/industrial-iot/connected-industry/survey-results-building-industrial-iot-systems-in-2024/

10. IMAGE INDEX

11. INDEX OF TABLES

12. ANNEX ES

12.1. APPENDIX 1: TARGET AUDIENCE FOR THE TWO SURVEYS

Table1. Target audience for the surveys

TARGET AUDIENCE	Distribution list
VET	Antoine Bourdelle High School, Montauban
	Louis Querbes Secondary School, Rodez
	Jean Dupuy Comprehensive School, Tarbes
	Déodat de Séverac High School, Toulouse
	Rodez University Institute of Technology
	Figeac University Institute of Technology
	Alexis Monteil High School, Rodez
	GRETA Midi-Pyrénées North
	In&ma Albi
	INU Champollion Albi
	Jean-François Champollion Comprehensive Secondary School, Figeac
	La Découverte Comprehensive High School, Decazeville
	Gaston Monnerville Comprehensive Secondary School, Cahors
	Jean Jaurès Comprehensive Secondary School, Saint Affrique
	UIMM Occitanie
	Carnus Higher Education Rodez
	Mirepoix School Complex
SME	2PS PLASMA PROJECTION SYSTEM
	A.E.M.
	Vauleon
	ACC
	ACMETO SAS
	Acti Group ALMERAS
	AD INDUSTRIE
	ACTIMETAL INDUSTRIE
	Ad'Up
	AEC Aveyron Elec Concept
	AGROPACK
	ALBAGNAC
	ALEA
	ALPHA MECA

	ATS Laser Tournié Group
	AVANTIS concept
	AVANTIS MANUFACTURING SN R2 MECA
	AVEYMECANIC
	LISI AERROSPACE BLANC AERO
	BODYCOTE
	BOURREL JEAN MARIE (VAULEON group)
	BROWN EUROPE
	CASEM 19
	CEMIP
	CHEZE RVC / SEP
	CFM 46
	CHASSINT Paints
	CLAUX ET FILS ET CIE
	CTM CORREZE MECHANICAL ENGINEERING
	DEBITEX
	DEFI 12 SAS
	DIACE FMH group
	EP3E
	AUTEC / EUROFABRICATION / EUROPE SERVICE
	eXcent
	FEM techno
	FGD
	FIGEAC AERO
	FIN'TECH INDUSTRIE
	FIVES CINETIC
	FIVES MACHINING
	FM2i
	FRAYSSE FOUNDRY
	GELY SERGE SARL
	EUCLIDE SOLUTIONS COREMO BARRIERE Group
	EUCLIDE CARE Group LAM LES ATELIERS MODERNES
	EUCLIDE MECANAT Group
	GUDEL SUMER
	HUGON Limited Liability Company
	I3D CONCEPT
	J P M
	LABROUSSE BODYWORK
	LACOTTE INDUSTRIE
	LASER SERVICES France
	LAVAYSSIERE Ets MAVENTIS MAVIPAL
	LF MECA

	LM Industrie
	M-TECKS EAC
	ERCOME Metal Forming Industry
	M2C
	MATERIAL
	MAVENTIS
	MECABRIVE INDUSTRIES SAS
	MECAFFÜT
	MECALLIANCE
	MECATEP
	META GROUPE FMH
	METRASUR INDUSTRIE
	MICHEL PIOCH SA
	MORAN
	MOUNEYRAC
	MP USICAP
	MPRO
	MTI (Mechanics and Industrial Works)
	NEXTER MECHANICS
	NIMROD
	META LASER (formerly OXYMETAL) MH GROUP
	PAGES MECANIQUE
	PATTYN BAKERY DIVISION OF LA BALLINA INDUSTRIES
	PIVAUDRAN
	PLASTIQ CONCEPT
	PLC PROCESS
	POLYLASE
	POTEZ COMPOSITES AEROFONCTIONS SAS
	POUDREX
	RAPIC
	PRECITOL
	RATIER FIGEAC COLLINS
	CHALLENGES group
	RECTIF 46 SARL
	RCI
	RGI France
	ROBERT BOSCH SAS
	SAMPEC
	SANZ Limited Liability Company
	SERMATI SAS
	SERRE
	SNAM

	SOCIETE TECHNIC SERVICES
	SOLEV
	SOTIMECO
	SOUD HYDRO
	Sud DECOUPE INDUSTRIE
	SUD OUEST SYSTEME
	SUD RECTIF MECA
	TEGMA: FRECHIN
	TEGMA: LRD
	TEGMA Finimétaux
	THIOT ENGINEERING
	Machining 46
	UVGERMI
	VADERE
	VAULEON INDUSTRIES and MURAT
	VM BUILDING SOLUTIONS UMICORE
	VPM Automation
	WHYLOT
	Aero XV YMCA Services Cahors ALTARIVA
	ZAJAC MECHANICAL
	Aerospace Valley

12.2. APPENDIX 2: RESULTS OF THE SURVEY SENT TO COMPANIES

12.2.1. RESPONSE RATE

16.8%: 20 respondents / 119 companies surveyed

12.2.2. RESPONDENT PROFILE (Q1, Q3&1)

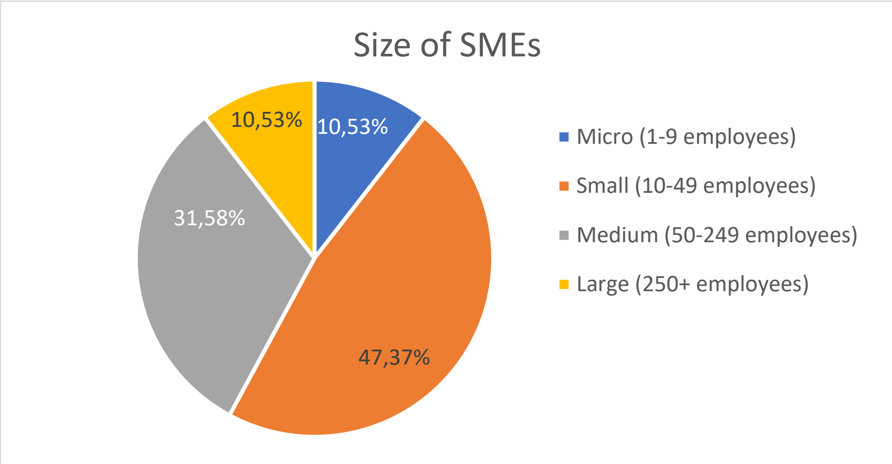

Figure1. Respondent profiles

Majority of small organisations

The reported workforce figures show:

- Very large majority: small companies (10–49 employees)
- A few micro-enterprises (1–9)
- A few medium-sized enterprises (50–249)
- A few large enterprises (250+)

➞ Trend: the survey mainly reflects the views of industrial SMEs, with no large players or start-ups in significant numbers.

12.2.3. SECTORS OF ACTIVITY (Q1&2)

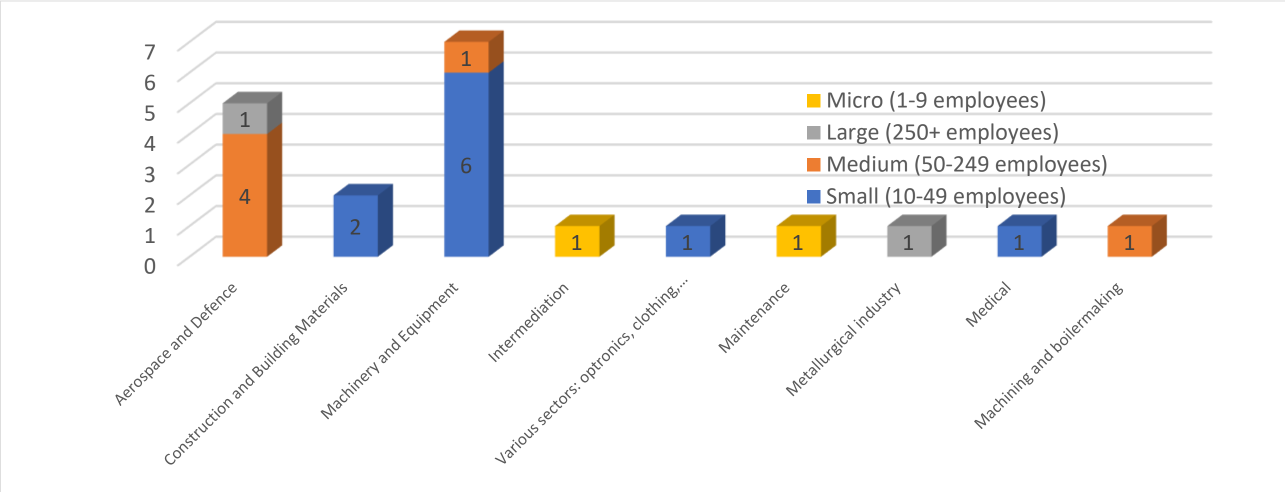

Figure2. Sectors of activity

The sectors represented show:

- A strong presence of Aeronautics & Defence and Machinery & Equipment, mainly driven by small companies.
- A few respondents from more specific sectors: construction, maintenance, metallurgy, medical, machining/boiler making, often in small or very small structures.
- A few medium-sized and large companies, solely in aeronautics and metallurgy.

➞ Trend: the sample mainly reflects technical industrial SMEs, with an over-representation of aeronautics and special machinery and equipment, while other sectors appear marginally.

12.2.4. ROLES OF RESPONDENTS (Q3&1)

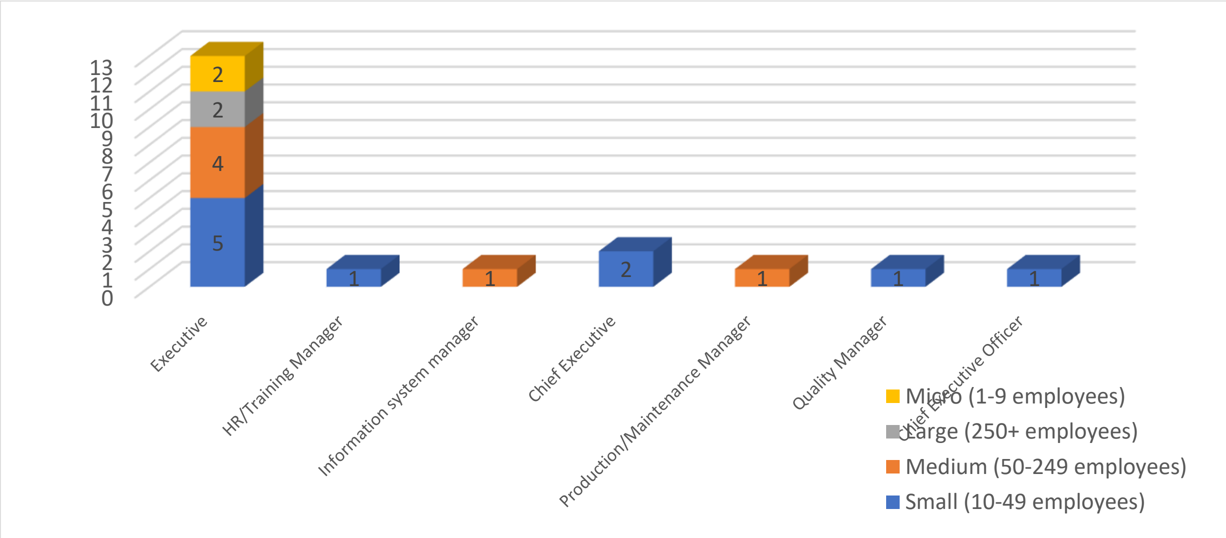

Figure3. Roles of respondents.

The most common roles:

- Senior executives/CEOs
- Production/maintenance managers
- Information systems managers
- HR/training managers

➞ Trend: The survey targets operational managers and decision-makers, so the responses are related to real-world needs and concrete industrial transformation.

12.2.5. USE OF CONNECTED OBJECTS (IOT) IN PROCESSES (Q4)

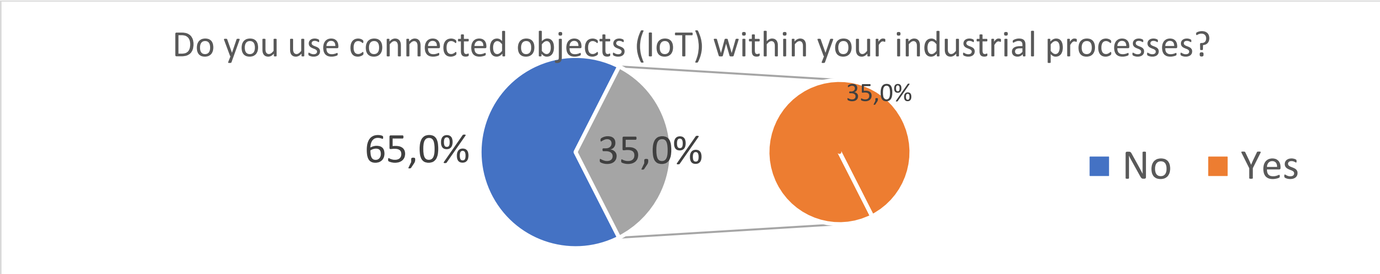

Figure4. Use of IoT

For the 35% who say they use IoT:

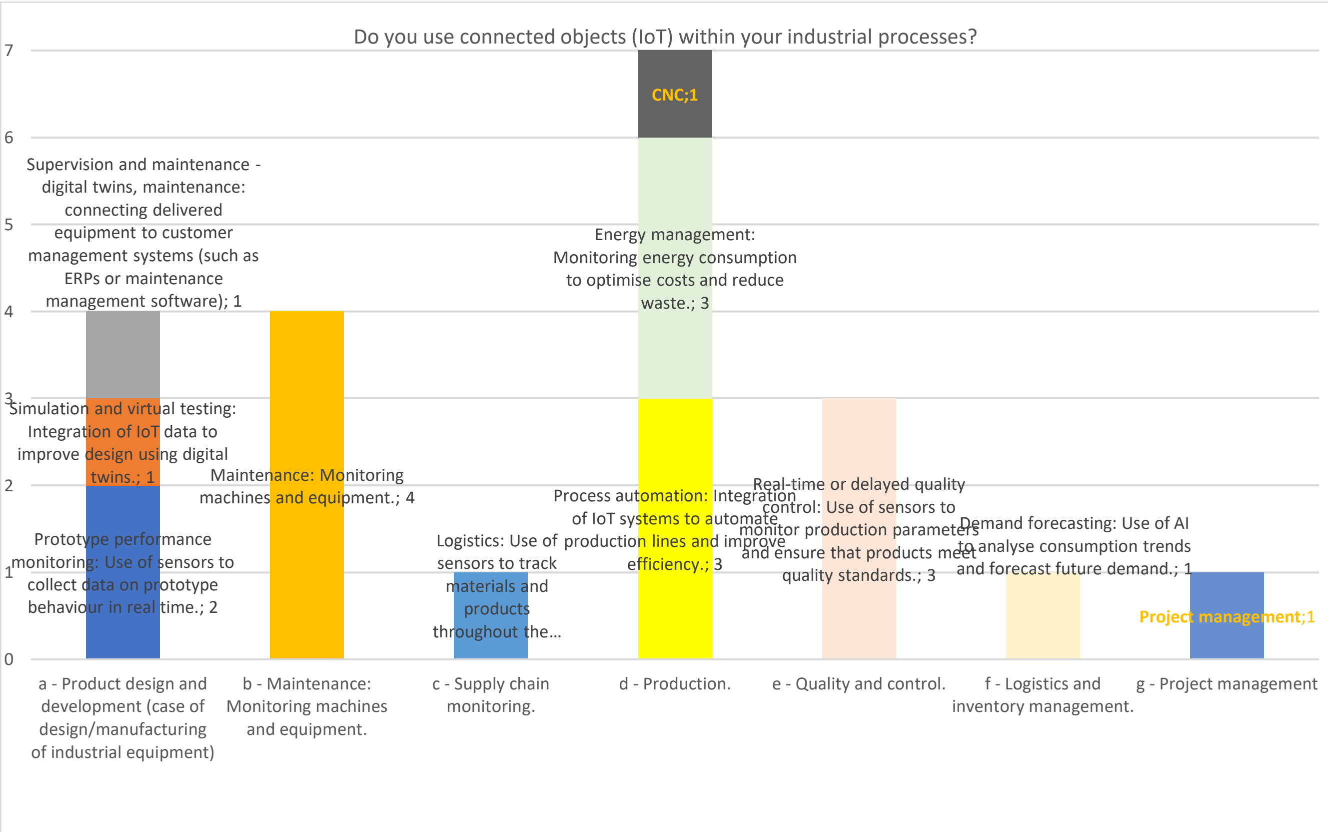

Figure5. Types of IoT use

The 35% of companies that report using IoT are **heavily focused** on two areas:

- **Maintenance and monitoring**
- **Improving industrial performance**

➞ Trend: IoT is used primarily to improve production reliability and reduce breakdowns rather than for advanced or innovative projects.

➞ More advanced uses (digital twins, predictive AI, supply chain) are still in their infancy.

12.2.6. USE OF AI (Q5)

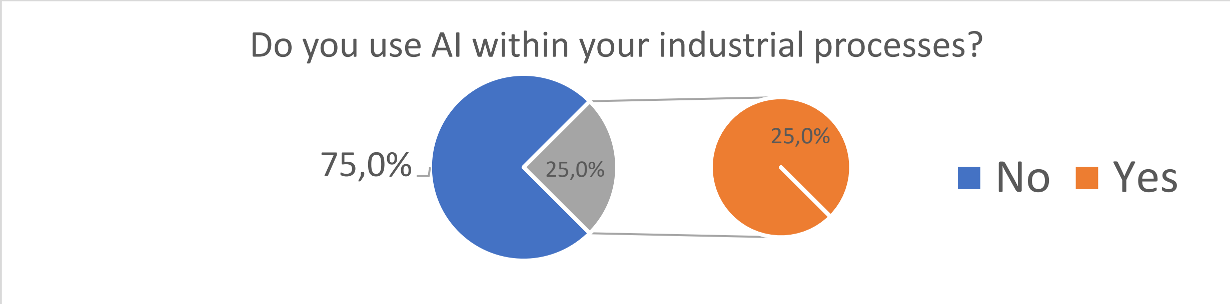

Figure6. Use of AI

For the 25% who say they use AI solutions:

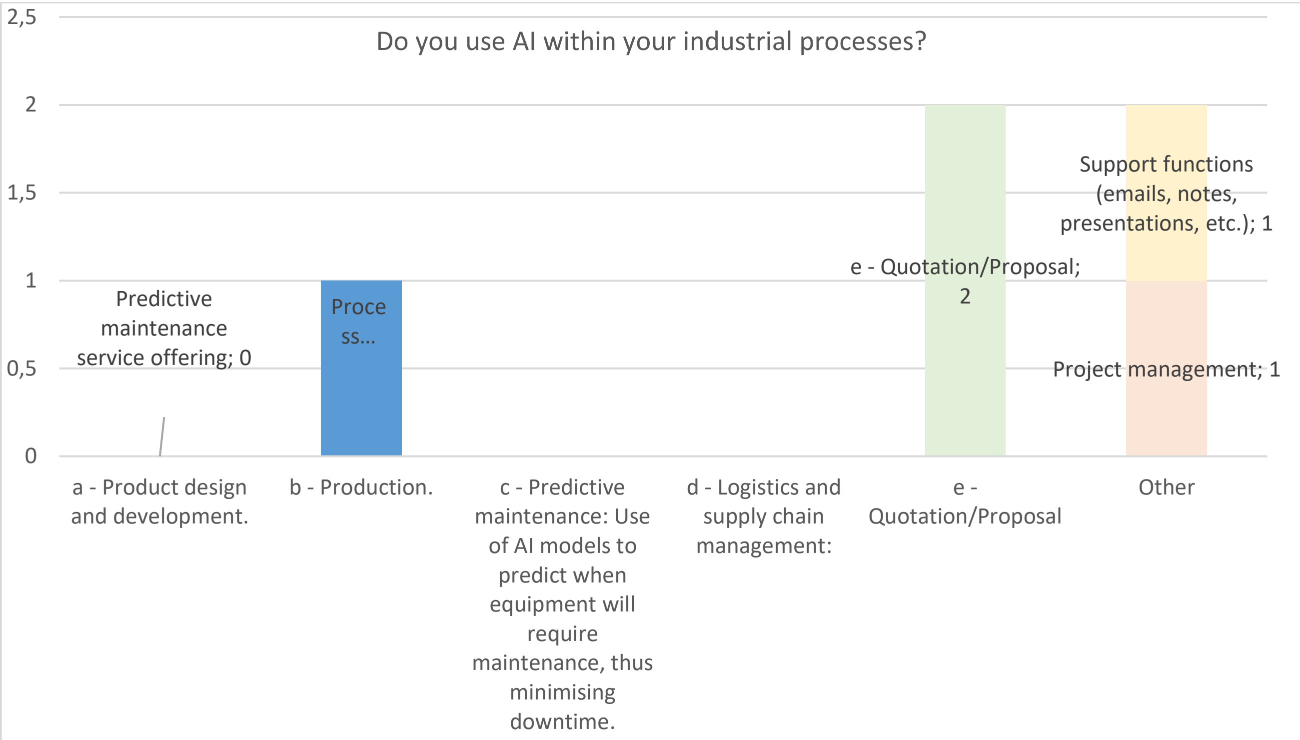

Figure7. Types of AI usage

The responses show:

- **Very** little use of AI in production, with only one case reported.
- The majority of uses relate to support functions: in particular, the preparation of quotes and proposals (2 respondents).
- A few scattered uses appear in project management and office tasks (emails, notes, presentations).
- No uses **have been identified** in product design or predictive maintenance, despite the suggested titles.

➞ **Trend:** the use of AI remains marginal in industrial processes and is mainly concentrated on **administrative support tasks**, while technical uses (production, maintenance, R&D) are virtually absent.

12.2.7. CONTINUING EDUCATION NEEDS: CROSS-ANALYSIS (AI & IOT × EQF LEVELS) (Q6)

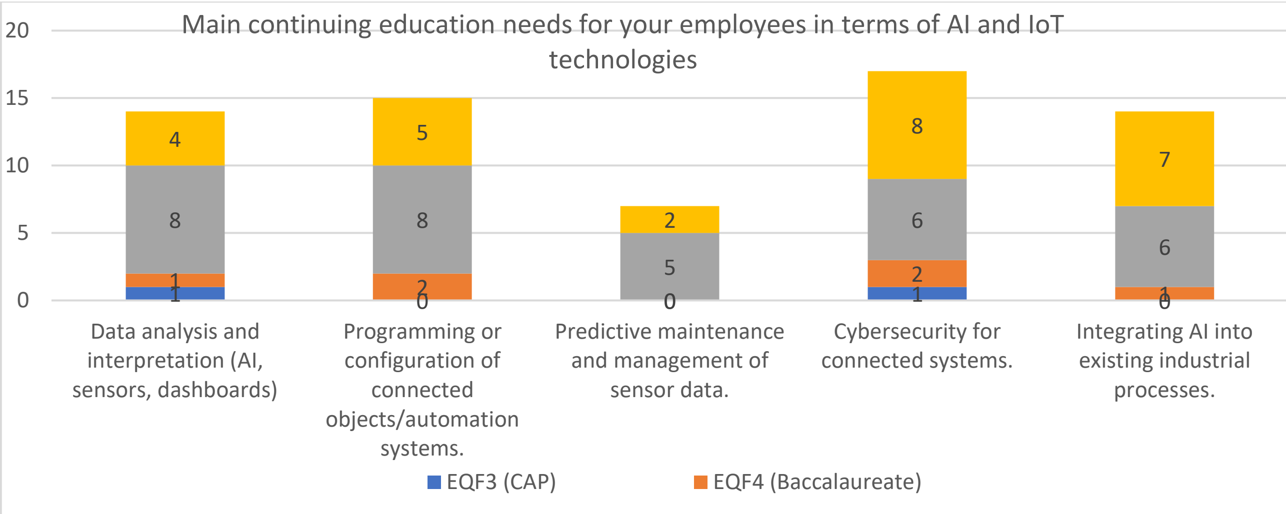

Figure8. IoT&AI continuing education needs - by field

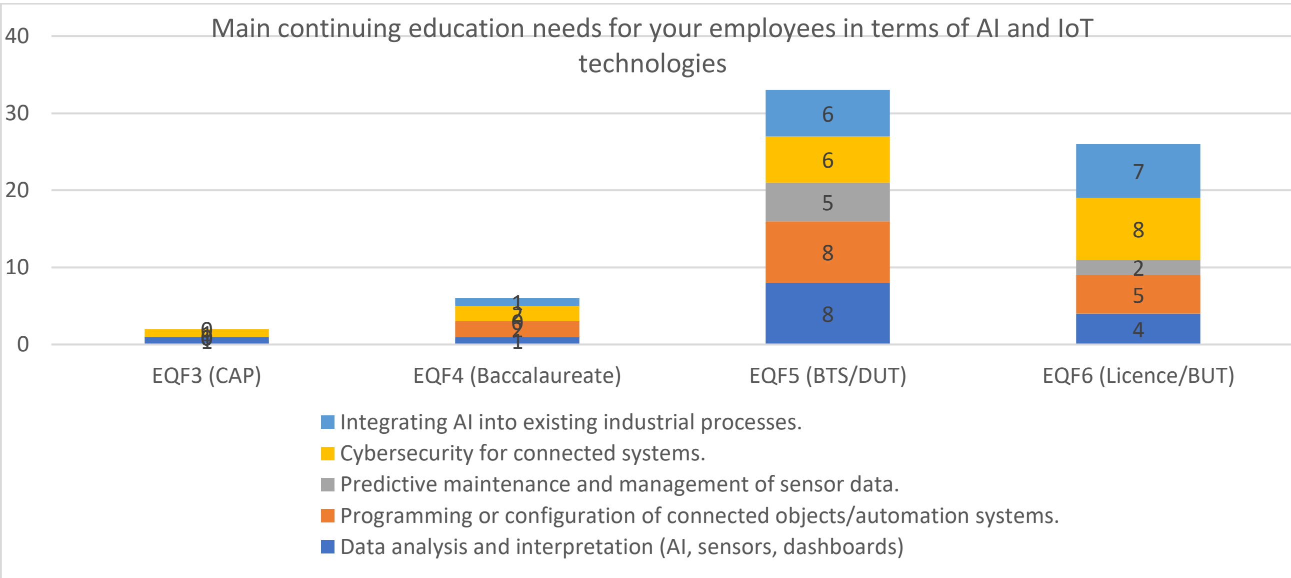

Figure9. IoT&AI continuing education needs - by training level

In summary, the two graphs show that companies mainly need advanced operational skills in data, cybersecurity, IoT and AI integration, primarily at EQF5 and EQF6 levels, while EQF3 and EQF4 levels are less relevant.

Cross-analysis shows that the dominant needs concern:

- **Cybersecurity** for connected systems (highest level of total demand).
- The integration of AI into existing industrial processes.

- Data analysis and interpretation (sensors, AI, dashboards).• Programming or **configuration of IoT/automation systems**.

➞ **Trend:** needs focus primarily on skills *that enable the use, security and integration* of technologies, rather than purely theoretical skills.

12.2.7.1. THE MOST SOUGHT-AFTER EQF LEVELS

Companies are primarily looking for **senior technicians and technical managers** capable of handling, securing and integrating data/AI/IoT systems.

- **EQF5 (BTS/DUT)** is the most sought-after level for *all* skills.
- **EQF6 (Licence/BUT)** comes just behind and dominates in AI integration and cybersecurity.
- **EQF4 (Bac)** is in demand but to a much lesser extent.
- **EQF3 (vocational qualification)** is almost never mentioned and is limited to very simple requirements (basic data or cybersecurity training).

12.2.7.2. SKILL REQUIREMENT PROFILES

- **Data analysis and interpretation:** very high demand for **EQF5**, supported by significant demand for **EQF6**. EQF3 and EQF4 remain marginal.
  ➞ Companies need profiles capable of understanding and exploiting sensor/AI data.

- **IoT programming/configuration:** demand concentrated at **EQF5** and **EQF6**, virtually absent at lower levels.
  ➞ Tasks require advanced technical expertise (OT/IT, industrial protocols).

- **Predictive maintenance and sensor data management:** demand is lower than for other areas, but still focused on **EQF5**.
  ➞ Advanced maintenance remains a requirement but is less of a priority than cybersecurity or AI integration.

- **Cybersecurity** for connected systems: this is the most cross-functional and in-demand skill in both graphs, with high volumes at EQF5 and EQF6.
  ➞ Companies perceive industrial cybersecurity as a major challenge.

- **AI integration into industrial processes:** very high demand, mainly in **EQF6**, confirmed in both tables.
  ➞ Companies are seeking to understand "how to integrate AI into existing systems", not to create their own models.

12.2.8. COMPANIES' INTEREST IN CO-DEVELOPING AI/IOT MODULES WITH A TRAINING CENTRE (Q8)

Despite interest in co-constructing educational programmes (54.5%), a significant proportion (45.5%) of companies remain cautious or unavailable.

- **45.5%** of companies **do not** wish to collaborate on the co-development of AI/IoT modules at this time.

- **22.7%** would be willing to collaborate **for both audiences**: initial training (EQF 3–6) and continuing training for employees.
- **18.2%** are only interested in **continuing education** for current employees.
- **13.6%** would accept collaboration for **initial training** for young graduates.

12.2.9. SUMMARY OF KEY CROSS-CUTTING TRENDS

Most companies are SMEs → They are adopting AI/IoT gradually, with a very operational focus.

IoT is more widely implemented than AI → Priorities: maintenance, supervision, logistics, energy.

AI is seen as a means of improving decision-making → Not as a replacement for processes.

There is a huge need for skills → Especially technical, field-based and data-oriented skills.

Training must be practical → Less theory, more industrial case studies and concrete applications.

12.3. APPENDIX 3: RESULTS OF THE SURVEY SENT TO TRAINING CENTRES

12.3.1. RESPONSE RATE

58.9%: 10 respondents / 17 organisations contacted

12.3.2. PROFILE OF TRAINING CENTRES

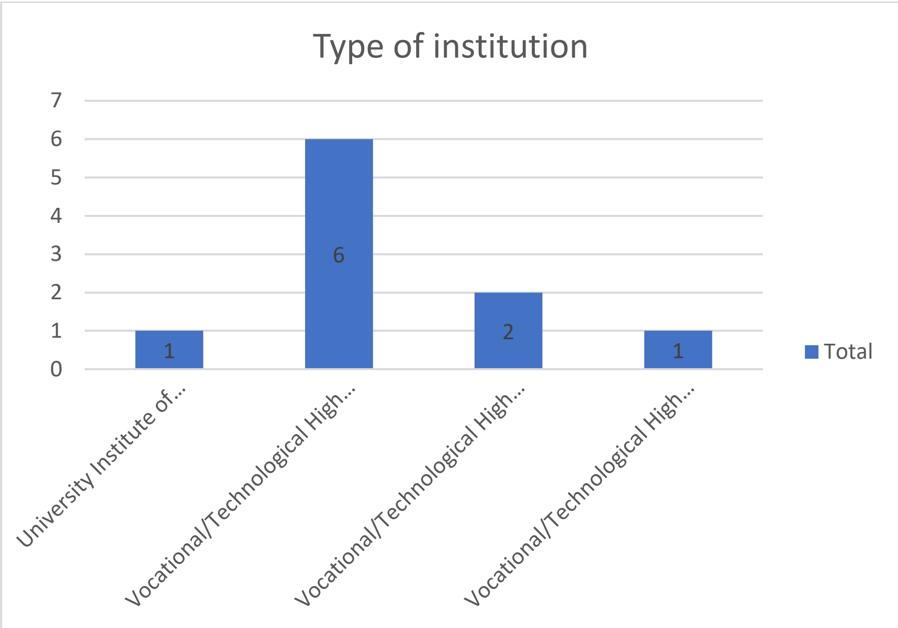

Figure10 : Profile of the training centre

The distribution of respondents shows a predominance of vocational and technical secondary schools.

- University Institute of Technology (1/10)
- Vocational and technical secondary schools / Apprentice training centres (9/10)

These centres offer vocational and technical baccalaureate programmes, BTS programmes and vocational bachelor's degrees.

12.3.3. SIZE OF TRAINING CENTRES

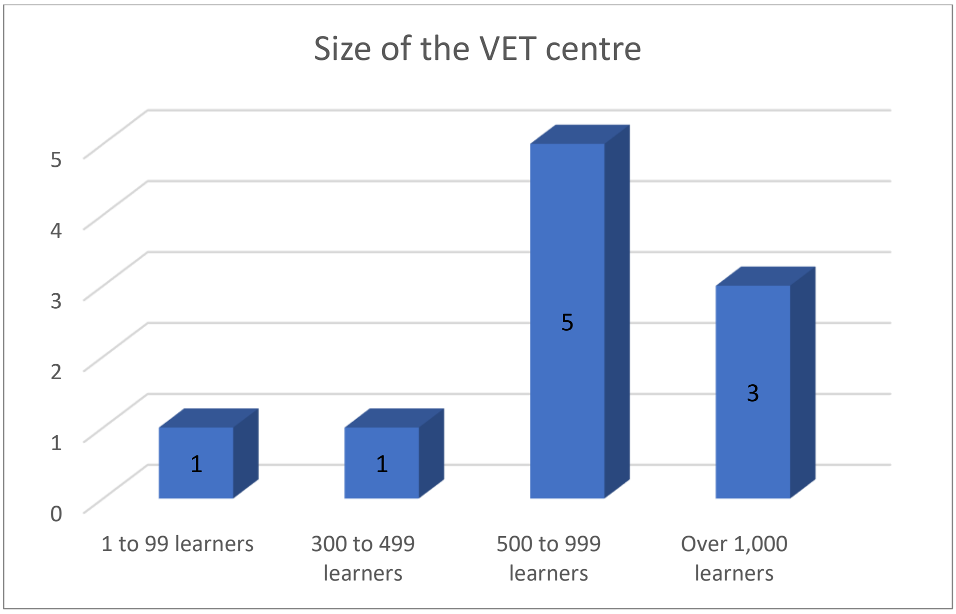

Figure11 : Size of training centre

The majority of centres that responded are medium to large in size

- 5 centres with 500-999 learners
- 3 with over 1,000
- 2 smaller centres: 1-99 and 300-499

12.3.4. ROLES OF RESPONDENTS

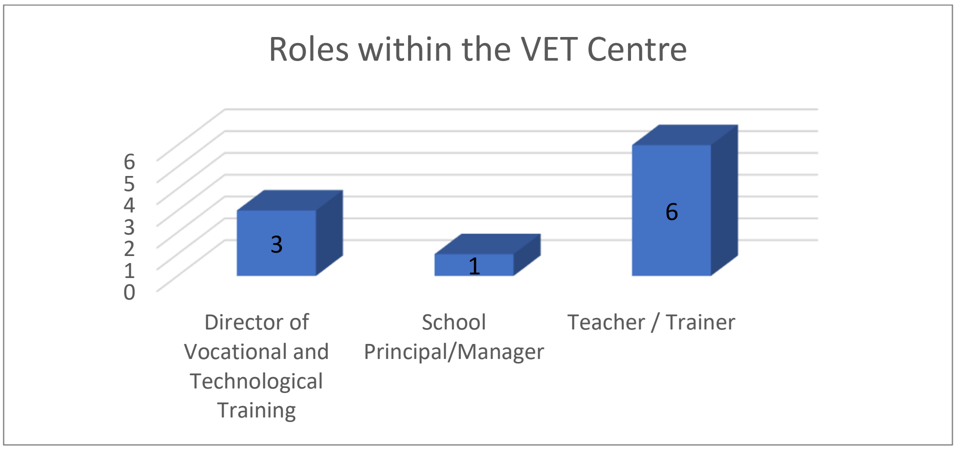

Figure12 : Role of respondent

- 60% of respondents are teachers or trainers
- 30% are directors of vocational and technological training
- 10% are school principals

The majority of respondents are teachers or trainers, reflecting a primarily operational involvement closely linked to teaching practice.

12.3.5. MAIN AREAS OF TRAINING

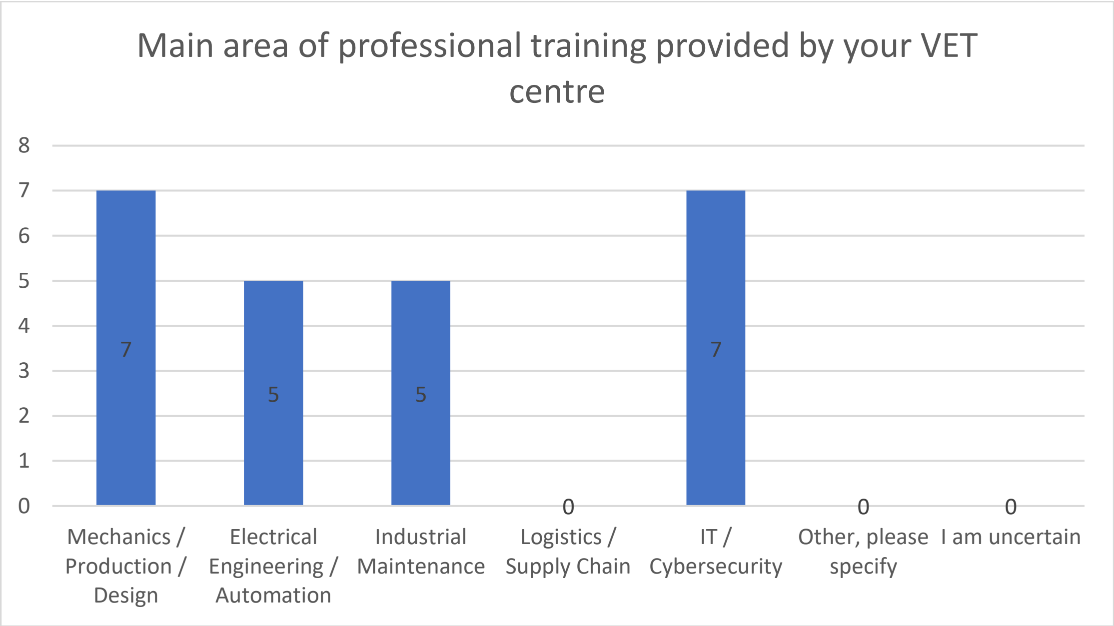

Figure13 : Main areas of training

Two main areas:

- Mechanics, Production and Design
- IT/Cybersecurity

Strong presence of:

- Electrical Engineering, Automation and Maintenance

No representation for Logistics and Supply Chain.

12.3.6. NUMBER OF GRADUATES EACH YEAR

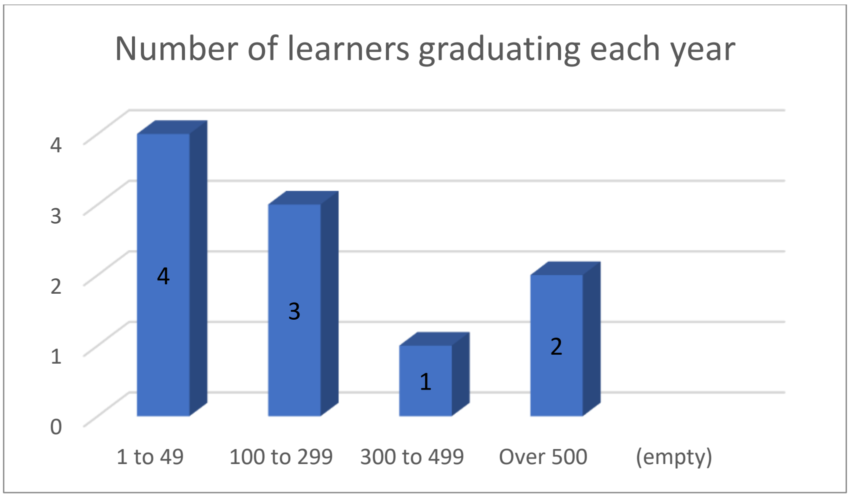

Figure14 : Number of graduates per year

- 1 to 49 graduates: 4 centres
- 100 to 299 graduates: 3 centres
- 300 to 499 graduates: 1 centre
- More than 500 graduates: 2 centres

12.3.7. PERCEPTION OF THE IMPACT OF IOT/AI

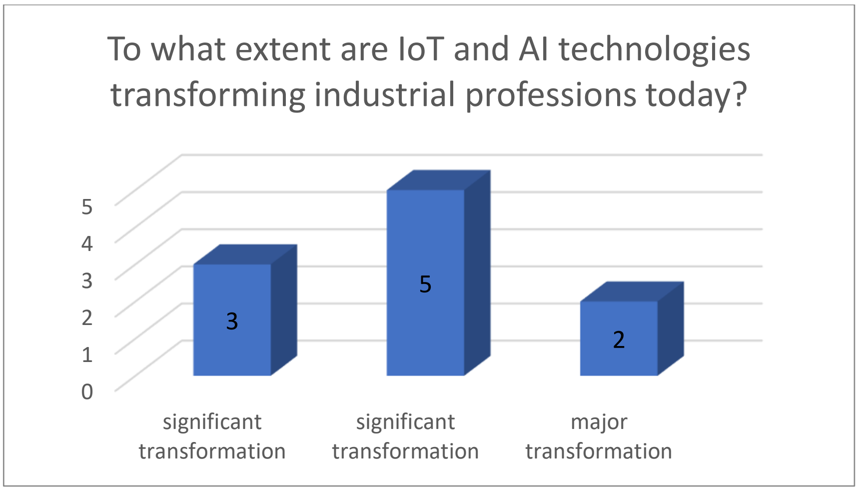

Figure15 : Perception of the impact of IoT/AI

- New technical skills requirements: 3

- Increased autonomy and versatility: 5
- Proficiency in digital tools and data: 8
- New cybersecurity requirements: 3
- New teaching approaches: 4

- No change: 0

The growing importance of digital tools appears to be the strongest trend. Expectations in terms of autonomy and versatility reinforce the idea of a more adaptable learner profile. Cybersecurity remains an issue, although respondents consider it to be less of a priority.

12.3.8. INTEGRATION OF IOT INTO TRAINING

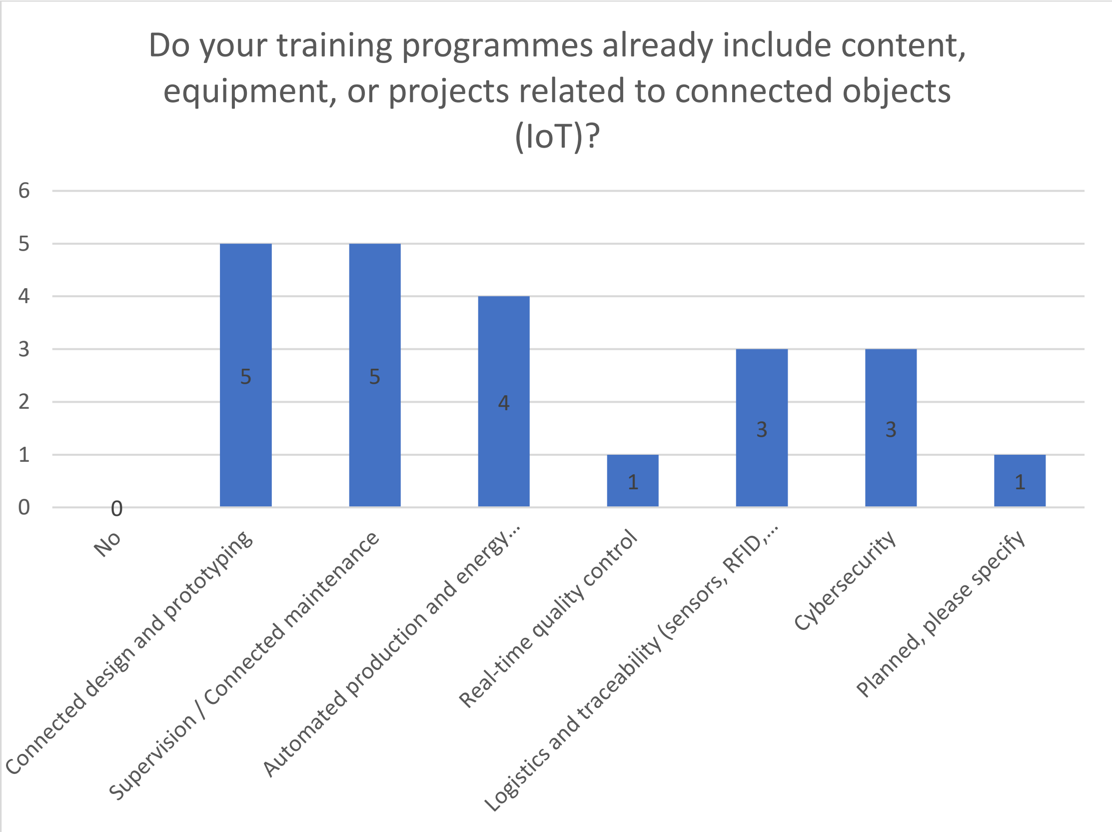

Figure16 : Integration of IoT into training

The results indicate that the integration of IoT technologies is already well advanced in several key areas, including connected design, maintenance and automated production:

- Connected design and prototyping: 5
- Connected supervision/maintenance: 5
- Automated production and energy management: 5
- Real-time quality control: 4
- Logistics and traceability (sensors, RFID, etc.): 1
- Cybersecurity:
- Planned for the near future (scheduled): 1

12.3.9. EDUCATIONAL EQUIPMENT

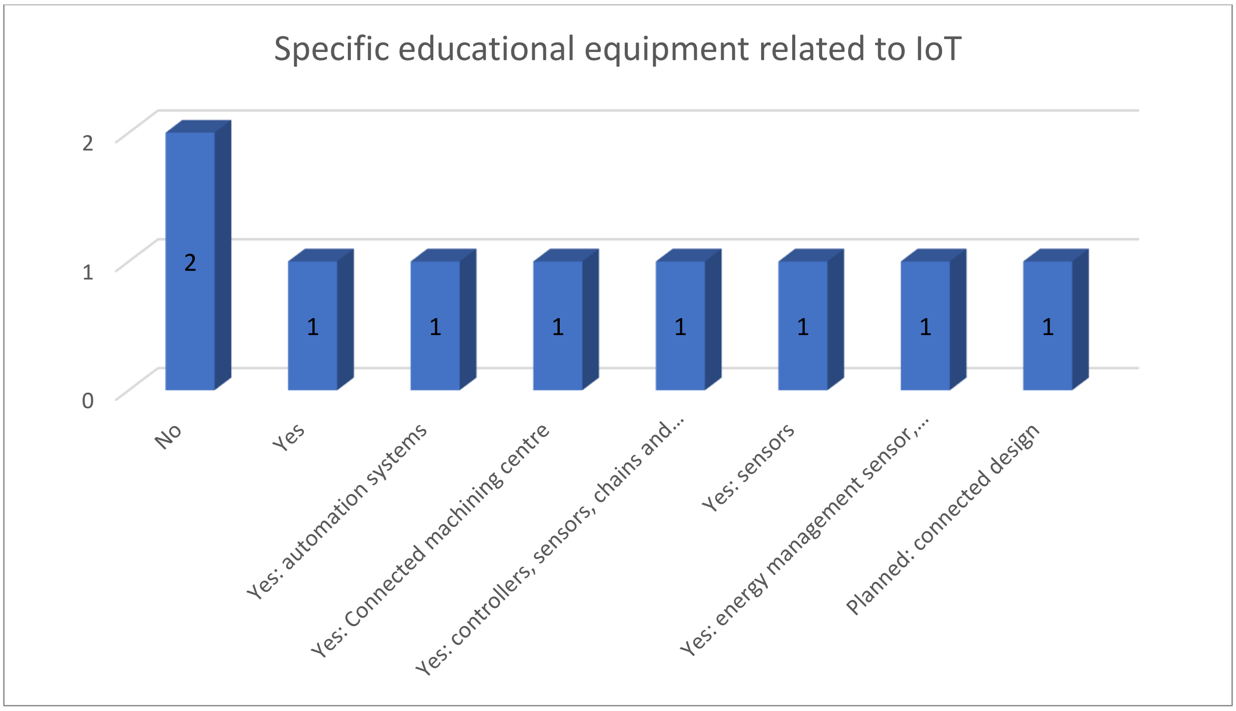

Figure17 : Specific IoT teaching equipment

The results show that IoT equipment is still limited but present in institutions. Two centres report that they have no equipment, highlighting significant heterogeneity between institutions.

- No specific equipment: 2
- Yes (equipment not specified): 1
- Automation systems: 1
- Connected machining centre: 1
- Controllers, sensors, chains, etc.: 1
- Sensors: 1
- Energy management sensors: 1
- Planned: connected design: 1

12.3.10. INTEGRATION OF AI INTO TRAINING

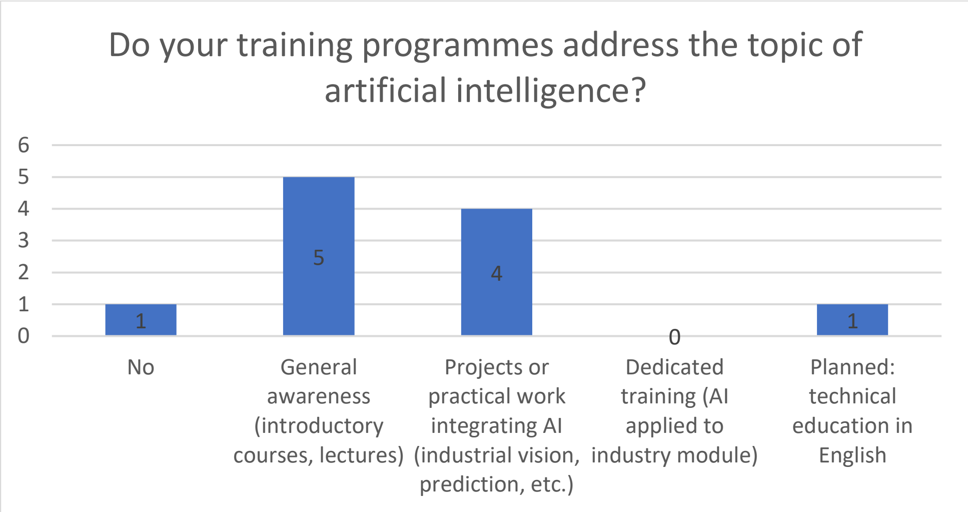

Figure18 : Integration of AI into training programmes

The majority of institutions approach AI in the form of awareness-raising or introduction, a sign of the first stage of disseminating the subject in the curriculum:

- No: 1
- General awareness (introductory courses, conferences): 5
- Projects or practical work incorporating AI (industrial vision, prediction, etc.): 4
- Dedicated training (AI module applied to industry): 0
- Planned: technical teaching in English including AI: 1

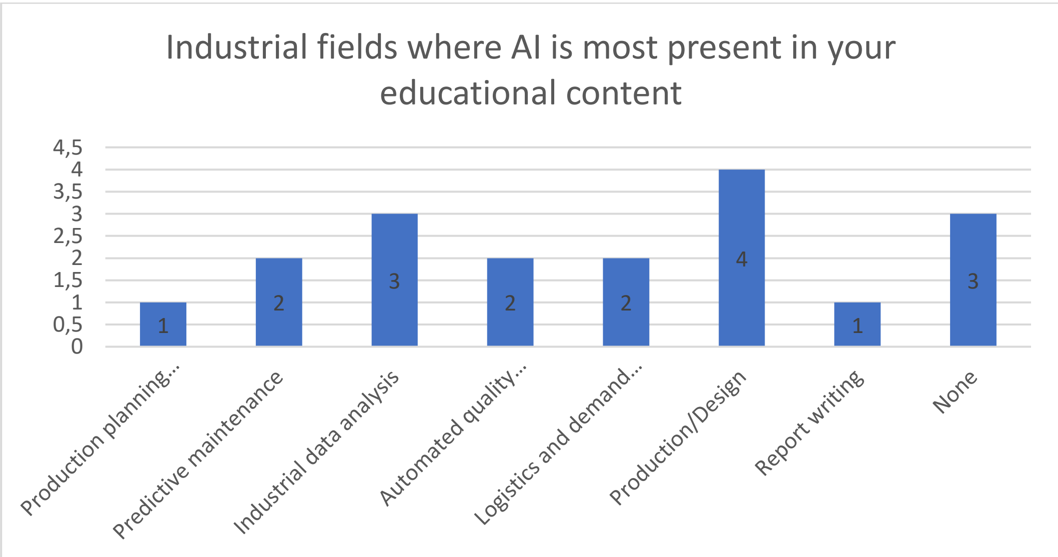

Figure19 : Industrial sectors where AI is most widely used

AI is mainly used in the fields of production and design, which appear to be the most mature in terms of technological integration. Industrial data analysis is also a frequent use, confirming the growing importance of data in technical training:

- Production planning: 1
- Predictive maintenance: 2
- Industrial data analysis: 3
- Automated quality control: 2
- Logistics and demand forecasting: 2
- Production/design: 4
- Report writing: 1
- None: 3

12.3.11. PRIORITY SKILLS (TECHNICAL AND CROSS-FUNCTIONAL)

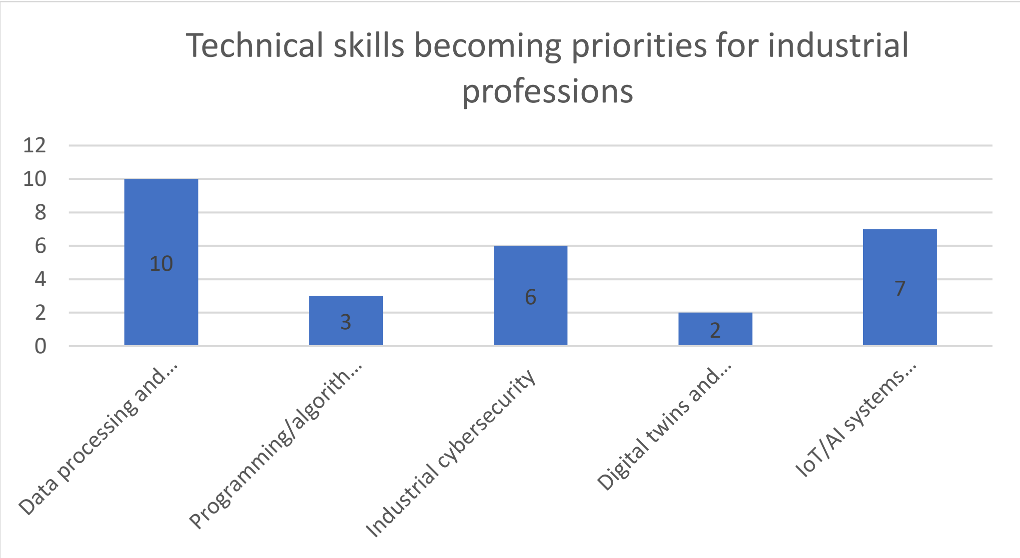

Figure20 : Priority technical skills

Data processing and analysis appear to be the priority technical skill, reflecting the growing importance of data in the industry:

- Data processing and analysis: 10
- Programming/Algorithms: 3
- Industrial cybersecurity: 6
- Digital twins and simulation: 2
- IoT/AI systems integration: 7

12.3.12. PRIORITY CROSS-DISCIPLINARY SKILLS

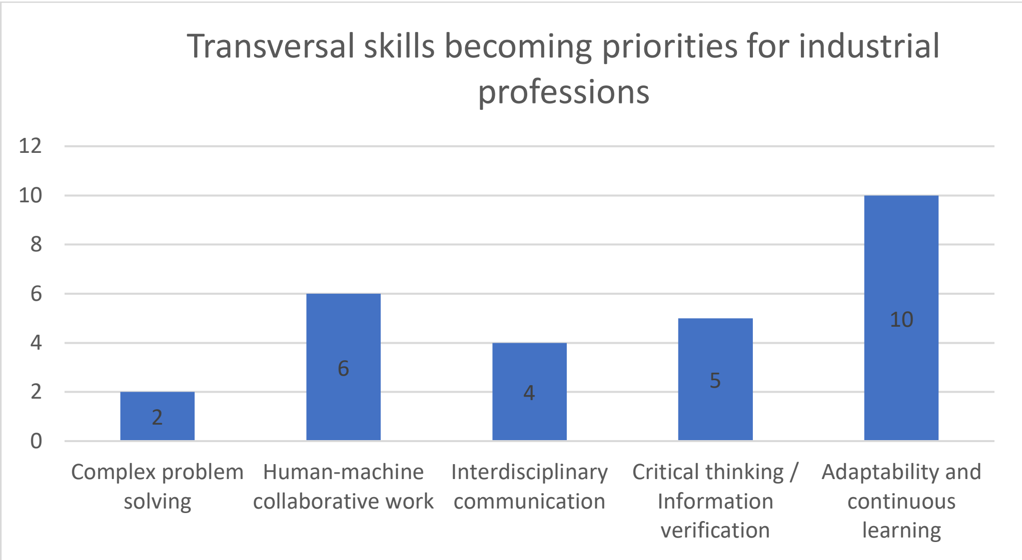

Figure21 : Priority cross-cutting skills

Adaptability and continuous learning stand out very clearly as essential cross-cutting skills, in line with the rapid evolution of industrial technologies.

- Complex problem solving: 2
- Human-machine collaboration: 6
- Interdisciplinary communication: 4
- Critical thinking/information verification: 5
- Adaptability and continuous learning: 10

12.3.13. SPECIALISED TRAINERS

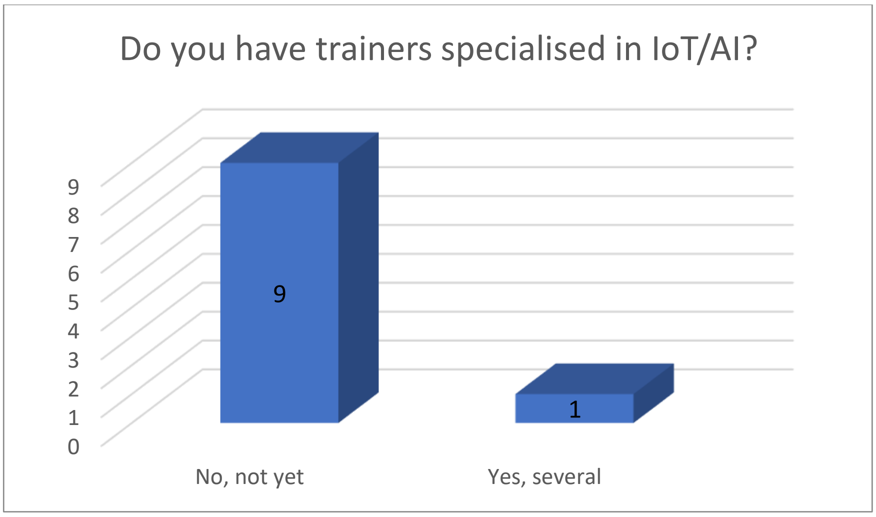

Figure22 : Specialised trainers

The vast majority of centres (9/10) do not yet have trainers specialising in IoT or AI, which shows that internal capacity to support the integration of these technologies is still limited.

12.3.14. BARRIERS TO INTEGRATION

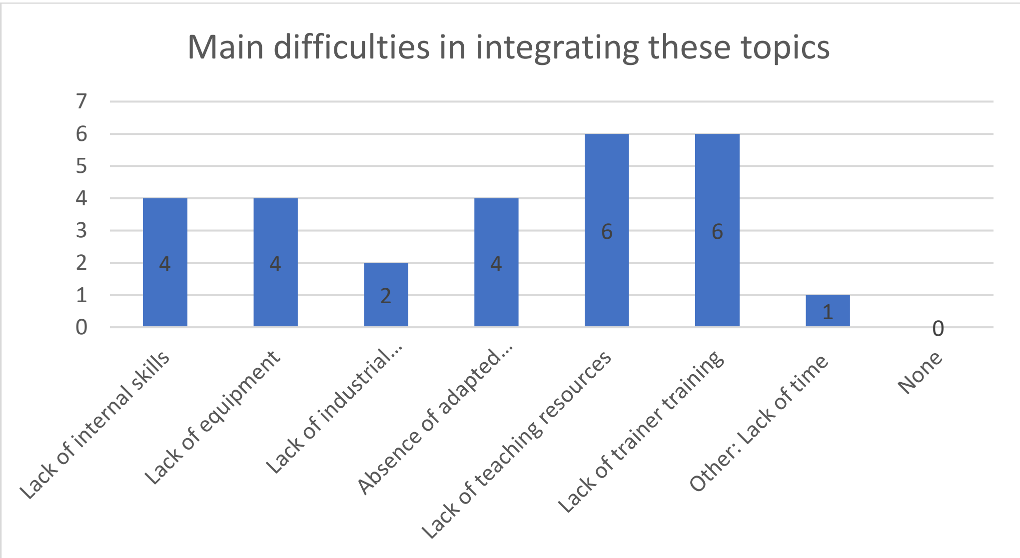

Figure23 : Main barriers to integration

The main difficulties encountered when integrating these technologies are:

- Lack of internal skills: 4
- Lack of equipment: 4
- Lack of examples or industrial cases: 2
- Lack of appropriate resources: 4

- Lack of educational resources: 6
- Lack of trainer training: 6
- Other: lack of time: 1
- No difficulties: 0

12.3.15. MOST USEFUL FORMS OF ASSISTANCE

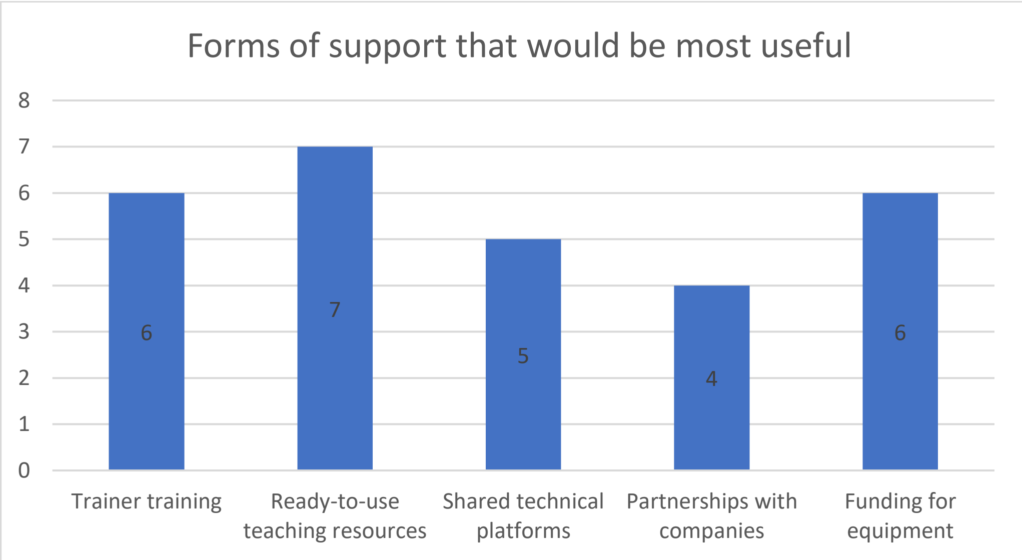

Figure24 : Most useful aids

Establishments identify the need for ready-to-use teaching resources and trainer training as priorities, revealing strong demand for tools that can be used immediately and for strengthening internal skills:

- Training for trainers: 6
- Ready-to-use teaching resources: 7
- Shared technical platforms: 5
- Partnerships with businesses: 4
- Funding for equipment: 6

12.3.16. PARTNERSHIPS AND PROJECTS

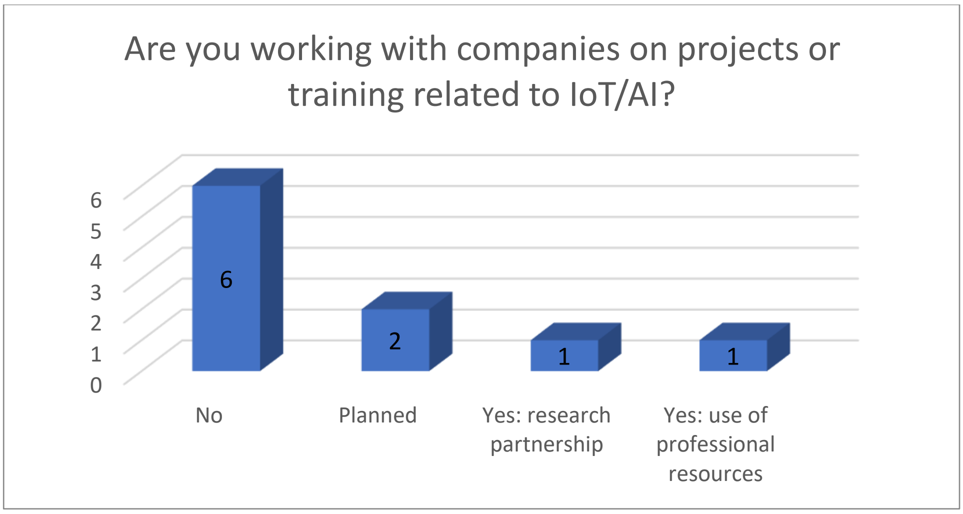

Figure25 : Partnerships and projects related to AI and IoT

The majority of institutions have not yet developed collaborations with companies around IoT or AI:

- No: 6
- Planned (collaboration currently being planned): 2
- Yes: research partnership: 1
- Yes: use of professional resources: 1

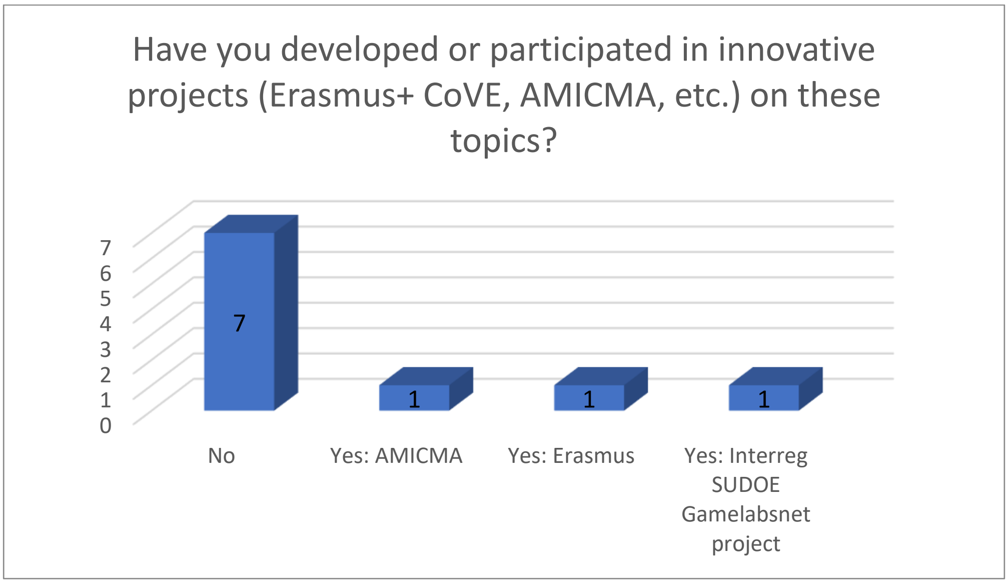

Figure26 : Participation in innovative projects

Most centres have not yet participated in innovative projects related to IoT or AI, highlighting significant potential for development in this area. However, a few institutions are involved in European or transnational initiatives, demonstrating a growing interest in these collaborative dynamics:

- None: 7
- AMICMA: 1
- Erasmus: 1
- Interreg SUDOE Gamelabsnet project: 1

12.3.17. EDUCATIONAL PRIORITIES FOR TOMORROW

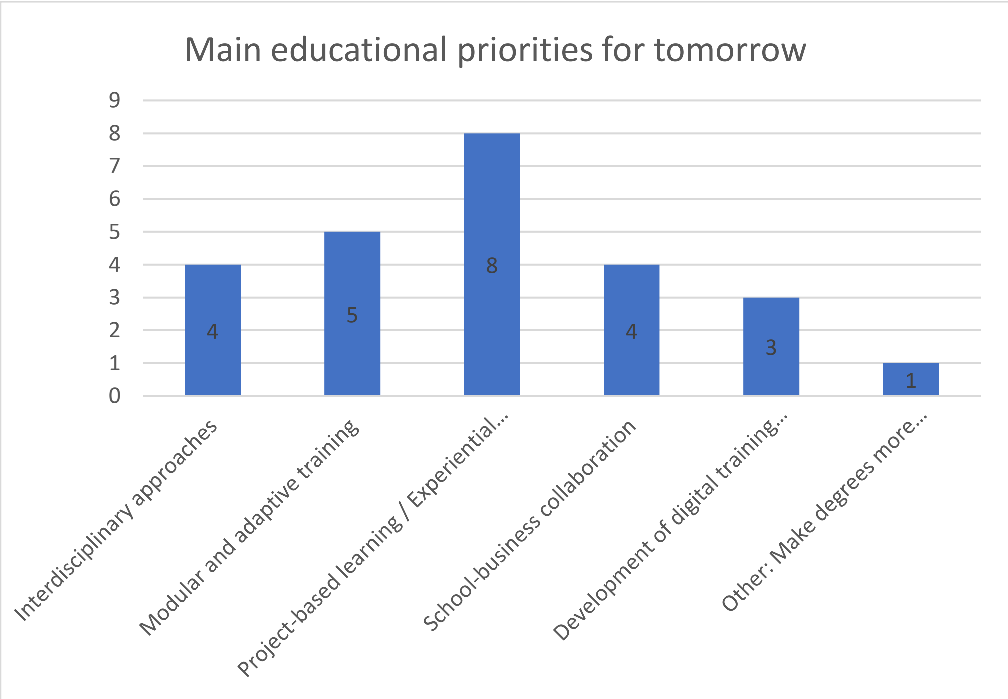

Figure27 : Educational priorities for tomorrow

Project-based learning and experiential approaches clearly appear to be the main priority for institutions, reflecting a desire to strengthen active and vocational teaching methods. Modular training and interdisciplinary approaches are also important areas for adapting curricula to rapid changes in the workplace:

- Interdisciplinary approaches: 4
- Modular and adaptive training: 5
- Project-based learning/experiential learning: 8
- School-business collaboration: 4
- Development of digital training programmes: 3
- Other: making qualifications more demanding (curriculum overhaul): 1

12.3.18. EVOLUTION OF TRAINING NEEDS

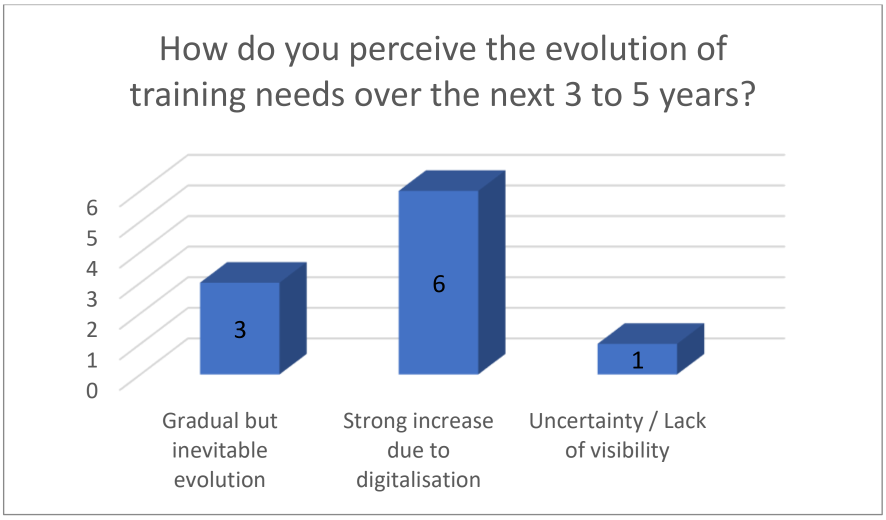

Figure28 : Changes in needs (3 to 5 years)

The majority of respondents anticipate a sharp increase in training needs, directly linked to the acceleration of digitalisation in industrial professions. Some institutions foresee a more gradual, albeit inevitable, change:

- Gradual but inevitable change: 3
- Sharp increase linked to digitalisation: 6
- Uncertainty/lack of visibility: 1

The overall results highlight a clear trend towards transformation in training centres, driven mainly by the accelerated digitalisation of industrial professions. Institutions recognise the growing need to integrate IoT and AI, while highlighting a significant lack of internal skills, appropriate teaching resources and trained trainers. This situation still limits the ability to offer advanced content or applied projects, despite a clear desire to move towards more active, modular and interdisciplinary teaching methods. Collaboration with businesses and participation in national or European projects remain limited, but intentions are emerging. Priority needs converge on team training, the development of ready-to-use resources, the modernisation of equipment and the creation of shared technical platforms.

LCAMP

Learner Centric Advanced Manufacturing Platform

Co-funded by
the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.