TRiREME

DIGITAL & GREEN SKILLS TOWARDS FUTURE OF THE MOBILITY ECOSYSTEM

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D2.2 SECTORAL SKILLS INTELLIGENCE – RELEASE I

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LIST OF ABBREVIATIONS

AI: Artificial Intelligence

ASA: Automotive Skills Alliance

BEV: Battery Electric Vehicle

CAPEX: Capital Expenditures

CBAM: Carbon Border Adjustment Mechanism

CO_2: Carbon Dioxide

CRM: Critical Raw Materials

CSRD: Corporate Sustainability Reporting Directive

CX: Customer Experience

EQF: European Qualifications Framework

ESG: Environmental, Social and Governance

ESPR: Eco-design for Sustainable Products Regulation

EUDR : EU Deforestation Regulation

Euro 7 : European emission standard (Euro 7 regulation)

EV: Electric Vehicle

GHG: Greenhouse Gas

ICE: Internal Combustion Engine

JLR: Jaguar Land Rover

ML: Machine Learning

MaaS: Mobility as a Service

OEM: Original Equipment Manufacturer

REACH: Registration, Evaluation, Authorisation and Restriction of Chemicals

RPA: Robotic Process Automation

SMEs: Small and Medium Enterprises

TaaS: Tyre as a Service

WP2: Work Package 2

WP3: Work Package 3

WP5: Work Package 5

WP6: Work Package 6

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INTRODUCTION

The present study is part of TRIREME **Work Package 2 (hereafter, "WP2")** named **"Continuous Skills Intelligence Gathering"**, and represents the **second deliverable (hereafter, D2.2) "Sectoral Skills Intelligence – Release I**". D2.2 is the second annual main deliverable produced by TRIREME WP2.

The study provides an update of **the key main challenges currently faced by the automotive-mobility ecosystem during late 2024 and throughout 2025**, in light of the recent and substantial transformations that have reshaped the sector. These include pressures on **profitability contraction**, intensifying **global competition** driven by the rise of new economic players, the **transformation of traditional business models**, increasing **regulatory requirements** at the European level, and **shortages of critical raw materials** resulting from **geopolitical tensions and conflicts**.

The study also contextualizes these challenges by examining their **impact on skills and occupational profiles**. Technical competencies, together with innovation and design capabilities, are becoming essential for the workforce to adapt to these changes. In this context, upskilling and reskilling programs emerge as strategic priorities, supporting workers in managing transitions and addressing the redefinition of traditional job roles. At the same time, EU initiatives, along with corporate and regional programs, play a central role in aligning education and training systems with the evolving needs of the sector.

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METHODOLOGY

The study explored the above issues by addressing **6 research questions**, which guided the direction of the investigation:

1. *What is shaping the automotive-mobility sector and how the sector is going to look like in near future?*
2. *What kind of skills or job roles are/will be needed based on this impact?*
3. *To understand the size of the need – how many people will be needed with this kind of skills/job roles?*
4. *To understand the size of the need – how many people will leave the sector, as their roles will be not needed anymore?*
5. *Having information about the needed skills and job roles and on which education/training level it is (EQF) & number of people with there skills needed, is the educational and training offer sufficient?*
6. *Is the current education and training effective and delivers the needed skills in time? Consider formal and informal educational system, initial and continuous education. Consider ways of training delivery, training verification, etc. Consider different EU countries, EU as such.*

Such questions represented the basis to carry out an **extensive desk research and experts consultations (workshops)**. The desk research has examined the most recent literature at EU and global level (articles, reports, academic papers). The workshops served as collaborative platforms that, starting from a shared understanding of short and medium-term innovation and development priorities in the automotive and mobility sector, engaged key stakeholders to gather comprehensive insights, validate initial findings and forecasts on emerging and critical skills. They also represented an opportunity to collect and document innovative training methodologies and best practices in digital learning and teaching approaches. By bringing together expert perspectives and leveraging collective knowledge, the workshops contributed to a more robust analysis, enabling a refined prioritization of the sector's evolving

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skill needs and training solutions. This, in turn, provided clearer focus and alignment for TRIREME's strategic objectives. To achieve the aforementioned objectives, the TRIREME partners involved in this task conducted three dedicated workshops (detailed information are available in annex I-IV of this report).

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1. THE EUROPEAN AUTOMOTIVE-MOBILITY ECOSYSTEM IN 2025: CHALLENGES AND FUTURE SCENARIOS

The European automotive industry, long regarded as a cornerstone of industrial strength, innovation and employment, is undergoing one of the most complex and disruptive transitions in its history. This transformation is driven by the convergence of three major forces: the **shift toward decarbonisation**, the rapid adoption of **new digital and clean technologies**, and the intensifying impact of **geopolitical instability**.

The sector is under mounting pressure to meet ambitious **sustainability targets**, while navigating an increasingly **complex regulatory environment**. A dense network of EU legislation now affects every stage of the automotive value chain—from raw material sourcing to end-of-life management. From climate and environmental rules under the European Green Deal to sector-specific regulations like CO_2 standards, the REACH Regulation, and the Carbon Border Adjustment Mechanism (CBAM), manufacturers must navigate overlapping compliance requirements. While these policies support sustainability objectives, they also pose significant administrative and financial burdens.

On the technological front, **new innovations** such as artificial intelligence, green and net-zero vehicles, and software-defined mobility systems are entering the market at an unprecedented pace. These advancements are reshaping the entire automotive value chain—from vehicle design and production to retail, maintenance, and end-of-life services. **AI and digitalisation** are accelerating the transition towards connected and autonomous vehicles, which rely on embedded systems, real-time data processing, and increasingly sophisticated software architectures. This is redefining job roles and skills requirements as well as consumers expectations, which are now moving towards seamless digital experiences, personalised vehicle interfaces, and integrated services.

At the same time, the **geopolitical context** is growing more volatile. Conflicts such as the **Ukraine-Russia war**, the **Palestine-Israel conflict**, and global trade tensions driven by **U.S. tariffs** and retaliatory measures are creating significant uncertainty. These developments are disrupting supply chains, increasing costs, and limiting the sector's capacity to thrive.

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1.1. Production Volumes and Profitability

This volatile environment has had a profound impact on production volumes across Europe. In 2024, vehicle output remained 3 million units below pre-pandemic levels. Compared to 2023, production is projected to fall by an additional 700,000 units, reflecting not only supply chain challenges but also weakened demand and structural shifts in the global automotive market. OEMs have responded with **aggressive cost-cutting measures to protect profitability**—often at the expense of workforce stability.

Indeed, the **human cost of this transformation** is becoming starkly visible. More than 80,000 job losses were announced across the European automotive industry in the second half of 2024 alone, marking the worst year for employment in the sector in decades. The first quarter of 2025 offers little indication of economic recovery, with an additional 10,000 job cuts already announced. Automotive suppliers alone have announced approximately **145,000 job cuts since 2019**, while only about 51,000 new jobs have been created, resulting in a net loss of nearly 100,000 positions[1]. As of early 2025, only 500 new positions have been reported[2]. The majority of these losses stem from business closures or insolvencies, and the overall outlook remains worrisome amid persistent issues like overcapacity and rising fixed costs. As a result, **production capacity in Europe is under increasing strain**—as demonstrated by the closure of nine tyre manufacturing plants and the loss of over 4,400 jobs in the European tyre sector since 2024. This negative trend includes Volkswagen, Europe's largest carmaker, which has planned to cut 35,000 jobs by 2030, while aiming to avoid compulsory layoffs. Even workers' representatives acknowledge an "overcapacity"[3] in the industry: Volkswagen produces approximately nine million cars annually with 680,000 global employees, whereas Toyota achieves similar output with just 375,000 staff.

[1] https://www.clepa.eu/insights-updates/data-digests/clepa-data-digest-18-job-losses-escalate-as-demand-stays-below-expectation/
[2] https://mailchi.mp/clepa/factory-closures-overshadow-eus-mobility-transition-10665957?e=ab15e29bcb
[3] https://www.euractiv.com/section/economy-jobs/news/whats-behind-europes-car-industry-crisis/

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These cuts are not isolated, as they extend across the entire value chain, affecting both large manufacturers and smaller component suppliers. The erosion of job security and income in such a vital industrial sector underscores the urgency of ensuring a just and inclusive transition.

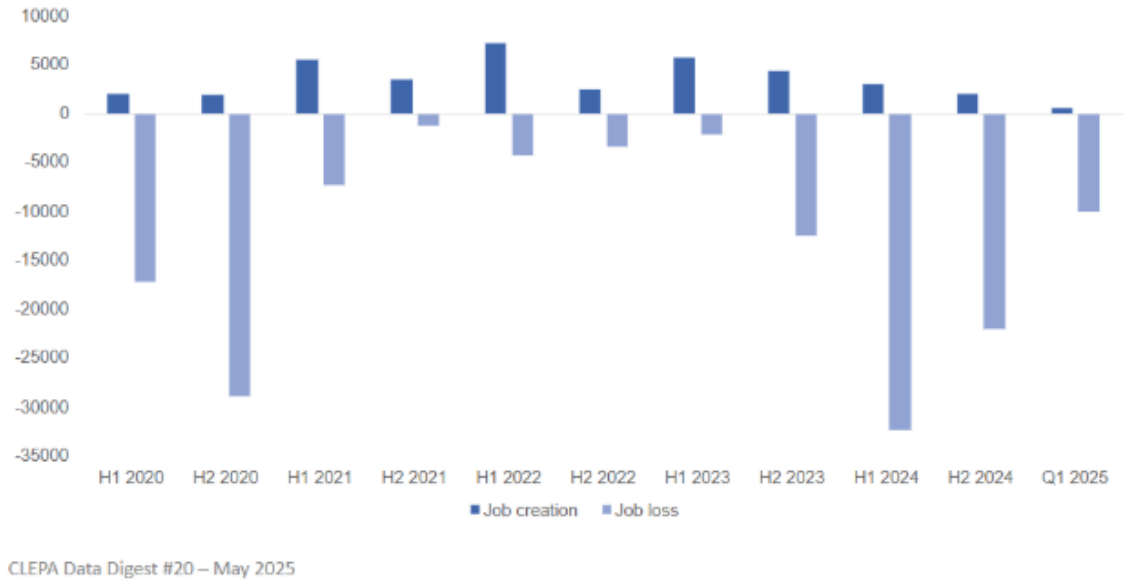

Figure 1 Employment announcements in the automotive supply chain

According to a 2019 study by the BMW ("Automotive Value Creation 2030/2050"), the shift toward battery-electric powertrains is expected to further intensify job losses[4]. The report estimates that if 80% of passenger cars produced are electric, the automotive sector—including both manufacturers and suppliers—could see a reduction of around 170,000 jobs. This represents a decline of over 18% compared to employment levels in the industry in 2017. While electrification will generate some new roles—such as those related to the assembly and integration of electrical components—these gains do not fully offset the overall losses. The drop in employment is mainly attributed to two factors: electric motors have significantly fewer components than traditional combustion engines (which include parts like pistons,

[4] https://www.bundeswirtschaftsministerium.de/Redaktion/DE/Downloads/Studien/automobile-wertschoepfung-2030-2050-executive-summary-english.pdf

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valves, and injection systems), and much of the value creation in electric drivetrains, particularly battery production, occurs outside the EU, especially in Asia. A subsequent 2021 study by PwC Strategy&[5] on the employment impact of the EV transition projected an even greater impact, estimating that the automotive supply industry could lose up to 500,000 jobs over the next 15 years, despite the potential creation of about 226,000 new positions.[6].

Profitability poses another significant challenge, with more than 75% of automotive suppliers forecasting profit margins below the critical 5% threshold—widely seen as the minimum required to support long-term investment. Even more concerning, 42% expect to operate with minimal or no profit margins, marking the highest level reported since the disruption caused by the 2022 pandemic. These shrinking margins, coupled with rising production costs and global overcapacity, threaten the viability of Europe's automotive manufacturing base and call for urgent strategic and policy responses.

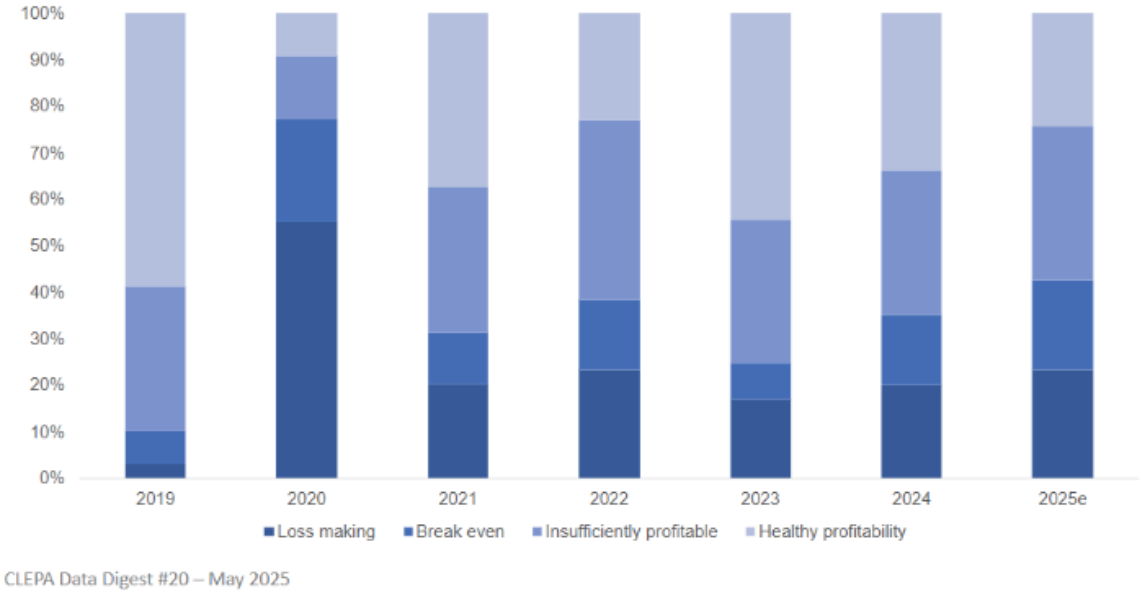

Figure 2 Automotive supply industry profitability radar

[5] https://www.clepa.eu/wp-content/uploads/2021/12/Electric-Vehicle-Transition-Impact-Report-2020-2040.pdf
[6] https://www.clepa.eu/insights-updates/data-digests/clepa-data-digest-18-job-losses-escalate-as-demand-stays-below-expectation/

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Electrification, once seen as a clear path to industrial revitalisation, **has not delivered the expected boost in 2024**. Battery electric vehicle (BEV) production declined slightly compared to the previous year, and forecasts for BEV and plug-in hybrid electric vehicle (PHEV) output in 2025 have been revised down by 1.25 million units from earlier projections. One of the main causes is policy uncertainty—particularly around tax incentives—which has undermined consumer confidence and delayed purchasing decisions. Nevertheless, modest recovery is expected. In 2025, electric vehicles (including BEVs and PHEVs) are forecast to account for 27% of total production, up from 20% in 2024. According to GlobalData (LMCA), BEV production could reach 10 million units annually by 2031. However, this optimistic scenario depends heavily on **clear and stable policy frameworks, improved infrastructure, and sustained investment in innovation**.

1.2. Global Competitiveness and Investment Challenges

The European automotive industry is facing mounting challenges to its global competitiveness. The emergence of assertive industrial strategies in other major economies—such as China, India, the United States as well as North America—is reshaping the competitive landscape and exposing **structural weaknesses in Europe's investment approach**. In these areas energy and labour costs are much lower than in Europe, creating a strong competitive advantage on the global market. This disparity is particularly evident in the European tyre industry, where trade figures over recent years show a decline in EU market share—from 76% to 66%—for both passenger car (PC) tyres and truck and bus (TB) tyres. At the same time, market access for European products in these emerging countries remains problematic when not completely blocked by quota systems (e.g. India and, increasingly, Indonesia, in the case of tyres). Free and fair trade remains one of the fundamental pillars of EU competitiveness and one that it is becoming increasingly difficult to maintain. This is not only relevant in terms of market access, but also in terms of supply of raw materials at a competitive price.

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1.2.1. The Rise of China and the USA and the European Stagnation

China has rapidly expanded its presence in global automotive markets, especially in the electric vehicle (EV) segment. With strong state support, Chinese EV manufacturers are scaling production and exports, capturing increasing market share and pushing down global price points. Simultaneously, the U.S. Inflation Reduction Act has unleashed an unprecedented wave of public and private investment in clean transportation and domestic battery manufacturing, further strengthening the competitiveness of the U.S. automotive industry and posing a growing challenge to Europe's industrial base.

These developments are positioning **China and the U.S. as dominant forces in the automotive race**, while the EU struggles to match their strategic coherence and scale of investment. Europe, indeed, lacks a unified and ambitious industrial strategy capable of responding to this global competition. EU **small and medium-sized enterprises (SMEs), which form the backbone of Europe's automotive supply chain, are especially vulnerable**: limited financial resources and strategic capacity make it difficult for them to adapt to the rapidly changing environment. This situation is leading more companies—especially those in the supply chain—to consider relocating operations to jurisdictions offering clearer incentives and more supportive industrial ecosystems.

The intensifying rivalry between the U.S. and China is reverberating across global supply chains, further undermining Europe's trade position and access to key markets. The EU is particularly exposed due to its heavy dependence on exports: China and the United States together account for 35% of EU automotive component exports. Meanwhile, imports from China have nearly doubled over the past five years, —from €3.9 billion to €7.3 billion—now accounting for 25% of all EU automotive parts imports. Over 57% of European suppliers report facing increasing competition from Chinese imports. Pursuing trade agreements that secure resilient and diversified supply chains will be essential to strengthen industrial competitiveness and economic sovereignty.

Investor confidence is also weakening. Capital expenditure (CAPEX) projections for 2025–2030 have been revised downward by €22.3 billion, reflecting growing unease about the

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sector's future. Annual investment is now expected to stagnate at around €35.6 billion by 2030, well below the €39.6 billion previously forecasted by Oxford Economics. Without a significant shift in investment sentiment and industrial policy alignment, Europe risks falling further behind its global competitors—not just in vehicle production, but in innovation, job creation, and economic resilience.

1.2.2 European BEV Market at a Crossroads: Industrial Challenges and Consumer Barriers

A recent analysis by the European Commission has revealed that some Chinese manufacturers of battery-electric vehicles (BEVs) benefit from state aid. This allows them to offer vehicles at lower prices and put them on the European market, leading to unfair competition and economic damage for European producers. As a countermeasure, the Commission has imposed countervailing duties on imports of Chinese BEVs. Chinese BEVs are reliable, technologically advanced and, above all, affordable. **European models are more expensive and, according to consumer organisation BEUC, do not sufficiently match consumers' needs** – especially in terms of price and range. An additional challenge is the US trade strategy. The Trump administration has imposed important tariffs on European goods, including cars destined for export to the US. This increases pressure on the European automotive sector, which is already facing the technological and green transition as well as high investment costs.

According to ACEA figures, BEV market share fell from 14.6% in 2023 to 13.6% in 2024. This drop is due to the fact that the first wave of electric vehicles was introduced mainly through company car schemes. For private buyers, the high sticker price, limited range, charging infrastructure limitations, and uncertainty about residual value are significant barriers. In addition, BEV adoption is highly income-dependent. Consumers with lower or declining purchasing power delay their purchase of a new car or are more likely to opt for cheaper alternatives. The direct consequence is that many consumers continue to drive their existing internal combustion engine vehicles for longer. This has a negative impact not only on climate

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goals, but also on the economic stability of the European automotive industry as a whole. European manufacturers are struggling to scale the production of affordable, competitive models. The used BEVs continue to grow. Large car parks full of unsold vehicles are already emerging in several Member States. This situation prompts the European Commission to hold regular consultations with industrial and societal stakeholders. The aim is to identify necessary policy action – a broad and inclusive exchange that will continue in the years ahead.

1.3 Transforming Business Models and Aftermarket Challenges

This section describes transforming business models and aftermarket challenges.

1.3.1 From Traditional Dealership to Direct-to-Consumer Models

With the rise of smart vehicles, software is increasingly taking the driver's seat. Connected vehicles now generate vast amounts of data through a wide array of onboard sensors and processors, unlocking unprecedented opportunities for digitalisation. This evolution enables automotive manufacturers to develop direct-to-consumer (D2C) and direct-to-business (D2B) business models.

In pursuit of greater profitability, manufacturers are shifting toward comprehensive global strategies aimed at capturing value across the entire automotive value chain. In terms of vehicle distribution and retail, European manufacturers are rethinking their business models by consolidating distribution networks to reduce costs. Many have transitioned from the traditional franchised dealer model to agency models. However, according to recent developments, some manufacturers are now considering a return to the franchise model. Simultaneously, the growth of online sales platforms has placed manufacturers in direct competition with their own retailers.

The automotive sales and repair businesses have undergone significant consolidation over the years, with large dealer groups expanding and acquiring smaller dealerships. This consolidation has led to significant fewer independent dealerships. Smaller, family-owned

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businesses have been acquired or forced to close due to competitive pressures. Car manufacturers increasingly opt for large dealer groups due to several strategic advantages that align with their business goals and market demands. Large dealer groups have the infrastructure and resources to streamline operations. Partnering with large dealer groups allows manufacturers to benefit from economies of scale in distribution, reducing costs associated with logistics and operations.

The global trend of cutting out the 'distribution' layer is becoming increasingly evident across various industries. In many sectors, manufacturers are opting to take direct control of the distribution process, reducing reliance on independent distributors. This trend has significant consequences for customers and SMEs in Europe. As manufacturers take control of the distribution, they set uniform prices across their direct channels, leading to fewer discounts and less price competition. Accessibility can also be limited as manufacturers may consolidate locations, leading to fewer points of sale, especially in less profitable or rural areas, making it harder for some customers to access products and services. Direct control allows manufacturers to standardize customer experiences, which can be positive in terms of consistency. However, it can also mean a less personalized service compared to independent distributors, who often build long-term relationships and offer tailored services.

Independent distributors, dealers, and other intermediaries, which are predominantly SMEs, **face significant risks which can lead to business closures and job losses.** Europe's economy heavily relies on SMEs, which are the backbone of economic activity, employment, and innovation across the continent.

1.3.2 The Critical Role of Data Access and Battery Repairability in Automotive Aftermarket

As the automotive industry evolves towards a future driven by data-based services, the importance of equitable access to in-vehicle data cannot be overstated. It is imperative that automotive repairers are granted direct, unmonitored, unrestricted, and real-time access to this data. Such access is not merely a technical requirement but a foundational element for

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the development of new data-enabled services. Moreover, it is crucial for preserving competition, fostering innovation, and safeguarding consumer choice within the automotive repair industry.

For years, aftermarket stakeholders have advocated European policymakers to introduce robust and ambitious sector-specific legislation underpinned by precise technical and legal requirements that ensure a level playing field for all market participants. Without these critical provisions, the industry risks undermining fair competition, stifling innovation, and eroding consumers' freedom of choice. The potential consequences are severe: a monopolization of data control by a few entities could lead to a less dynamic market, where independent repairers are squeezed out, reducing the diversity and quality of services available to consumers. The urgency of this issue cannot be overstated. As vehicles become increasingly connected, the data they generate will become the lifeblood of the automotive ecosystem. This data encompasses everything from diagnostics and maintenance schedules to real-time performance metrics and predictive analytics. If access to this data is restricted or controlled by a limited number of players, the entire industry stands to lose.

Another critical aspect concerns the reparability of batteries. Battery reparability not only impacts the operational longevity and sustainability of vehicles but also plays a significant role in determining the residual value of vehicles. As the core component of an electric vehicle, the battery's condition is a major factor in a vehicle's overall value. If batteries are not allowed to be repaired (on the vehicle itself), the depreciation rate of these vehicles will be significant.

To maintain the value of electric vehicles over time and to support a healthy second-hand market, it is essential that battery reparability is prioritized. Manufacturers, policymakers, and industry stakeholders must work together to ensure that batteries are designed with repairability in mind. This includes developing standards for battery construction, repair protocols, and ensuring that repairers have the tools, training, and access to the necessary parts to carry out these repairs.

CECRA (the association of European vehicle dealers and repairers) is currently engaged in active discussions with the European Commission concerning the revision of existing battery

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regulation through a delegated act. CECRA's key objective is to ensure that repairs can be carried out directly on batteries installed in vehicles. Under the current regulation, batteries must first be reused or repurposed before any repair is permitted.

1.4 Sustainability Targets and Regulatory Pressure

The European automotive-mobility sector is navigating a complex transition also with regards to climate neutrality goals. While these targets are ambitious and necessary, the path to achieving them is heavily influenced by **regulatory frameworks that are often perceived as rigid and overly prescriptive**.

One of the most pressing concerns relates to CO_2 emission standards. Although essential for driving decarbonisation, the current regulatory approach tends to prioritise specific technologies—such as battery electric vehicles—at the expense of a broader innovation landscape. This risks prematurely locking the industry into limited solutions, potentially increasing compliance costs and slowing the pace of the green transition.

There is a growing consensus within the sector that a technology-neutral approach is urgently needed. Such an approach would allow for a more diverse portfolio of low-emission and zero-emission solutions, including advanced hybrids, hydrogen, synthetic fuels, and other emerging technologies. Revising the CO_2 regulation to better align with evolving market realities would not only enhance flexibility but also support cost-effective and inclusive decarbonisation pathways.

However, regulatory pressure alone cannot drive transformation. Effective change requires robust enabling conditions, including reducing administrative burdens for companies, accelerating the deployment of charging and refueling infrastructure, and ensuring coherence between EU-level and national policies. Fragmented or conflicting regulations delay investment, create market uncertainty, and undermine business confidence.

The European Green Deal set a new policy framework to reduce emissions and protect the environment. Although the industry supports the general aim of this policy, its targets have

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been particularly burdensome and difficult to achieve due to the challenges mentioned above. Many European automotive products are subject to stringent regulations throughout their lifecycle. **Tyres, in particular, are among the most heavily regulated components**, encompassing requirements from raw material sourcing—such as compliance with the REACH Regulation and the EU Deforestation Regulation—to end-of-life treatment under directives like the Waste Framework Directive and the Landfill Directive. Additional rules apply to safety, emissions, and performance (e.g., General Safety Regulation, Euro 7, EU Tyre Labelling), as well as manufacturing standards (e.g., Ecodesign Regulation). These high standards, especially for tyres produced within the EU, deserve stronger support in the market. High-performing tyres, for instance, can significantly enhance road safety by reducing stopping distances by up to 4 car lengths, while also improving fuel efficiency by as much as 7.5%. This, in turn, could lead to a reduction of CO_2 emissions by 4 million tonnes annually—the equivalent of removing 1.3 million passenger cars from EU roads[7].

Beyond these specific regulations, the industry also faces **additional compliance pressures related to carbon leakage** (e.g., Carbon Border Adjustment Mechanism – CBAM), **corporate sustainability reporting, and due diligence**. These add layers of administrative complexity that may disadvantage European manufacturing.

Without targeted improvements in regulatory design and policy coordination, the sector's ability to invest, innovate, and remain competitive on a global scale will continue to be undermined. A smart regulatory framework—ambitious in its goals but flexible in its methods—is essential to ensure that the transition to sustainable mobility is both effective and economically viable. Regulatory simplification would incentive compliance with EU regulations especially when consumers, environment and businesses needs converge. While several initiatives proposed under the European Commission's **Omnibus packages** provide useful support, there remains a clear need for a dedicated automotive-focused omnibus framework.

[7] https://road-safety.transport.ec.europa.eu/eu-road-safety-policy/priorities/safe-vehicles/tyres_en

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1.4. Geopolitical Tensions and Raw Materials Shortages

As economic and trade competition is mounting, geopolitical tensions arise. Besides the Russia and Ukraine War impacts on Europe geopolitics, **conflicts in the global commercial hubs** such as the Red Sea in the Middle East, the Malacca Straits in Southeast Asia or the Panama Canal in Central America can increase shipping time and uncertainty at global scale. Furthermore, **stiff trade policies** based on technical barriers and tariffs are increasing uncertainties and destabilising the world trade ecosystem. This is particularly delicate for the European automotive industry, as 64% of all motor vehicles produced are exported to countries outside the European Union, and 43% of Europe's value added originates from vehicle sales to non-European countries[8].

In addition, disruptive events have placed **significant pressure on local supply chains and car and component manufacturers**, potentially limiting the availability of strategic products such as semiconductor chips and tyres and critical raw materials like aluminium and lithium. This is even more evident in the context of the electric vehicle (EV) transition. The shift to battery electric mobility has heightened the need for materials such as lithium, cobalt, and rare earth elements—many of which are controlled or heavily processed by China. The access to raw materials is heavily dependent on China's recent restrictions, which have led to the shutdown of several production lines and plants across Europe, and which now extend beyond raw materials to include key processing technologies, such as those used for permanent magnets, which are essential for electric motors[9].

To safeguard the long-term competitiveness and technological sovereignty of the European automotive industry, the EU must reinforce its strategic autonomy by maintaining the production of essential components—such as tyres—within Europe, while also accelerating the development of underrepresented sectors like chip and battery manufacturing. This effort requires the establishment of preferential legislative corridors to secure access to critical raw

[8] https://iri.jrc.ec.europa.eu/scoreboard/2023-eu-industrial-rd-investment-scoreboard
[9] https://mailchi.mp/clepa/urgent-action-needed-china-export-restrictions-on-rare-earths-10666259?e=ab15e29bcb

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materials. Specifically, it involves delaying the extension of the Carbon Border Adjustment Mechanism (CBAM) to additional raw materials and developing targeted strategies for those insufficiently addressed by the Critical Raw Materials Act, such as rubber. Tyres, for instance, are indispensable for road mobility, yet their production depends heavily on raw materials imported from third countries, notably natural rubber from ASEAN (Association of Southeast Asian Nations) and West Africa, alongside limited EU capacity for synthetic rubber and carbon black. These vulnerabilities risk supply shortages and an increased dependence on imported finished products.

This tightening control over strategic resources introduces a new layer of risk for European automotive supply chains. It complicates supply chain planning, discourages long-term capital investment, and increases the overall cost and uncertainty associated with the green transition. Without a coordinated strategy to secure stable access to critical materials—whether through strategic partnerships, diversified sourcing, or domestic production—Europe risks falling behind in the global race for sustainable mobility leadership.

1.5. Insights from Experts Consultations

As detailed above, **findings on the state of the automotive industry and the challenges it faces were gathered not only through desk research, but also via dedicated expert workshops**. During these sessions, participants were asked to provide feedback on the perceived urgency of the identified challenges. This process allowed to **cross-check and validate the desk research findings with practical insights from industry experts**.

The key findings from the first of three workshops held in Cinisello Balsamo, UCIMU association, Milano, Italy, on June 25th, 2025 (further details about the workshop are in the annex section) are summarized below:

- When asked to assess the automotive industry's current state, workshop findings indicate that **while the sector is undoubtedly experiencing significant transformations, these changes are more predictable and manageable than one**

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would assume. This is particularly noteworthy given the widespread disruption in global trade relations and commercial activities. The even spread of observations implies that industry stakeholders have a measured understanding of the challenges ahead, despite the apparent turbulence in international markets. This view suggests a more stable and calculated evolution of the automotive sector rather than dramatic, unforeseen shifts.

- Recent geopolitical events have highlighted the critical need to assess and **comprehend capabilities across local, national, and European Union levels**. This understanding has become increasingly vital as nations work to balance economic interests while avoiding harmful protectionist measures. There was a relative consensus among participants to the workshop that a thorough evaluation of these capabilities is essential to prevent trade barriers and maintain healthy international commerce relationships.
- There was a strong awareness and **deep concern for environmental sustainability** and circular economy principles across the entire group of expert participants.

The key findings from the second of three workshops organized online within the framework of the ASA regional implementation working group, on July 7th, 2025 (further details about the workshop are in the annex section), are summarized below:

- The analysis of potential future scenarios indicated a **strong inclination towards increasingly volatile, unpredictable and fragmented market environments** that the automotive industry would likely encounter. This perspective suggested that traditional linear forecasting might become less reliable, as the sector would need to navigate through more complex, interconnected, and unpredictable business landscapes in the coming years.
- Participants acknowledged the significance of **comprehending and obtaining accurate information about ongoing geopolitical disruptions and conflicts**. However, they classified this capability as **valuable but not critical to their operations**. While recognizing its importance for informed decision-making, attendees considered it a secondary priority compared to other essential business functions and competencies.

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- The participants expressed a strong consensus regarding the **critical need to comprehend foreign automotive protectionism at both local and European Union levels**. They emphasized the importance of thoroughly understanding domestic and EU manufacturing capabilities, while simultaneously working towards reducing dependency on foreign supply chains. This dual approach would strengthen the automotive sector's resilience and promote regional industrial autonomy.

The key findings from the third of three workshops held in Reggio Emilia, CIS - Unindustria Reggio Emilia, Emilia Romagna Region, Italy, on September 9th, 2025 (further details about the workshop are in the annex section) are summarized below:

- When asked to provide feedback on the transformations currently underway in the automotive sector, participants described a **complex and uncertain picture**. Their responses indicate that even among experts, the future of the industry is difficult to predict. This underlines the need for skills and expertise characterized by flexibility and adaptability, enabling rapid responses to emerging scenarios.
- When asked how different institutions could address geopolitical disruptions affecting the automotive industry, participants emphasized how EU and national frameworks can play a key role in effectively managing and mitigating both sector-specific challenges and their broader implications.
- The expert participants collectively demonstrated a distributed awareness and understanding to environmental sustainability practices and circular economy concepts.
- Current global developments and oscillating disruptions (mostly generated outside the EU) have emphasized the importance of evaluating and understanding capacities at municipal, state, and European Union scales. This insight has become crucial as countries strive to protect financial interests without supporting and implementing detrimental isolationist policies. Workshop attendees strongly agreed that a comprehensive analysis of these capacities is necessary to eliminate trade restrictions and sustain robust international business connections.

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2. SKILLS, JOB ROLES, EDUCATION AND TRAINING: GRASPING THE SCALE OF TRANSFORMATION

When examining the evolution of skills and job roles, the driving forces can generally be divided into two categories:

1. Normal development and progress of technologies
2. Revolutionary - in some cases also tectonic - developments (e.g., industrial revolutions, global crisis, wars)

While the first category typically generates broad benefits for society, sometimes on a global scale, the second often exacerbates inequalities between rich and poor, skilled and unskilled, as well as between those who resist and those who adapt. In the European Union, current challenges reflect both dynamics. These include the ongoing transition toward electrification and the entry of new automotive manufacturers into the market; the simultaneous cooling of the electrification drive and the downsizing of internal combustion engine (ICE) production among certain European manufacturers; and the global acceleration of artificial intelligence (AI) developments, with their profound implications for the labor market.

The scale of this transformation is already evident in the labor market. According to the ACEA Pocket Guide (2024)[10], the automotive sector accounted for over 10% of all EU manufacturing jobs in 2022 (Figure 3). Yet in 2024 alone, suppliers announced approximately 54,000 job cuts[11], primarily due to restructuring and cost pressures, but also, in part, to company closures and bankruptcies**Error! Bookmark not defined.**. These developments underscore the disruptive forces currently reshaping the industry and highlight the urgent need for adaptation.

[10] https://www.acea.auto/files/ACEA-Pocket-Guide-2024-2025.pdf#page=7
[11] https://www.clepa.eu/insights-updates/data-digests/factory-closures-overshadow-eus-mobility-transition/

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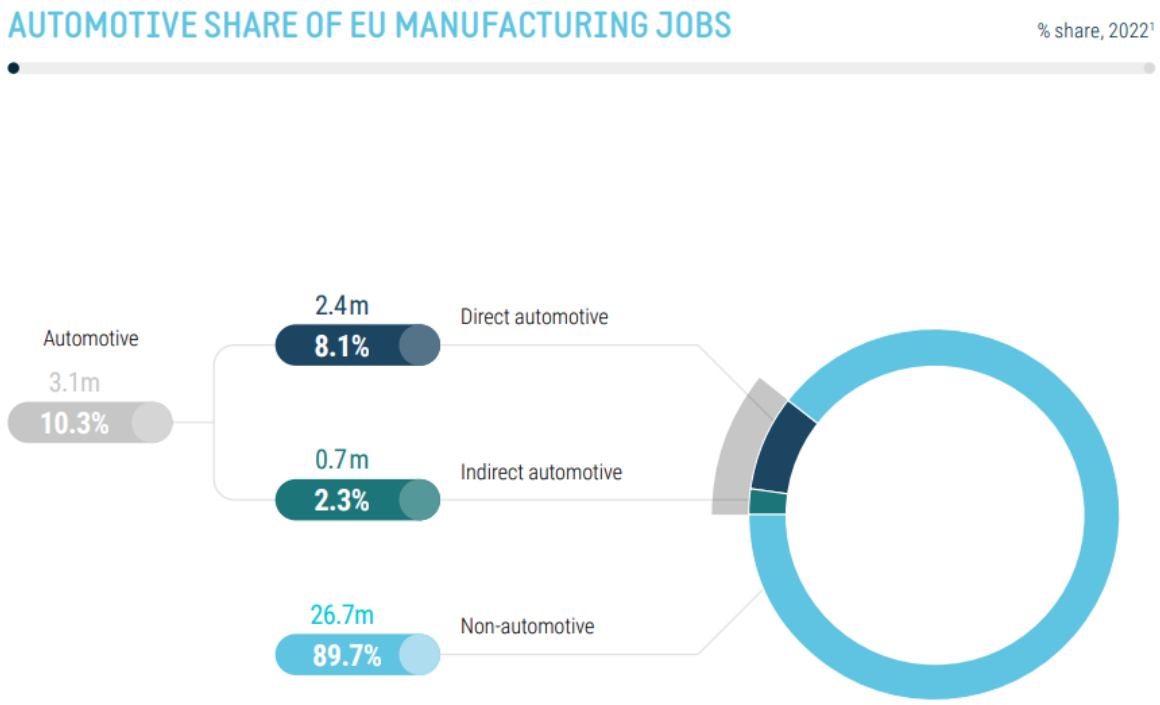

Figure 3 The EU automotive sector accounts for over 10% of EU manufacturing jobs[12]

In this context, the question of skills becomes critical. According to the World Economic Forum's *Future of Jobs Report 2025*[13], demand is surging for **robotics engineers, data analysts, and AI and machine learning specialists**. Conversely, skills tied to more traditional roles—such as assembly line work and accounting—are in decline. These trends clearly illustrate how digitalization and electrification are not only transforming the structure of the automotive sector but are also redefining the very capabilities that will determine competitiveness and resilience in the years ahead.

[12] https://www.acea.auto/files/ACEA-Pocket-Guide-2024-2025.pdf
[13] https://reports.weforum.org/docs/WEF_Future_of_Jobs_Report_2025.pdf

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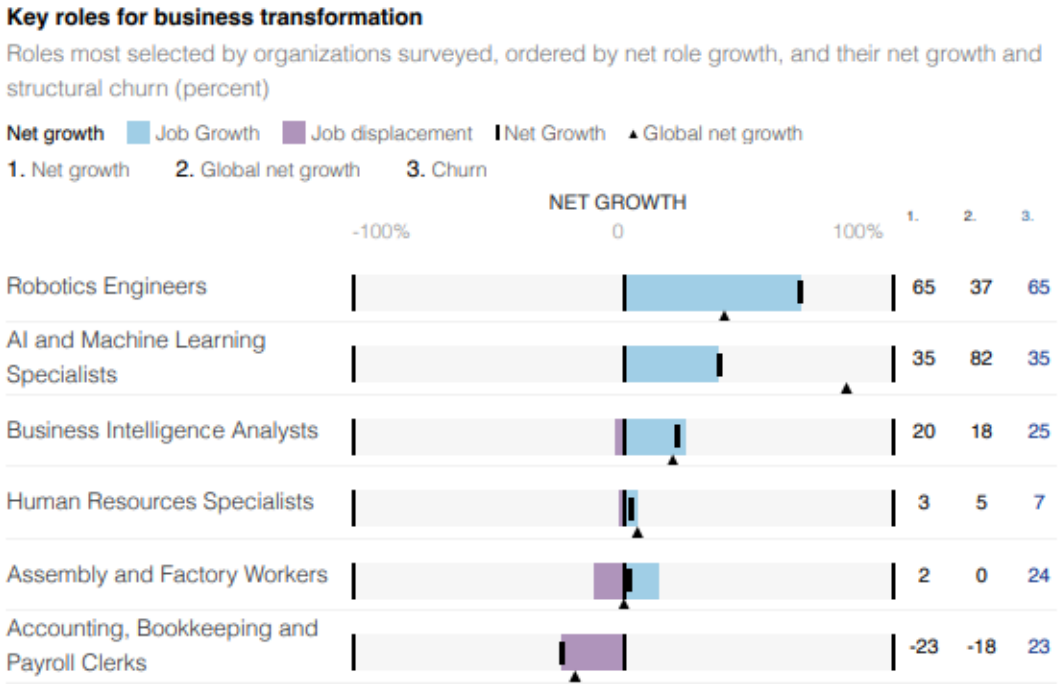

Figure 4 Key roles for business transformation in Europe[14]

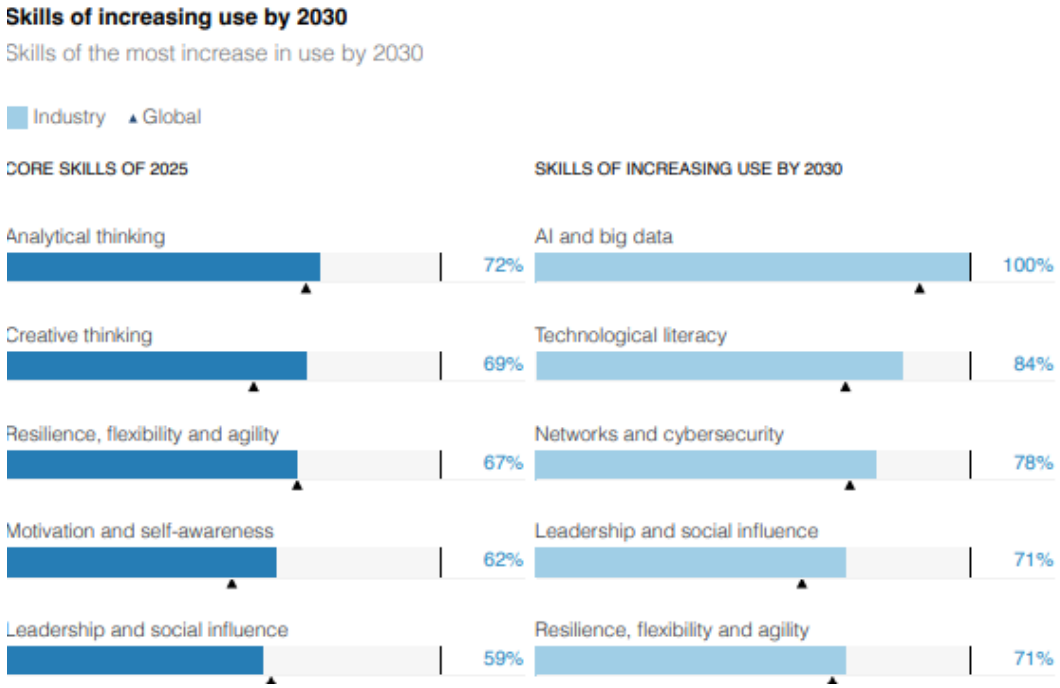

Figure 5 Skills of increasing use by 2030 in Europe[15]

[14] https://reports.weforum.org/docs/WEF_Future_of_Jobs_Report_2025.pdf
[15] https://reports.weforum.org/docs/WEF_Future_of_Jobs_Report_2025.pdf

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2.1. Overview of Needed Skills and Job Roles

The Industrial Action Plan for the European automotive sector sets out concrete measures to help secure global competitiveness of the European automotive industry and maintain a strong European production base through action in five key areas[16], which will strongly drive the changes in terms of skill needs and job roles.

One of the most pronounced areas of change is the growing **digitalization** and the transition towards software-enabled, AI-powered connected and autonomous vehicles. Engineers and technicians must now be proficient not only in mechanical systems but also in **programming, data analysis, embedded systems, and cybersecurity**. The vehicles of the future are increasingly defined by software, and the ability to develop, maintain, and secure digital vehicle systems is now central to many roles. **Autonomous vehicle development** introduces another layer of complexity. It requires experts in **sensor technology, artificial intelligence, robotics, and real-time data processing**. The design and integration of autonomous systems rely heavily on advanced software, system simulation, and regulatory alignment.

Simultaneously, the push toward **electric mobility** is driving demand for workers skilled in **battery technology, including battery assembly, diagnostics, recycling, and raw material processin**g. Technicians who once focused on fuel systems or transmissions are now expected to understand high-voltage systems and energy management. The availability of electric recharging and hydrogen refuelling infrastructure needs to increase and will be anticipated, including smart and bi-directional charging, which will require a prepared workforce.

Equally important are skills related to the **circular economy and sustainability**. As the sector embraces environmental responsibility, new roles are emerging in **end-of-life vehicle management, battery recycling, and sustainable materials innovation**. These roles bridge

[16] Communication From the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Industrial Action Plan for the European automotive sector, Brussels, 5.3.2025

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technical know-how with environmental consciousness and require cross-disciplinary knowledge.

Among all of this, understanding **regulatory frameworks** and achieving compliance with evolving EU standards for safety, emissions, and digital access is becoming an indispensable function across the sector. Professionals with **up-to-date knowledge of type-approval processes, environmental legislation, and data governance are increasingly valuable**.

2.1.1. In-Demand Skills in the Automotive Sector

As new technologies emerge and market needs evolve, the skills required in the automotive sector are also continually changing. Here is a summary of the most sought-after skills[17]:

- **Technical Knowledge:** This encompasses core automotive mechanics, electronics, materials engineering, and mechanical engineering.
- **IT and Software Skills:** With the increasing integration of electronics in vehicles, expertise in IT, software development, and programming is crucial. This includes knowledge of control systems, embedded software, artificial intelligence (AI), machine learning (ML), and cybersecurity.
- **Innovation and Design:** Skills in automotive design and engineering, particularly in the development of lightweight and sustainable materials, are vital for creating modern and efficient vehicles.
- **Expertise in Energy and Sustainable Mobility:** The transition to electric and sustainable vehicles necessitates specialized knowledge in energy storage technologies, renewable energy sources, and charging infrastructure design.
- **Automation and Artificial Intelligence:** As the industry moves towards autonomous vehicles, skills in automation, advanced sensing, computer vision, and AI are increasingly in demand.

[17] https://www.kilpatrickexecutive.com/working-in-the-automotive-sector-skills-in-demand/

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- **Supply Chain Management and Logistics:** To ensure efficient production and optimal distribution, strong skills in supply chain management, logistics, and process optimization are essential.
- **Sales and Marketing Skills:** In a highly competitive market, proficiency in marketing, sales, and business strategies is required.
- **Communication Skills and Teamwork:** Beyond technical abilities, crucial soft skills include effective communication, teamwork, problem-solving strategies, and adaptability.
- **Regulatory and Safety Knowledge:** Given the highly regulated nature of the industry, knowledge of safety and homologation regulations is critical to ensure vehicles meet necessary standards.

2.2. Job Roles: Overview of People Affected

As stated in chapter 1, the European automotive industry is currently experiencing significant workforce reductions. **Job losses** are widespread across the supply chain, manufacturing, and related services, primarily driven by slowing demand, increased competitive pressures, and the fundamental shift towards electric vehicles (EVs). Additionally, the aging workforce in the automotive industry is expected to result in a wave of natural retirements over the next few years.

While some new roles are emerging, they do not offset the overall decline, and **companies are increasingly restructuring to address overcapacity**. These trends underscore the urgent need to understand not just the scale of job losses, but also which roles are more at risk and how work itself is changing.

The most **vulnerable workers** are those in **clerical and administrative support roles**, which involve repetitive, predictable tasks that are highly susceptible to automation through digital tools and generative AI. These roles are often held by individuals with vocational-level

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qualifications (EQF levels 3–4), meaning the impact may also deepen social disparities unless mitigated by targeted support and inclusive upskilling efforts[18].

In **manufacturing and inspection**, jobs that involve a high degree of manual skill, such as assembly line work, are more resistant to full automation. However, the integration of robotics and AI-assisted tools is gradually changing job content. Workers may no longer assemble or inspect components manually, but they need to operate or supervise intelligent systems that perform these tasks. This shift does not eliminate jobs but transforms them, requiring new digital literacy and system management skills[19].

Intermediate positions, such as **technicians**, who have roles that blend hands-on technical work with diagnostic and analytical tasks, are increasingly subject to partial automation. Without continuous training, these workers could see their tasks narrowed or downgraded, but with effective reskilling, they are well-positioned to move into more complex, oversight-focused positions.

Engineers and highly qualified professionals face a lower risk of job loss, but their work is also changing. Tools powered by AI and big data are transforming how engineers design, test, and improve products. Simulation software enhanced by AI enables faster prototyping but also requires proficiency in new digital tools. While human expertise remains essential, its focus is shifting from hands-on execution to the orchestration and management of complex, technology-driven processes.

2.3. Education and Training Levels of Required Job Profiles

The massive transformation ccurrently underway in the European automotive industry necessitates widespread **upskilling and reskilling** across all job roles and levels within the entire value chain, from manufacturing to R&D, sales, and after-sales services. The **European**

[18] Generative AI and Jobs - A Refined Global Index of Occupational Exposure, International Labour Organization, May/2025

[19] https://www.ilo.org/publications/generative-ai-and-jobs-refined-global-index-occupational-exposure

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Qualifications Framework (EQF)[20] is widely used to classify the required education and training levels for these evolving roles.

A valuable resource for understanding the necessary skills, job roles, and their corresponding EQF-aligned education and training levels in the automotive sector is the **Sectoral Qualifications Framework for the Automotive Sector (SQF Auto)**[21]. This framework serves as a tool to help automotive industry employers and employees develop competencies, enhance human resource processes within companies, and empower employees to independently define their career and learning paths. It also proves to be useful for educational and training institutions.

According to a recent Eurofound article[22], there is a growing demand for skills in **STEM fields, advanced technical training, and higher education**. On average, workers can expect that approximately two-fifths (39%) of their existing skill sets will be transformed or rendered obsolete between 2025 and 2030. In response, automotive employers are increasingly prioritizing workforce strategies that emphasize upskilling, process automation, and the redeployment of staff from declining roles to positions aligned with emerging industry needs[23].

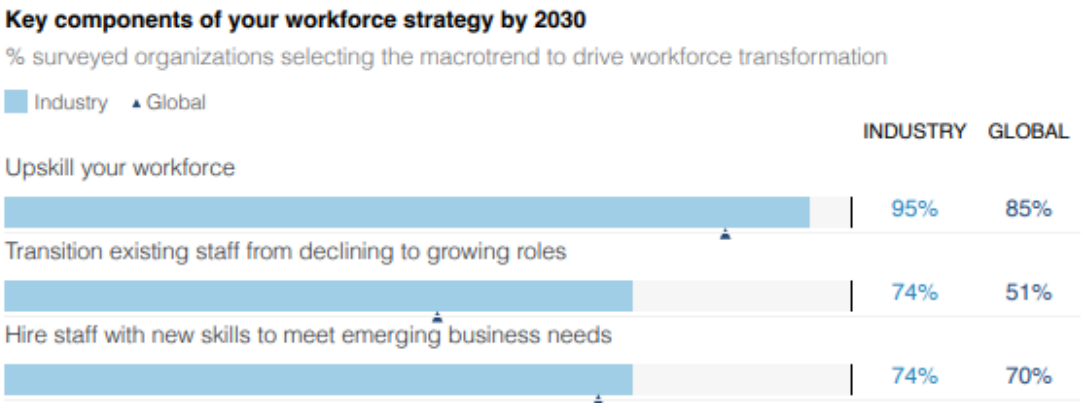

Figure 6 Workforce Strategy outlook in Automotive and Aerospace[24]

[20] https://europass.europa.eu/en/description-eight-eqf-levels
[21] https://kwalifikacje.edu.pl/wp-content/uploads/publikacje/PDF/SRK-Moto-EN.pdf
[22] https://www.eurofound.europa.eu/en/resources/article/2025/employment-eus-automotive-sector
[23] https://reports.weforum.org/docs/WEF_Future_of_Jobs_Report_2025.pdf
[24] https://reports.weforum.org/docs/WEF_Future_of_Jobs_Report_2025.pdf

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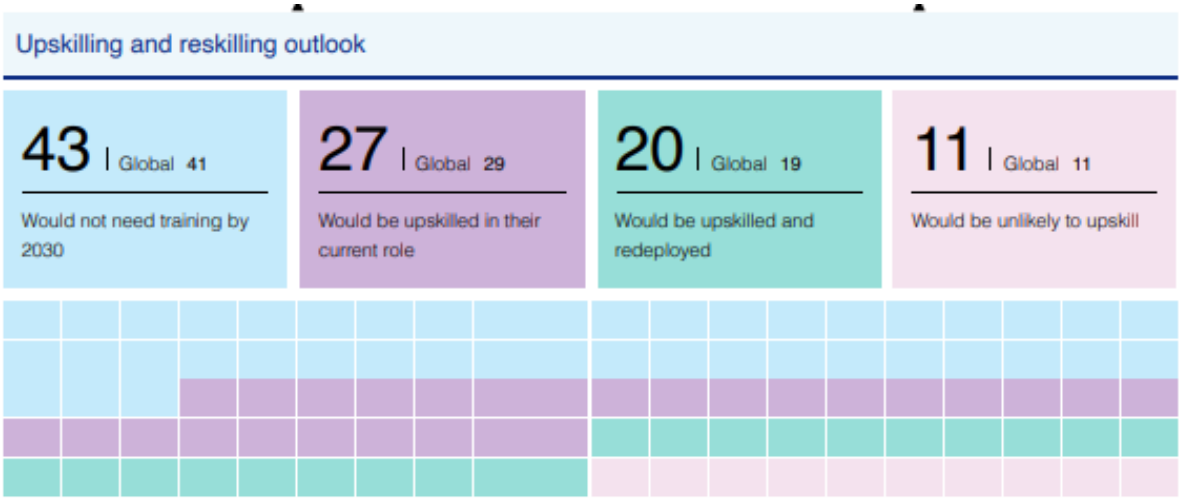

Figure 7 Upskilling and reskilling outlook in Automotive and Aerospace[25]

2.4. Analysis of Education and Training Offer

A key element in addressing this transformation is the urgent need to adapt knowledge and skills comprehensively to the demands of the evolving industrial landscape.

To this purpose, the European Commission has addressed these challenges through initiatives such as the European Skills Agenda, the Pact for Skills, the Automotive Skills Alliance, and several projects under the Erasmus+ programme, including DRIVES[26] and ALBATTS[27]. These frameworks aim to foster skills development for a green and digital future, but their practical impact varies significantly across Member States and even among individual regions.

Despite encouraging beginnings, the effectiveness of current education and training offerings in the automotive and mobility sector is increasingly questioned. At the European level, some progress has been made – for instance, competence frameworks have been developed for emerging roles linked to electromobility, battery handling, software diagnostics, and digital

[25] https://reports.weforum.org/docs/WEF_Future_of_Jobs_Report_2025.pdf
[26] DRIVES Project (2023). Final Competence Framework. https://automotive-skills-alliance.eu/the-year-2022-has-brought-new-partnerships-projects-and-opportunities-to-advance-the-skills-agenda-at-a-european-level/
[27] ALBATTS Project (2023). Battery Skills Roadmap. https://www.project-albatts.eu/Media/NewsEvents/40/NewsEvents_40_SLIDES_20240529_101531.pdf

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platforms. Hundreds of companies, schools, and institutions have taken part in pilot projects, indicating a generally high level of willingness among key stakeholders to engage.

Nevertheless, according to CEDEFOP[28] data, a significant share of employers in the automotive sector still reports a **mismatch between the available educational offering and their actual needs**. In 2024, 45% of companies stated they were struggling to find workers with adequate digital or environmental competencies. This indicates that existing programmes often fail to provide training that is sufficiently specific or responsive to emerging skill gaps.

2.4.1 Participation in Lifelong Learning and Access Challenges

Eurostat[29] data show that in 2024, only around 39% of adults in the industrial sector participated in lifelong learning programmes, which is far below the European Union's goal of reaching at least 60% participation by 2030. These numbers reveal a systemic **gap between ambition and implementation**. Current programmes tend to focus on larger industrial hubs and well-established companies, while **micro and small enterprises often lack access or capacity to involve their workforce** in upskilling activities.

One of the most common issues in the current training landscape is **fragmentation**. In many Member States, a variety of parallel programmes exists, but these are often poorly coordinated, both in terms of content and qualification recognition. As a result, employees who complete training in one region or with one provider may encounter problems when attempting to transfer those competencies or gain formal recognition in another setting.

Another concern lies in the **outdated nature of many vocational programmes**, especially those in mechanics and automotive electronics. A large number of curricula still fail to include

[28]CEDEFOP (2024). Skills Panorama Report. https://www.cedefop.europa.eu/en/keywords/skill-mismatch
[29]Eurostat (2024). Adult learning participation in the EU. https://ec.europa.eu/eurostat/statistics-explained/index.php/Adult_learning_statistics

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knowledge areas that are now central to modern industrial roles such as data systems in vehicles, sensor technologies, or the operation of advanced battery systems.

2.4.2 Social and Structural Barriers to Access

Socio-economic factors also significantly impact access to education. Older workers engaged in traditional manufacturing processes often struggle with low levels of digital literacy, which makes it more difficult for them to participate in modern forms of learning that rely on online platforms or self-directed study. Similarly, low-skilled workers frequently lack the motivation or support structures to pursue further education, particularly if they are in insecure job positions or working under conditions with limited prospects for advancement.

Gender and diversity also remain important issues. Despite continued efforts, the inclusion of women in technical training programmes is still weak, representing a missed opportunity to expand the talent pool and address labour shortages. The same applies to migrants and ethnic minorities, who often require additional support structures to enter and succeed in training programmes.

Regional inequality adds another layer of complexity. In highly developed industrial regions such as Bavaria, Auvergne-Rhône-Alpes, or Emilia-Romagna, there are already strong ties between the industrial base and the education system, allowing for curricula to be co-designed in line with real market needs. In contrast, many regions, particularly in Eastern Europe — still lack such mechanisms, leading to delays and unequal opportunities for competence development.

2.4.3 Innovations in Learning and Training Methods

When updating education systems, the focus should not lie solely on content, but also on the **methods** used to deliver it. Traditional approaches as classroom teaching, frontal instruction, written exams, often no longer meet the needs of today's learning environments, especially in fast-changing industrial contexts.

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One of the most promising innovations is the use of **virtual reality (VR).** With VR, training participants can simulate real work tasks, such as servicing electric vehicles or handling high-voltage batteries, without the risks of injury or the cost of using actual components. Companies like ZF Friedrichshafen report that VR-based training has helped reduce onboarding time and costs by over a third, while also improving participants' confidence in applying new skills.

Artificial intelligence (AI) is also introducing important changes. AI-powered systems can analyse individual progress in real time, adapt content to learners' specific needs, and suggest additional modules where knowledge gaps are identified. This enables more personalised and efficient learning, especially when dealing with large or diverse groups of participants.

Another effective approach is **microlearning**: short, focused learning units. Instead of long lectures, employees can access 5-to-10-minute segments via mobile devices, for instance during breaks or between tasks. This method is particularly suitable for work environments where time and attention are limited.

Finally, **blended learning**, a combination of classical instruction, digital tools, mentorship, and simulations, offers a more flexible and accessible way to learn, while retaining the human interaction that remains key to the learning process.

2.4.4 Recommendations for Systemic Development

To address the challenges outlined above, more coordinated and systemic measures are required. At the policy level, it would be necessary to establish permanent **national and regional centres for skills intelligence**, entities that would monitor labour market needs based on real-time industry data and guide the updating of curricula and the development of training programmes. These observatories should operate in close cooperation with industry chambers, trade unions, and educational institutions to ensure timely and flexible responses to evolving demands.

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Another key step is the formal recognition of **micro-credentials**. Many short, specialised training programmes currently lack legal or formal value, despite their practical relevance. Introducing a structured micro-credential system would allow for modular skill-building, which is particularly important for adults who wish to upgrade their competencies without enrolling in long-term education programmes.

At the implementation level, the **active involvement of companies** in the design of training content should become the rule rather than the exception. Programmes based on real work processes and current technologies are more likely to be relevant and effective. Evidence shows that when institutes, employers, and vocational schools co-create educational content, the outcomes are significantly stronger and more sustainable.

Particular attention should also be given to **vulnerable groups**. The inclusion of older workers, women, and migrants requires targeted support such as free counselling, flexible scheduling, mentorship, and the development of soft skills. Only a holistic approach like this can ensure more equitable access to education and training.

The successful transformation of the European automotive and mobility sector will not be possible without a bold and comprehensive renewal of education and training systems. Knowledge is becoming the new infrastructure, a foundational element without which competitiveness, environmental sustainability, and social fairness cannot be ensured.

European initiatives have laid the groundwork, but the time has come for implementation on the ground in a way that is flexible, inclusive, and supported by technology. Only through strong cooperation between industry, the education system, public authorities, and individuals it will be possible to create a learning environment capable of meeting future demands and ensure that the transition is truly just for everyone.

2.5. Bridging Europe's Skills Gap: Corporate and Regional Initiatives

In a time of accelerated transformation across the European economy, driven by digitalisation, the green transition and industrial restructuring, it is becoming increasingly

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clear that workforce knowledge and skills are not evolving quickly enough to keep pace with these changes. Despite efforts at both EU and national levels, many sectors, particularly the automotive and mobility industry, are facing a significant shortage of adequately trained workers.

In this context, company-led and regionally driven initiatives are playing an increasingly important role by introducing concrete mechanisms at the operational level to close the gap between education systems and the actual needs of the labour market. As employers often detect changes in required skills earlier than formal education providers, they are becoming active participants in shaping training content, whether through internal programmes or in cooperation with educational institutions.

At the same time, many European regions have recognised that investing in human capital is essential for remaining competitive, both locally and internationally. This has led to the emergence of regional strategies, partnerships and platforms that bring together education, industry and public authorities. These models, often referred to as public-private partnerships, not only enable faster responses to industry needs, but also support greater flexibility and the inclusion of vulnerable groups.

Such initiatives are no longer merely a supplement to national and EU-level measures. They are becoming a key element in a broader strategy to address the skills gap. Their value lies in their focus on the end user, the worker and the employer, and in their ability to bring together different actors in a joint effort to build a more flexible, inclusive and responsive skills system.

2.5.1 Corporate Initiatives

Automotive companies are investing in education and training to equip their workforce with future-ready skills. The following initiatives highlight how leading manufacturers are developing employees, apprentices, and young talent through dedicated academies and learning programs:

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1. **ReKnow University**[30] is supporting the industry in developing the skills necessary to shape the mobility of the future. Unique in France, the university offers courses based on "learning by practice", to prepare future generations and reinforce the long-term employability of employees. Since 2021, more than 40,000 employees at Renault Group have already benefited from ReKnow University's programs. But they have also co-developed content with leading academic partners. They have opened courses outside of the company and have tested multiple formats: long, short, hybrid, practical. ReKnow University is developing its international programmes through local branches in Turkey, Spain, Argentina, Brazil and, in the medium term, Romania, India and Morocco.
2. The **Jaguar Land Rover Academy**[31] is a world-class learning and development hub established to support lifelong education and upskilling across Jaguar Land Rover (JLR) and its retailer network. Its mission is to provide inspiring, hands-on, and future-focused training opportunities that equip employees, apprentices, and early-career professionals with the skills needed for the rapidly evolving automotive sector.
3. In 2024, the **BMW Group**[32] invested over 400 million euros in training and development, with an effective and forward-looking training portfolio. The BMW Group offers a host of different entry options for young, talented people. The BMW Group currently has some 4,800 apprentices and student apprentices worldwide (3,681 of them in Germany) and offers approximately 30 apprenticeships and 20 student apprenticeships at its 20 sites in ten different countries across the globe (as at 31.12.2023). The BMW Group Academy offers a forward-looking further education portfolio for all employees and partners around the world. Courses primarily focus on qualifying individuals to work with the new battery and high-voltage systems of the Neue Klasse, furthering digital skills such as artificial intelligence (AI), and the New Retail sales system. From the summer of 2025, the BMW Group Talent Campus

[30] https://www.renaultgroup.com/en/careers/reknow-university/
[31] https://www.jlr.com/jaguar-land-rover-academy
[32] https://www.bmwgroup.com/en/news/general/2024/engine-for-change.html

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Munich – which is currently under construction to the north-east of the home plant – will be the main educational institution for the company's approx. 40,000 Munich-based employees

4. The **Volkswagen Group Academy**[33] offers numerous qualification opportunities for specialists and interdisciplinary topics, most of which can be followed from the comfort of a computer. In addition, they offer comprehensive learning opportunities through the Degreed platform. This platform supports employees in identifying skill gaps, planning development paths, and accessing tailored learning content to meet the demands of digital transformation, electrification, and evolving automotive technologies[34]. In 2024, the Volkswagen Group trained 17,201 apprentices in 30 professions and over 20 dual study programs[35].
5. **Mercedes-Benz Global Training**[36] is the training service provider for all retail staff who work for the Mercedes-Benz brand. It enables continuous professional and personal development in the workshop, when in contact with customers and at the management level.
6. **Mercedes-Benz Mobility**[37] offers dual study programs that combine academic education with practical work experience, which is ideal for secondary school students looking to enter the automotive financial services sector.

2.5.2 Regional Initiatives for Skills Development

Regional initiatives are crucial for addressing skills gaps and mismatches by aligning training and workforce development with local economic and industry demands. Programs like the

[33] https://www.volkswagen-karriere.de/en/working-at-volkswagen/Advanced-Training-Development-Paths-Career-Planning.html
[34] https://explore.degreed.com/our-platform/
[35] https://www.volkswagen-group.com/en/publications/presentations/esg-conference-people-sustainabilty-3035
[36] https://www.mercedes-benz.com/en/global-training/
[37] https://www.mercedes-benz-mobility.com/en/career/pupils/

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Pact for Skills[38] and the **Union of Skills**[39] are vital for bridging Europe's skills gap. They achieve this by promoting collaboration among various stakeholders, customizing training to local economic realities, and supporting workforce transitions in specific sectors. These efforts benefit from EU funding, data intelligence tools, and strategic partnerships, all of which enhance the quality, relevance, and accessibility of skills development across Europe.

While individual Member States are primarily responsible for education and training, the Union of Skills advocates for the active involvement of **local and regional authorities (LRAs)**. These authorities are key to designing and implementing tailored training programs that meet local economic and labour market needs, thereby ensuring a skilled workforce that aligns with regional industries. LRAs are instrumental in fostering regional partnerships under the Pact for Skills, leveraging their close understanding of local needs and industries. Effective partnerships between LRAs, businesses, educational institutions, and civil society organizations are essential for sharing knowledge and exchanging best practices[40].

2.5.3 Regional Skills Partnerships under the Pact for Skills

The European Commission actively supports the development of **Regional Skills Partnerships**[41] through the Pact for Skills. These partnerships unite diverse stakeholders to help working-age individuals in a given region acquire new skills or improve existing ones. This includes both localized skill partnerships and larger collaborations involving regions from multiple EU countries that share geographical or economic ties. Currently, **13 regional partnerships**[42] are active across Europe, facilitating cooperation among local industries, education providers, and authorities.

[38] https://pact-for-skills.ec.europa.eu/index_en
[39] https://commission.europa.eu/topics/eu-competitiveness/union-skills_en
[40] https://op.europa.eu/en/publication-detail/-/publication/5a39d834-70b0-11ef-a8ba-01aa75ed71a1/language-en
[41] https://pact-for-skills.ec.europa.eu/about/regional-skills-partnerships_en
[42] https://pact-for-skills.ec.europa.eu/about/regional-skills-partnerships_en

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For the automotive sector, there was launched in June 2025, the **Regional Skills Partnership for Automotive Regions' Twin Transition**[43]—led by the Automotive Skills Alliance—supports EU regions through the green and digital shift in the sector. It aligns training with policy, connects stakeholders, exchange on the best practices and execute a joint concrete activities.

Recent examples of these partnerships from other sectors include:

- The **Regional Skills Partnership for the EURADRIA region**[44], which focuses on agriculture, tourism, construction, and maritime industries across Italy's Friuli Venezia Giulia and Slovenia's Goriška, Obalno-kraška, and Notranjsko-kraška regions.
- The **Regional Skills Partnership for the Skåne region**[45] aims to develop and test training models for upskilling and reskilling, with a focus on building digital, green, innovative, and entrepreneurial skills within the creative industry.
- The **Regional Pact for Skills Partnerships for Lifelong Learning Mobility (EARLALL)**[46] seeks to increase mobility opportunities for students in Vocational Education and Training (VET), apprenticeships, adult education, and informal education, particularly for those with fewer opportunities.
- The **Regional Skills Partnership for the Iberian Peninsula**[47], which concentrates on the aerospace and defence sectors in Spain and Portugal.

2.5.4 Flagship Regional Projects for Workforce Upskilling

The impact of the twin transformation varies significantly across EU regions. In Romania's North-West and Centre regions, for instance, the digital and green transitions are accelerating

[43] https://pact-for-skills.ec.europa.eu/about/regional-skills-partnerships/regional-skills-partnership-automotive-regions-twin-transition_en
[44] https://pact-for-skills.ec.europa.eu/about/regional-skills-partnerships/regional-skills-partnerships-euradria-region_en
[45] https://pact-for-skills.ec.europa.eu/about/regional-skills-partnerships/regional-skills-partnerships-skane-regions-cultural-and-creative-sectors-and-industries_en
[46] https://pact-for-skills.ec.europa.eu/regional-skills-partnerships-lifelong-learning-mobility_en
[47] https://pact-for-skills.ec.europa.eu/about/regional-skills-partnerships/pact-skills-regional-skills-partnerships-upskilling-iberian-peninsulas-aerospace-and-defence-sector_en

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structural workforce changes. Despite the IT sector contributing around 14% to national GDP, only 27.7% of the population possesses basic digital skills (EU average: 55.6%), and just 9% have advanced skills (EU average: 27.3%)[48]. Roles most at risk include administrative, HR, and logistics staff within IT companies, where automation, AI, and CRM systems are replacing routine functions.

The ***FutureReady IT*** project (POEO 4.7), led by the **Transilvania IT Cluster**, addresses these challenges through 17 training programs targeting 602 employees from 54 IT companies. Based on the identification of over 5,700 skill gaps across 54 companies, the initiative aims to certify more than 90% of participants, with a focus on high-impact domains such as cybersecurity, AI, and automation. This initiative demonstrates how regional ecosystems can activate collaborative solutions, connecting companies, digital innovation hubs and training providers. This bottom-up, ecosystem-driven approach complements EU-level strategies and is especially relevant for the automotive value chain, where AI, automation and green transformation are rapidly reshaping workforce needs across all stages, from design and manufacturing to recycling and after-sales.

Two additional flagship projects highlight how corporate and territorial cooperation can generate tangible results:

- **TEDIHT, European Digital Innovation Hub**: it delivers digital maturity assessments and training plans for over 120 SMEs, focusing on AI, robotic process automation (RPA), and cloud adoption aligned with Industry 4.0.
- **AIRISE Ambassador Programme**: it supports manufacturing SMEs with AI readiness assessments and access to experimentation services, addressing both tech and skills barriers.

[48] https://digital-strategy.ec.europa.eu/en/factpages/romania-2024-digital-decade-country-report

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2.6. The Role of Social Partners

'Social partners' is a term generally used in Europe to refer to representatives of management and labour (employer organisations and trade unions), and in some contexts, public authorities, that engage in social dialogue. The term 'European social partners' specifically refers to those organisations at EU level which are engaged in European social dialogue, provided for under Articles 154 and 155 of the Treaty on the Functioning of the European Union (TFEU)[49]. The social partners play a key role in the governance of the employment relationship and are key actors in industrial relation systems. In most EU Member States, they shape working conditions and influence social policy, either through collective bargaining or tripartite social dialogue. They are interlocking parts in a multilevel system of governance that includes the European, national, sectoral, regional (provincial or local), company and establishment levels. Social dialogue relies thus on strong and representative national organisations to ensure its proper functioning. It is a fundamental pillar of the European Social model and is today a crucial component in dealing with the impact of the twin transition in the workplace.

At national level, industrial relations are characterised by many different models across Europe. In several of those, social dialogue and collective bargaining systems play a prominent role in determining working conditions and regulating the employment relationship. As a matter of fact, recognised mandated and autonomous social partners play a critical role in shaping the world of work in the frame of collective bargaining at the appropriate level, be it company, regional, national. By doing so collective agreements remain one of the best tools to deal with the challenges and rapid transformation that the world of work is undergoing due to multiple structural factors such as the twin transition, skills and labour shortages, etc. These agreements provide a framework for addressing labour market challenges and adapting employment conditions to the evolving needs of the world of work (connected to the twin transitions and others). The flexibility of collective bargaining in comparison to

[49] https://eur-lex.europa.eu/eli/treaty/tfeu_2016/art_154/oj/eng https://eur-lex.europa.eu/eli/treaty/tfeu_2016/art_155/oj/eng

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legislation leaves a larger room for manoeuvre for social partners at the appropriate level to negotiate customised agreements that provide with flexible solutions to a rapidly changing world of work. This is the case of the automotive-mobility ecosystem, where sectoral social partners play a significant role in shaping working conditions and wage setting in the MET sector through established collective bargaining systems in many Member States.

Beyond collective bargaining agreements, social partners at the appropriate level (company, regional, sectoral) continue to be better placed to understand the challenges that companies and workers go through and thus to find the most suitable and efficient tailor-made solutions that take into account the specificities of their companies and of their workers in a certain sector and that do not need to be part of collective bargaining agreements.

At the EU level, and in view of the privileged role that the TFEU gives the social partners, EU policy makers should consistently ensure that social partners are consulted within the appropriate time frame on all employment-related topics as well as on those initiatives that have an impact on the labour market.

2.7. Change in Customers Experience and Needs

An additional challenge for the automotive industry lies in the evolving needs and behaviours of customers, where a **seamless digital experience has become a non-negotiable feature**. A recent survey by McKinsey reveals that 59% of electric vehicle (EV) buyers and 48% of traditional car buyers expect to increase their use of in-car connectivity solutions in the future[50]. Moreover, over half of both EV and traditional car buyers expect automatic smartphone integration to be included in their vehicles—either free of charge or as an optional upgrade. Premium car buyers, in particular, are demanding a more intuitive and personalized user experience, including seamless interaction with their vehicles. To meet these shifting expectations, established manufacturers must accelerate innovation—either

[50] https://executivedigest.sapo.pt/wp-content/uploads/2024/06/Mobility-Consumer-Pulse-2024_Overview.pdf

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by developing in-house technologies such as voice and gesture recognition or by integrating advanced features from third-party providers[51].

The tyre industry illustrates how digital transformation is reshaping traditional sectors. The emergence of "**Tyres as a Service**" leverages data from connected vehicles to offer telematics-based solutions. Today, advanced algorithms analyse vehicle data to deliver alerts and guidance for repair, maintenance, diagnostics, prognostics, and even the wholesale or retail of spare parts.

Younger generations also have different attitudes toward mobility. There is a marked shift away from car ownership towards **mobility-as-a-service (MaaS) and leasing models** that allow better control over monthly mobility expenditures. Currently, private buyers account for 42% of all new vehicle registrations in the EU—a figure that is expected to decline. Millennials and Gen Z, projected to represent 75% of all new vehicle acquisitions by 2026, place less importance on ownership than previous generations. This trend underscores the need for the automotive industry to rethink how mobility is offered and consumed.

To remain competitive, the sector must prioritize the development of new digital services and solutions that align with consumers' increasing demand for connectivity and personalization. Ensuring seamless, free, and real-time access to vehicle data is fundamental for enabling these innovations. At the same time, such access must be carefully regulated to address cybersecurity and privacy concerns, which are becoming increasingly critical in a data-driven mobility ecosystem.

2.8. Insights from Experts Consultations

As done previously in the present study, **workshops with industry experts** were carried out to **cross-check and enrich the desk research findings** also related the **impact of the**

[51] https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/european-automotive-industry-what-it-takes-to-regain-competitiveness#/

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automotive transformation on skills and job roles. It also helped identify **key strategic levers** to address the sector's **evolving needs** and **challenges in workforce development**.

The key findings from the first of three workshops held in Cinisello Balsamo, UCIMU association, Milano, Italy, on June 25th, 2025 (further details about the workshop are in the annex section) are summarized below:

- Soft skills and the ability to read consumer trends have become equally important as technical skills. Emotional intelligence, adaptability, and market insight are now essential competencies for automotive professionals. The ability to understand and anticipate changing customer preferences drives product development and innovation.
- Opinions regarding the importance of providing current, objective information about socio-political disruptions affecting the automotive industry were relatively balanced among respondents. This even distribution of views potentially indicates a prevailing skepticism about the relevance of such knowledge for both students and workers undergoing upskilling or reskilling programs. The survey results suggest that many stakeholders question whether understanding broader socio-political contexts and their impact on the automotive sector is truly necessary for workforce development. This perspective raises important questions about the scope of automotive education and training programs, and whether they should include awareness of external factors that could influence industry dynamics. Regarding potential actions at regional, national, or European Union levels, participants failed to reach a unified agreement on specific measures: while there was widespread acknowledgment that intervention is necessary, the exact nature and scope of these interventions remained a point of contention. The only clear consensus emerged around the urgent need for some form of action to address the situation.
- Participants agreed that challenges related to AI, work-based learning, cross-EU job dynamics, cross-disciplinary skills, and soft skills should be treated as immediate priorities. This positioning reflects both their substantial potential impact on organizational outcomes and the considerable resources required for successful

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implementation. This deliberate placement emphasizes that while these challenges present significant opportunities for transformation and improvement, they simultaneously demand extensive planning, resource allocation, and sustained effort to effectively overcome and realize their full benefits.

- There is a growing consensus among educators, industry experts, and policymakers of the audience regarding the integration of diverse educational subjects into student curricula. This widespread agreement emphasizes that even in highly specialized technical fields and professional roles, a comprehensive and well-rounded educational approach is essential. Such a holistic methodology must be implemented both in teaching strategies and learning processes, ensuring students develop not just technical expertise but also adaptability. This balanced approach prepares individuals to tackle complex challenges and succeed in an increasingly interconnected professional landscape.
- There is a notably diverse range of perspectives regarding cross-sector collaboration effectiveness. The distribution of responses spans broadly across the entire spectrum, indicating significant variability in how different stakeholders perceive the cooperation between industries, academic institutions, and government policymakers. This variation is particularly pronounced when examining different geographical regions, with some areas reporting strong collaborative frameworks while others indicate substantial room for improvement in fostering meaningful partnerships across these sectors.
- There was broad agreement among participant stakeholders regarding the critical importance of strengthening partnerships between academic institutions and businesses in emerging technological domains. Specifically, there was a strong focus on enhancing collaborative efforts in artificial intelligence (AI) and machine learning (ML) applications. This cooperation was seen as essential for developing cutting-edge solutions and preparing the workforce for future technological challenges.
- There was strong consensus among industry leaders and educational institutions experts participating to the workshop regarding the importance of incorporating data

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analytics and customer experience (CX) expertise into automotive education curricula. This integration aims to enhance students' and workers' comprehension of crucial business and economic concepts. By embedding these modern skillsets into teaching programs, future automotive professionals will be better equipped to understand market dynamics, consumer behavior patterns, and make data-informed decisions that drive business success in the evolving automotive sector.

- The participants emphasized the critical importance of integrating ethical and social considerations into curriculum development. They recognized that incorporating these elements would help create more well-rounded educational programs that better prepare students and workers for real-world challenges and responsibilities.

The key messages from the second workshop organized online within the framework of the ASA regional implementation working group, on July 7th, 2025 (further details about the workshop are in the annex section) are summarized below:

- Flexibility and adaptability were highlighted as the most significant skill dimensions, standing out compared to purely technical competencies. These qualities emerged as crucial attributes, underscoring the importance of being able to navigate changing market conditions and evolving data landscapes in today's dynamic professional environment.
- The general perception among the audience suggests that governing bodies across regional, national, and European Union levels are not doing enough to enhance geopolitical awareness among technical students and working professionals. There appears to be a significant gap in educational initiatives and resources dedicated to helping these groups understand complex global political dynamics. Stakeholders believe that authorities should implement more comprehensive programs and accessible learning tools to improve geopolitical literacy in vocational and professional settings.
- The most urgent challenges for preparing the future workforce and strengthening its capabilities include the development of comprehensive work-based learning programs, the facilitation of cross-border job mobility within the European Union, the

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cultivation of expertise in emerging technologies such as artificial intelligence, and the enhancement of soft skills and cross-disciplinary competencies. These areas require substantial investment, strategic planning, and sustained effort, yet they also hold the potential to deliver significant positive outcomes and transformative impacts on the workforce landscape. Their dual nature—high effort requirements combined with high impact potential—underscores the critical importance of addressing them promptly to ensure a well-prepared, adaptable, and skilled workforce capable of meeting the demands of the future European labor market.

- There was overwhelming agreement among experts regarding the critical importance of providing comprehensive education across multiple disciplines. The focus areas urban planning, data analytics, and transport engineering - all of which are becoming increasingly relevant due to the rapid expansion of smart mobility solutions and growing demands on urban transportation networks - ask for an interdisciplinary approach, seen as essential to develop professionals who can effectively address the complex challenges of modern urban mobility systems.
- Stakeholders' perspectives on the existence of a feedback loop between industries, educational institutions, and policymakers revealed a highly diverse range of opinions, ranging from strong disagreement to complete agreement. This broad distribution of responses reflects the complexity and variety of perspectives across the different EU nations involved in the discussion. The fragmented nature of the feedback underscores the significant differences in viewpoints and approaches among the representatives of the participating countries.
- The stakeholders reached a significant consensus that the automotive industry's transition to electric vehicles (EVs) requires a comprehensive transformation of automotive engineering education. This includes modernizing existing curricula to incorporate EV-specific content and enhancing educators' skills to effectively deliver this new material. Through the response to this slide the participants emphasized the need for updated teaching methodologies and learning approaches to prepare students for the evolving EV landscape.

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- Association and institutional experts unanimously agree that the development of future Autonomous Vehicle technologies heavily depends on advanced capabilities in AI, ML, and robust cybersecurity measures. This technological evolution necessitates stronger partnerships between academic institutions and technology companies to foster innovation, share expertise, and create a skilled workforce capable of addressing these complex technical challenges in the autonomous transportation sector.
- There was a unanimous consensus on integrating circular economy principles and sustainable manufacturing practices into automotive engineering education. This integration aims to cultivate environmental consciousness in future engineers, ensuring they understand the importance of resource efficiency, waste reduction, and eco-friendly production methods. Such education will prepare them to develop sustainable solutions for the automotive industry's environmental challenges.
- A significant majority of participants reached a consensus that emerging mobility business models heavily depend on data analytics and deep understanding of customer preferences. This realization should lead educational institutions to incorporate essential business and economics courses into their automotive engineering curricula, ensuring graduates possess both technical expertise and commercial acumen needed in today's automotive sector.
- There was widespread consensus among participants that automotive education curricula must integrate ethical considerations and social science perspectives. This interdisciplinary approach, incorporating insights from ethicists and social scientists during curriculum design, was deemed essential to prepare students for addressing complex societal implications of automotive technologies. It would require an update of teachers' capabilities and know how as well.

The key findings from the third of three workshops held Reggio Emilia, CIS – Unindustria Reggio Emilia, Emilia Romagna Region, Italy on September 9th, 2025 (further details about the workshop are in the annex section) are summarized below:

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- In this workshop, similarly to the other workshops already carried out, participants were asked to identify key future skills and competencies required in their sector. The overwhelming response highlighted flexibility as the most crucial attribute, closely followed by interdisciplinarity in job roles, security concerns in both cybersecurity and vehicle safety, and data analysis capabilities to handle the increasing digitalization of vehicles and manufacturing processes.
- Opinions regarding the importance of providing current, objective information about socio-political disruptions affecting the automotive industry were deemed by respondents to be quite important. This distribution of views indicates a prevailing positive approach towards the relevance of such knowledge for both students and workers undergoing upskilling or reskilling programs. The survey results suggest that many stakeholders agree that understanding broader socio-political contexts and their impact on the automotive sector is truly necessary for workforce development. This perspective raises important questions about the scope of automotive education and training programs, and whether they should include awareness of external factors that could influence industry dynamic.
- During the workshop, participants were tasked with allocating 100 points across key phases the automotive industrial process was divided in (for further details see annex I) to identify areas requiring skill enhancement. The results highlighted several key areas needing significant attention. “Strategy, Marketing & Sales” emerged as a critical focus, alongside “Design & Engineering” department, which demonstrated substantial skill development needs. Following closely behind were Procurement operations, while “Production & Assembly” also showed notable requirements for updated competencies and new capabilities.
- Respondents, who were asked to identify which challenges require immediate action, considered all the five key areas presented (work-based learning, artificial intelligence, micro-credentials, cross-disciplinary skills, and soft skills) as highly significant, as they are expected to strongly influence business outcomes while also demanding substantial effort and investment for effective implementation. This indicates that

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they represent not only urgent priorities but also major opportunities for transformation, provided that organizations commit the necessary planning, resources, and long-term dedication to address them effectively.

- The broad agreement among education professionals, industry leaders, and government officials about incorporating multiple academic disciplines into educational programs reflects a key transformation in contemporary learning theory. This shared perspective highlights that across specialized technical domains and career paths, a broad-based and balanced educational foundation remains crucial. This comprehensive framework must be reflected in both instructional methods and educational experiences, helping students gain not only technical knowledge but also versatility. This integrated approach equips learners to address multifaceted problems and thrive in today's connected professional environment.
- According to workshop attendees, the collaboration between industrial sectors, academic institutions, and government policymakers remains notably weak. They emphasized the urgent necessity for implementing more robust initiatives to strengthen these crucial partnerships and foster meaningful cooperation between these key stakeholders.
- Question was if the automotive industry's transition to electric vehicles demands a comprehensive transformation of educational programs and instructional approaches in automotive training: notwithstanding the fact that the area from which all respondents were coming (Emilia) is the historical seat of powerful cars and engines like Ferrari or Lamborghini, the rapid advancement of electric vehicle technology and its growing market led the participants to prioritize updating of teaching materials and methods to adequately prepare students for this electric future.
- Stakeholders participating in the discussion reached consensus on the vital need to build stronger connections between universities and industry partners in new technology sectors. The emphasis centered particularly on fostering joint initiatives in AI and ML implementations. Such strategic alliances were deemed crucial for

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innovating breakthrough solutions and equipping workers with skills for upcoming tech-driven demands.

- Workshop participants from both industry and educational institutions acknowledged the need to integrate data analytics and customer experience (CX) knowledge into automotive education programs, as it was also evident in the world cloud exercise. This curriculum enhancement would focus on strengthening learners' and employees' understanding of key business and economic principles. Integrating these contemporary capabilities into educational frameworks will prepare future automotive professionals to better grasp market forces, consumer trends, and leverage data-driven insights for achieving business objectives in the transforming automotive industry.
- The participants agreed upon the critical importance of integrating ethical and social considerations into curriculum development. They recognized that incorporating these elements would help create more well-rounded educational programs that better prepare students and workers for real-world challenges and responsibilities, keeping in due account all the relevant hurdles in re-organizing the curricula and preparing the teachers.

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3. Recommendations and Future Priorities

This section provides recommendations and future priorities.

3.1. Conclusions

The findings of this report demonstrate that the European automotive and mobility ecosystem is undergoing one of the most profound transformations in its history. Driven by decarbonization imperatives, rapid digitalization, and geopolitical uncertainty, the sector faces structural, technological, and social challenges that will redefine competitiveness and workforce dynamics in the coming decade.

Three overarching conclusions emerge from the combined desk research and stakeholder workshops:

- **A sector under pressure but with resilience potential**. The convergence of regulatory requirements, supply chain fragility, and global competition highlights the urgent need for coordinated action at EU and national levels. While Europe risks losing ground to other global players, its strong industrial base, innovation capacity, and regional ecosystems provide a foundation for renewed competitiveness, provided that policy, industry, and education systems act in alignment.
- **Skills as the decisive lever of transformation**. The transition towards electrification, digitalization, and circular economy models is reshaping job profiles at all levels, revealing a dual priority: the urgent development of new technical and digital competences, and the reinforcement of transversal, soft, and innovation-oriented skills. Without massive investment in upskilling, reskilling, and inclusion, labor market mismatches will deepen, with negative impacts on both productivity and social cohesion.
- **Collaboration as a prerequisite for impact**. The study results underline that no single actor can address these challenges alone. Effective cooperation between industry, educational institutions, policymakers, and social partners is essential to ensure that

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competence frameworks are translated into real, future-proof training offers and employment opportunities. The emergence of regional or national initiatives, corporate programs, and EU-wide strategies demonstrates that multi-level governance can deliver tangible solutions if supported by consistent and systematic implementation and monitoring.

In conclusion, knowledge and skills are becoming the new infrastructure for the automotive-mobility ecosystem. The capacity to anticipate skill needs, adapt training systems, and integrate technological and sustainability imperatives will determine whether Europe maintains its global leadership or falls behind in the race for sustainable and digital mobility. This study provides an essential first building block for this process, but its success ultimately depends on the collective ability of stakeholders to translate intelligence into coordinated actions, ensuring that Europe's automotive-mobility ecosystem remains innovative, competitive, and prepared to lead the global transition.

3.2. Future Actions of the TRIREME Project

The overall objective is to continuously provide an updated picture of the automotive ecosystem as a basis for the other TRIREME WP development and improvement. In the process of developing new occupational profiles, the **competence matrix** developed by **WP3** has used and will continue using WP2 inputs for its continuous improvement. The competence matrix is a strategic and analytical cornerstone. It enables the systematic identification, categorization, and mapping of relevant competences, either by aligning them with the European Skills, Competences, Qualifications and Occupations (ESCO) classification or flagging them as emerging, non-standard skills. Competences are further grouped into six clearly defined thematic areas: green, digital, transversal, sector-specific, soft, and other. This structure facilitates targeted gap analyses and informs the identification of training needs, which, in turn, serve as a basis for the definition and refinement of new job roles aligned with evolving industry and technological landscapes.

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To date, research conducted under the TRIREME project has identified more than 200 individual skills relevant to the automotive and mobility sectors, alongside 180 distinct job roles, each characterized by unique competence requirements. A detailed mapping exercise has established clear linkages between these skills and key industrial megatrends, underscoring strategic priorities within the sector. The most frequently associated trends include Connected Vehicles (46 skills), Industry 4.0/5.0 (42 skills), and Corporate Sustainability Goals (41 skills). Additional high-frequency mappings are observed for trends such as AI and Machine Learning, Electromobility, and Digital Twins and Simulation—highlighting the dual emphasis on technological innovation and sustainability. These findings reflect the increasing demand for a digitally literate and environmentally conscious workforce.

Furthermore, a cross-role frequency analysis reveals that a select subset of competences is consistently required across numerous job profiles—appearing in up to 39 roles, suggesting their status as core, high-priority capabilities. These competences predominantly reflect digital, analytical, and transversal domains. The 180 job roles have been clustered into functional families such as Production Maintenance, Logistics, Quality, Purchasing, Human Resources, and Finance, with Production Maintenance showing the highest concentration (18 roles). Notably, certain roles—including Electronics Technicians and Maintenance Technicians—span multiple departments, indicating their cross-functional relevance and alignment with transversal industry needs. The mapping between frequently required skills and industrial trends reveals that these cross-functional roles are often directly tied to strategic domains such as Industry 4.0, AI, and Connected Mobility. This evidences a strong interplay between occupational evolution and the adoption of transformative technologies, reinforcing the value of the competence matrix as both a diagnostic and forward-planning tool for future workforce development.

According to the present study conducted by WP2, future developments aimed at enhancing the competence matrix and refining the subdivision of job role families could benefit from the following considerations:

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- The current level of granularity in family identification could be streamlined, as reducing excessive fragmentation may improve usability and support implementation, particularly for SMEs with more limited resources.
- Simplifying the framework and clearly communicating its methodology would help make it more accessible and practical for organizations of varying sizes and structures.
- The 'Maintainers' family may warrant particular attention in terms of new skills, given the transition from ICE to EV maintenance and the potential introduction of alternative energy sources such as hydrogen.
- Priority should be given to families linked to emerging technologies—such as AI, ML, and cybersecurity—as well as sustainability and recycling (with a focus on EV batteries), as these areas are expected to have the greatest demand for new personnel.
- HR functions could be further supported in designing flexible, forward-looking training and recruitment strategies, enabling organizations to address evolving skill requirements across different families.

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ANNEX I – Workshops methodology

As part of deliverable 2.2 “Sectoral Skills Intelligence - Release I”, Work Package 2 was expected to conduct three expert workshops. Such workshops aimed at getting insights, new information and prioritization of information from respondents (stakeholders and public) on the main objectives of WP2, working specifically on selected topics and issues within the sectoral needs or offer – skills needs, job roles needs or offered intelligence, issues and gaps within the automotive-mobility ecosystem.

The audience of such workshops includes stakeholders from across the automotive-mobility sector, and in this iteration it mainly consisted of:

- Companies at national and EU level, including SMEs
- VET providers
- Sectoral/industrial Associations
- Regional clusters
- Industrial representatives

The workshop discussion focused on 4 key content areas:

1) Sector Transformative Challenges

- Objective: update the vision on future scenarios and identify resilience and development priorities for the European Automotive and e-mobility system
- Point of discussion: share insights on rapidly evolving sector scenarios, prioritize development pathways to support and innovate the sector (accelerated, gradual, or fragmented transition).

2) Ecosystem Skills Mapping for Automotive and Electric Mobility

- Objective: validate the TRIREME competence matrix (developed under WP3) through stakeholder feedback.

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- Point of discussion: validate TRIREME professional families and main job roles (identify similarities, redundancies, obsolete positions), integrate emerging profiles that may be missing from the current matrix.
- Reference: TRIREME competence matrix draft validation (D3.2).

3) Strategic Competence Development

- Objective: validate TRIREME professional families, job roles and process phases, incorporating best practice training approaches.
- Point of discussion: identify critical skills need across the Automotive value chain, map the use of skill intelligence systems and data-driven assessment methods, evaluate effectiveness of current training/education programs, explore innovative methodologies (dual systems, WBL, flipped classroom, immersive learning, VR, AI, microlearning, micro-certification, IA applied to skills intelligence…).
- Reference: Highlights from D3.2, potential integration with main stages of automotive industrial operational processes.

4) Action Planning & Recommendations

- Objective: prioritize challenges requiring immediate action and clarify stakeholder roles, collect actionable recommendations to enhance the Automotive training ecosystem's capacity to address business challenges.
- Point of discussion: conduct prioritization exercises for urgent challenges, define specific responsibilities for industry, education, and policy actors, formulate evidence-based policy suggestions.

All workshops followed a unified and agreed-upon methodology for collecting inputs and feedback from participants. Under the overall coordination of the WP2 Coordinator (SPIN360), the Task Leader (SFC Sistemi Formativi Confindustria) moderated the sessions by

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applying the following approach[52]. The methodology was structured as a multi-stage insight-gathering process, beginning with preliminary presentations on the TRIREME Project—its main purposes and objectives—delivered by representatives of SPIN360 and SFC, and followed by:

- **DIGITAL POLLING PHASE**. "Sentiment mapping" across key topic areas. This phase made use of Mentimeter to present predefined Likert scale statements, provoke immediate reaction through an anonymous platform for initial feedback. Each area could be investigated through at least 5 statements.
- **STRUCTURED DIALOGUE SESSIONS**. Depending upon participants background and time constraints a dedicated dialogue session was arranged to conduct focused discussion rounds using pre-determined investigative questions on the four primary thematic areas.
- **WRAP-UP & CONSOLIDATION**: to summarize the discussion, it was important to end the session listing the priorities that emerged from the discussion and highlighting convergent and divergent perspectives.
- **DATA REPORTING,** which consisted in filling this report.

To identify and consolidate previews results of the project, the job profiles for the main stages of automotive industrial operational process were discussed: this was done by means of a survey through Mentimeter to ascertain which job & skills profiles of the competence matrix are associated with the main phases of the operational process of the automotive industry, in order to check if all have been covered and there are no unnecessary major overlaps.

To maximize practical impact of our research for key stakeholders in industries and educational institutions, who are the main end users of our research, we suggested to identify automotive-specific operations and manufacturing processes. This approach allowed us to deliver more specialized and actionable insights for the automotive sector. We deliberately excluded from the subdivision into phases all general business functions that are common

[52] Note: questionnaires questions and data collection methods were in some cases modified based on participant profiles and background aiming at obtaining a thorough and comprehensive yet concise feedback output

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across all industry verticals, including financial operations, human resources management (with the exception of recruitment), administrative tasks, facility and building management, and other similar support functions. By this focus on automotive-specific processes, we can ensure our research outputs provide concrete value and directly applicable solutions to our primary end users in the automotive industry and related educational programs.

The complex, multi-stage automotive industrial process, for the sake of simplicity, was broken down into key phases (one of many possible summaries of the operational phases):

- **Design and Engineering:**
    - Designing of vehicle's specifications and components, including its aesthetics, performance and safety features
- **Raw Material and Parts Acquisition:**
    - Sourcing and procuring raw materials like steel, aluminum, plastics, rubber; selecting and procuring suppliers' produced individual components, such as transmissions, chassis parts, electronics and interior elements
- **Logistics & Transportation:**
    - Managing flow of materials and components from suppliers to automotive assembly plant as well as movements inside the plant/s and logistics related to final delivery
- **Production & Assembly:**
    - Manufactured parts systematically combined to construct complete vehicles, ensuring all components fit and function correctly
- **Quality Control and Testing:**
    - Testing conducted to ensure vehicles meet safety standards and perform as expected
- **Strategy, Marketing & Sales**

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- Trends, Data & Competitor analyses, customer interfaces, business models development, pricing

- **Distribution, Retail, and Aftermarket Services:**
  - Vehicles distributed to dealerships and retailers, making them accessible to consumers, including management of spare parts et sim

Such subdivision into phases supported the validation of previous substantial work of the TRIREME project and allowed to organize the planned activities focusing on automotive industry scenarios considering today's volatile market conditions and requirements for novel job profiles.

A dedicated slide in the Mentimeter presentation was specifically designed to gather insights from the audience regarding the essential skills and competences that will be crucial for the automotive industry's future. This interactive element utilized a word cloud visualization technique, allowing participants to contribute their thoughts and perspectives in real-time. The collective responses formed a dynamic visual representation, highlighting the most frequently mentioned skills and competences that industry professionals believe will shape the automotive sector.

With the Mentimeter charts, participants were asked to review and provide their general agreement to the previously outlined 7-step framework. This task involved a detailed discussion on how to effectively categorize and distribute various families within these established steps. This collaborative exercise served multiple purposes, since it enabled the team to identify any potential duplications, spot possible errors, locate gaps in the framework, and address similar concerns that might affect the implementation.

Interestingly, the exercise yielded diverse results, which were largely influenced by two key factors. First, the varying levels of familiarity that attendees had with the comprehensive scope of the Trireme project played a significant role in their interpretations. Second, their individual understanding of how specific families were categorized and how different job roles were defined within the project framework also impacted their responses. These

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variations in knowledge and understanding highlighted the importance of ensuring consistent project comprehension across all team members for more standardized outcomes.

Discussion on transition to scenarios was facilitated through an interactive Mentimeter bar chart visualization, where participants were invited to engage in real-time. During the session the audience was presented with 5 distinct potential trends in the automotive sector and asked to select which one they believed would emerge as the dominant scenario. This interactive element was specifically designed to address the mounting challenges and uncertainties that industries, particularly the automotive sector, are currently navigating. The focus was especially on recent global disruptions affecting international trade relationships and supply chain stability, which have created unprecedented challenges. These unpredictable market dynamics are forcing automotive manufacturers and suppliers to reassess their strategic planning and operational models to ensure resilience and adaptability.

To evaluate the perspectives and stances of different stakeholders regarding the issue dealt with by the TRIREME project, multiple Mentimeter charts were utilized as analytical tools. These interactive visualizations helped capture and assess various stakeholder opinions, beliefs, and positions regarding key statements and challenges. The comprehensive data gathered through these charts provided valuable insights into stakeholder alignment and areas of divergence. This systematic approach enabled a clear understanding of stakeholder dynamics within the project framework.

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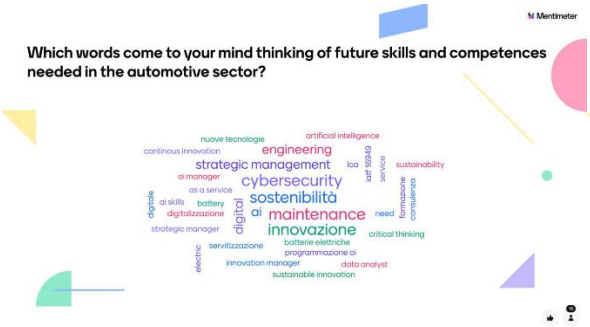
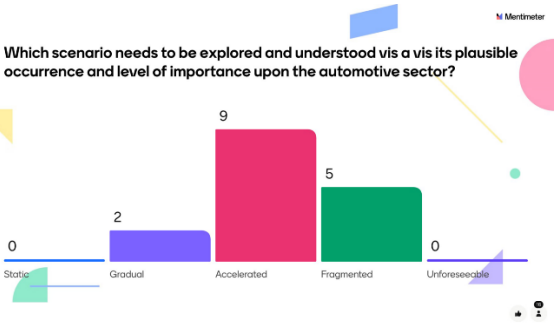
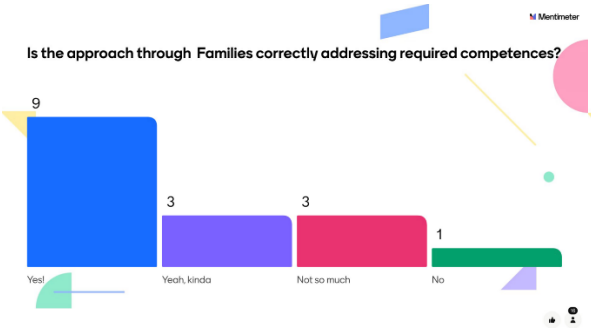
ANNEX II – 1st Workshop

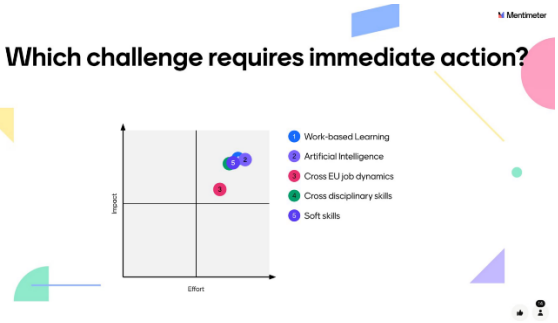
The first workshop was specifically organized in Milan, Cinisello Balsamo, Italy, on June 25th, 2025, within the facilities of the UCIMU association. UCIMU-SISTEMI PER PRODURRE is the Italian machine tool, robots, automation systems and ancillary products - NC, tools, components, accessories - manufacturers' association. UCIMU has today over two hundred associate member companies, which account for over 70% of the Made in Italy. The workshop, held in Italian, was in presence for the majority of attendees and on-line for those who could not attend personally.

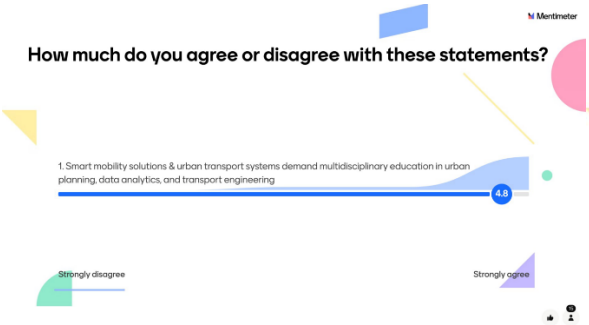
The detailed findings from the digital polling phase from this workshop are showed below:

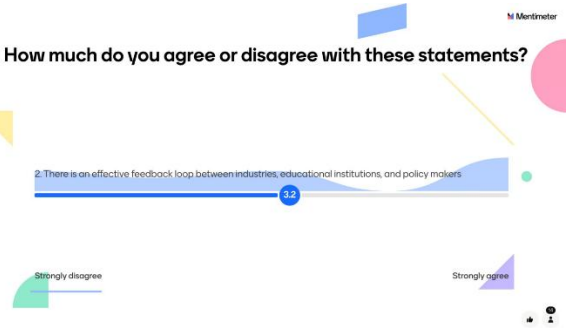












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Below are the list of participants and some pictures from the workshop:

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LIST OF PARTICIPANTS

ORGANIZATION	
FESTO Group	ECOLE – Enti Confindustriali Lombardi per l'Education
Foundation ITS Mechatronic of Lazio region	A.F.G.P. Associazione Formazione Giovanni Piamarta
INOCRE Europe srl	Sustainability advisor
ICIM Group srl	ACM Europe srl

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ANNEX III – 2nd Workshop

The ASA regional implementation working group run together with WRS/Stuttgart Region and ASA held its regular meeting to strengthen the collaboration between the European automotive regions, give them a platform to exchange information about past and ongoing activities (e.g., TRIREME project status and updates, ASA meeting in Strasbourg, the publishing of the regional pact for skills and the involvement of ASA in the European Week of Regions and Cities). The ASA working group meeting kindly hosted the 2nd Workshop on July 7th, 2025, on-line.

Such cooperation strengthened the close connection between the ASA WGs and TRIREME to guarantee the up-to-date information of the European regions about the TRIREME projects and roll-out the activities at regional level.

The methodology followed was similar to the previous workshop, with the only difference that since most of the participants was not fully aware of the scope and status of the TRIREME project, a brief introduction to it was done by Jakub Stolfa, president of ASA partnership, followed by some more details given by Leonardo Quattrocchi, from SFC. This workshop was conducted entirely in a virtual environment, bringing together diverse participants from various organizations and institutions across Europe. English was the language used.

To accommodate the varied expertise levels and professional backgrounds of the participants, the Mentimeter survey questions underwent slight modifications. These adjustments were carefully made to ensure the questions remained accessible and relevant to the audience's knowledge base while still gathering meaningful feedback about the project's core aspects.

The detailed findings from the digital polling phase from this workshop are showed below:

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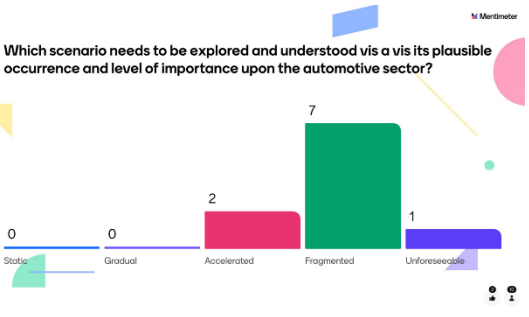

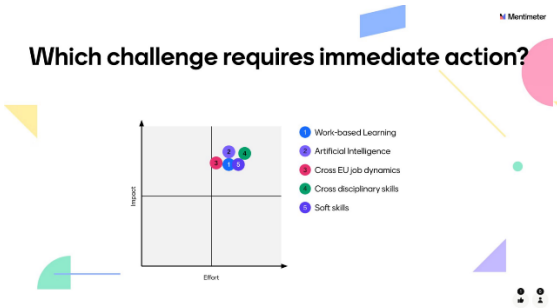

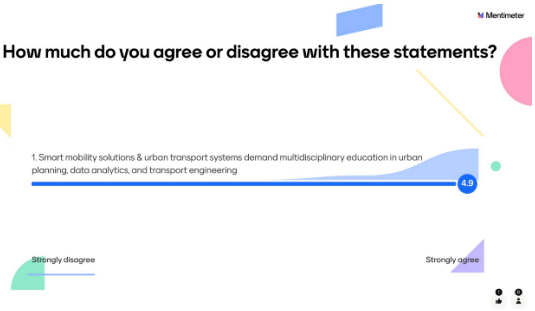

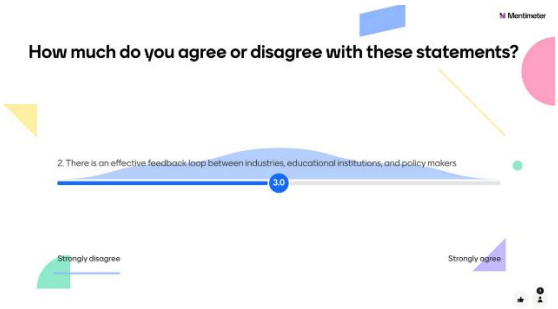

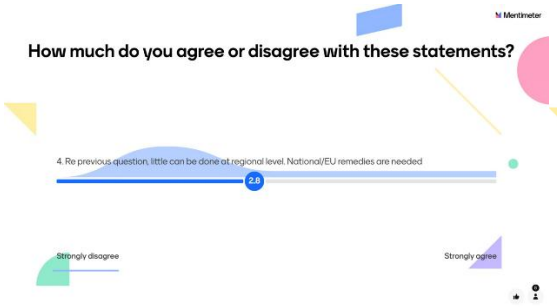

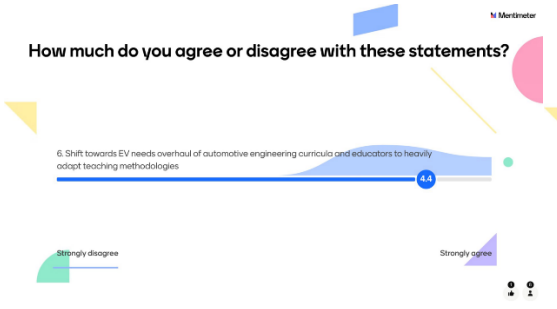

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Below are the list of participants and some pictures from the online workshop:

LIST OF PARTICIPANTS

ORGANIZATION	
WRS REGION	SPIN 360
LOMBARDIA REGION	TRNAVA REGION
ASA	CATALONIA REGION
GRAND EST REGION	

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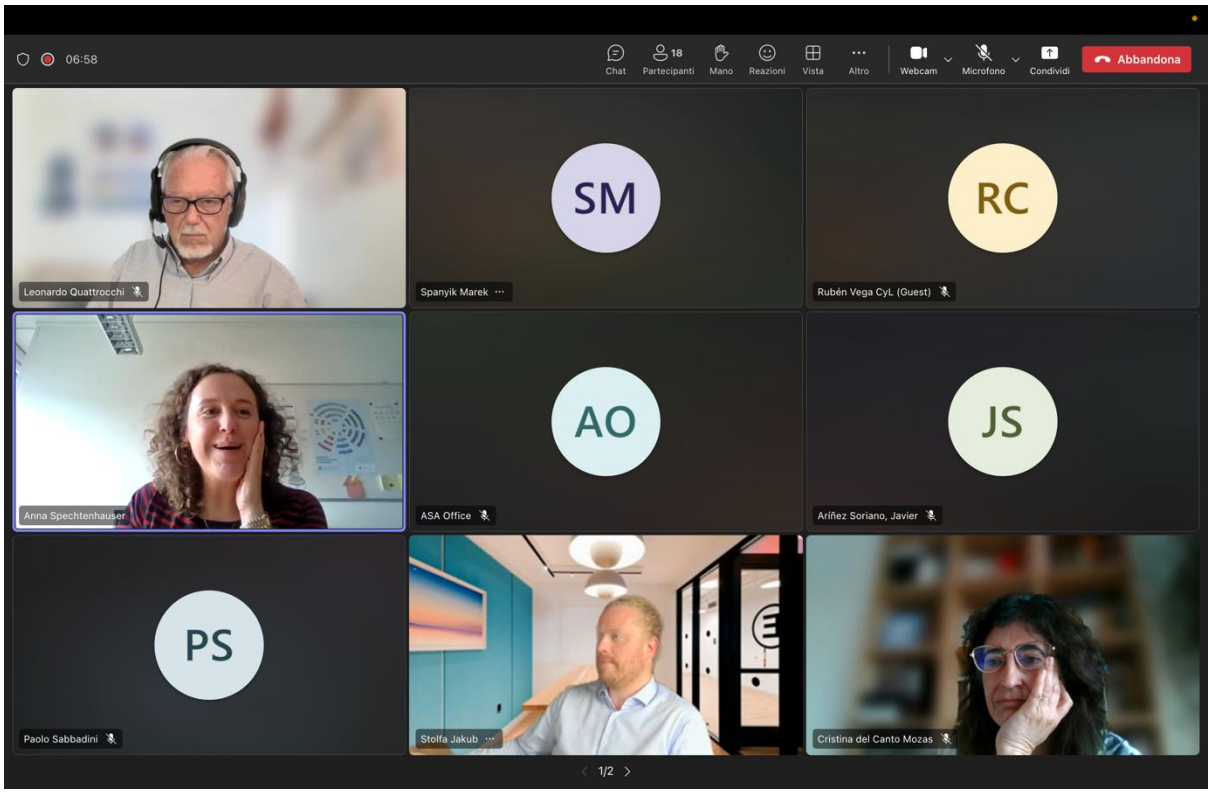

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ANNEX IV – 3rd Workshop

The Motorvalley cluster workshop, held on 9 September 2025 in Reggio Emilia, saw the participation of one of Europe's most significant automotive ecosystems as part of the TRIREME project. Entitled “The future of mobility: transformative challenges and strategic skills in the European automotive sector”, this workshop brought together industry leaders and training professionals to analyze the evolution of the European automotive sector.

The choice of Reggio Emilia was by no means random, as this region represents a unique ecosystem that brings together prestigious brands (Ferrari, Maserati, Lamborghini, Ducati, Pagani and Dallara, etc.), specialized suppliers, research centers and advanced services. The presence of innovative technology companies, manufacturing tradition and cutting-edge businesses created the ideal conditions for understanding the dynamics of transformation in the sector.

The workshop adopted an interactive approach aimed at gathering insights in real time and stimulating collaborative discussion. After the institutional greeting by Francesca Sorbi, General Manager of CIS Reggio Emilia, the proceedings continued with Eleonora Trento, Political Adviser for Transport and Mobility at the Confindustria Delegation in Brussels. Together, participants explored the scenario outlined in the Industrial Action Plan for the European automotive sector published in March 2025. Following the presentation of emerging scenarios in the EU automotive sector by SPIN 360, SFC led participants through an intensive session focusing on the skills dimension and role changes accompanying the transformation of the sector.

Consistent with the overall methodology of the TRIREME project, the interactive session explored issues that are critical to the future of automotive professionals, including evolving scenarios in which the TRIREME survey results describe sector trends for the period 2030-2050 in terms of relevance, urgency and implications for skills and employment forecasts. New professional roles were analyzed, examining emerging job categories in the sector as the industry embraces electrification, autonomous driving, connected services and circular economy principles, giving rise to new roles while transforming traditional positions.

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The methodology followed was similar to that of previous workshops, but with a particular focus on the context of Italy's Motor Valley and the specific needs of companies in the cluster. Given the concentration of automotive excellence and innovation in the region, the feedback focused on aspects of digital and green transformation in mobility production. The workshop was conducted entirely in Italian to ensure full understanding by all Italian participants, while the Mentimeter slides were kept in English to allow for immediate comparison with the results of other workshops in Europe. The online format of this workshop found Mentimeter to be a smart and quick tool for exchanging valuable insights for the professions of the future in the sector.

The detailed findings from the digital polling phase from this workshop are showed below:

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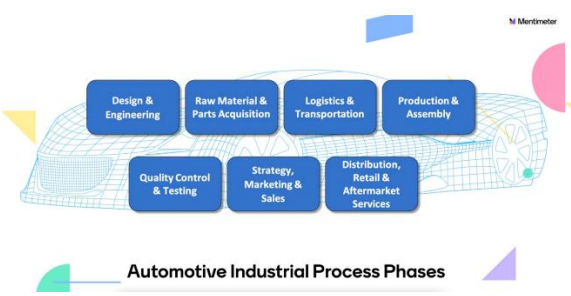

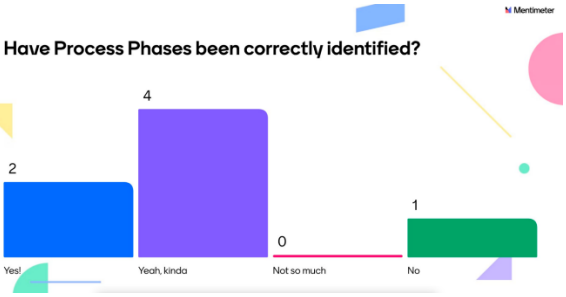

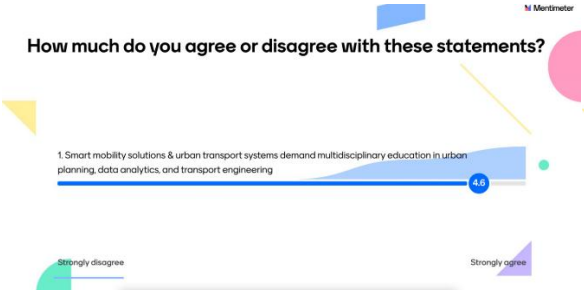

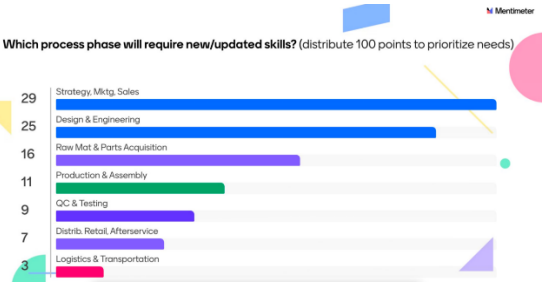

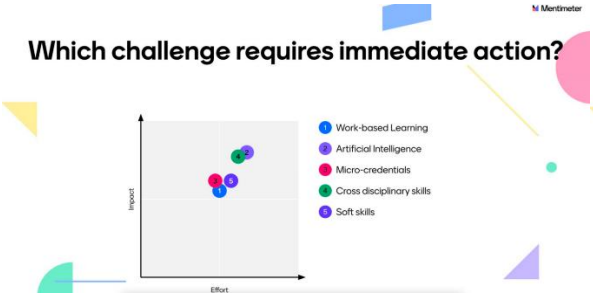

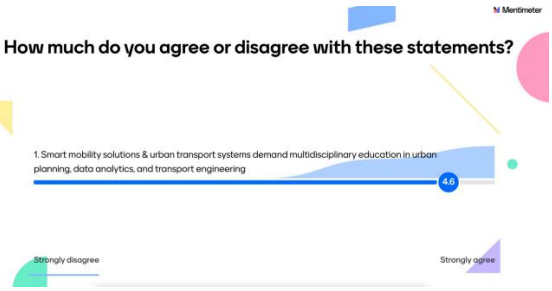

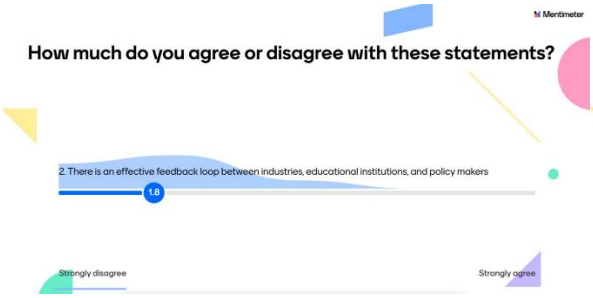

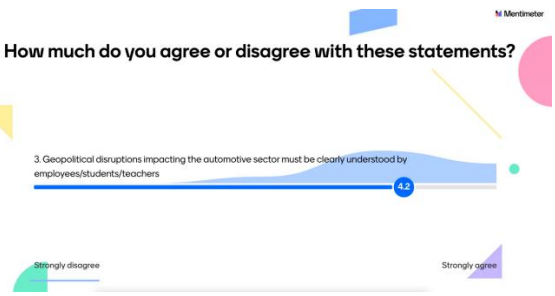

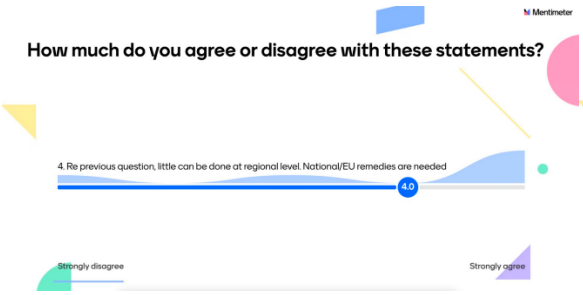

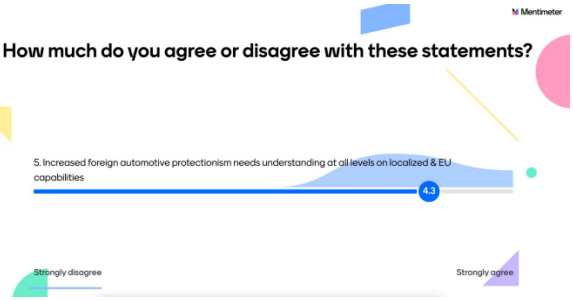

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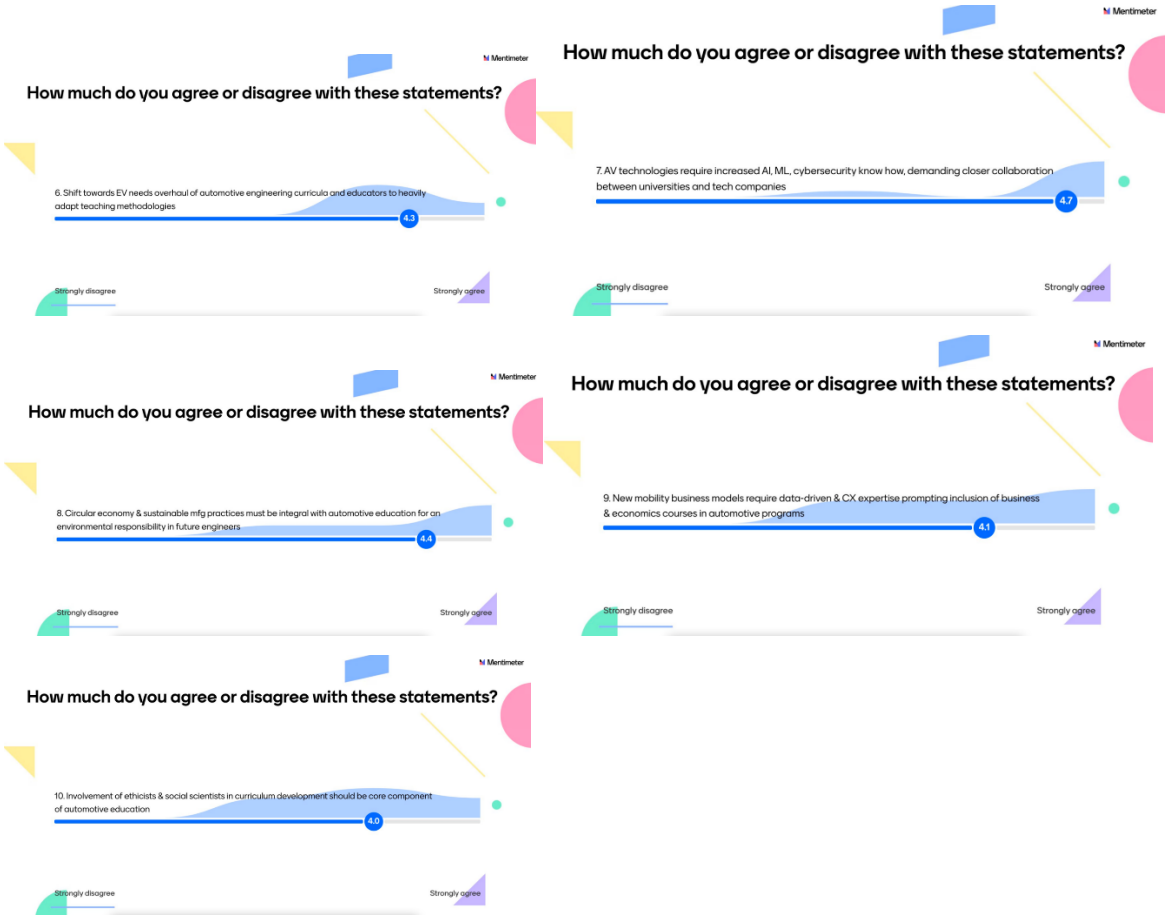

Here are the list of participants and some pictures from the workshop:

LIST OF PARTICIPANTS

ORGANIZATION	
ASOTECH Integrated engineering solutions for industry	CIS business school
ASK Industries S.p.A	Iter Consulting
JustHumans Communication & Counseling	Autoleone Lancar
Confindustria Reggio Emilia	Sistemi Reggio Emilia Training & Consulting

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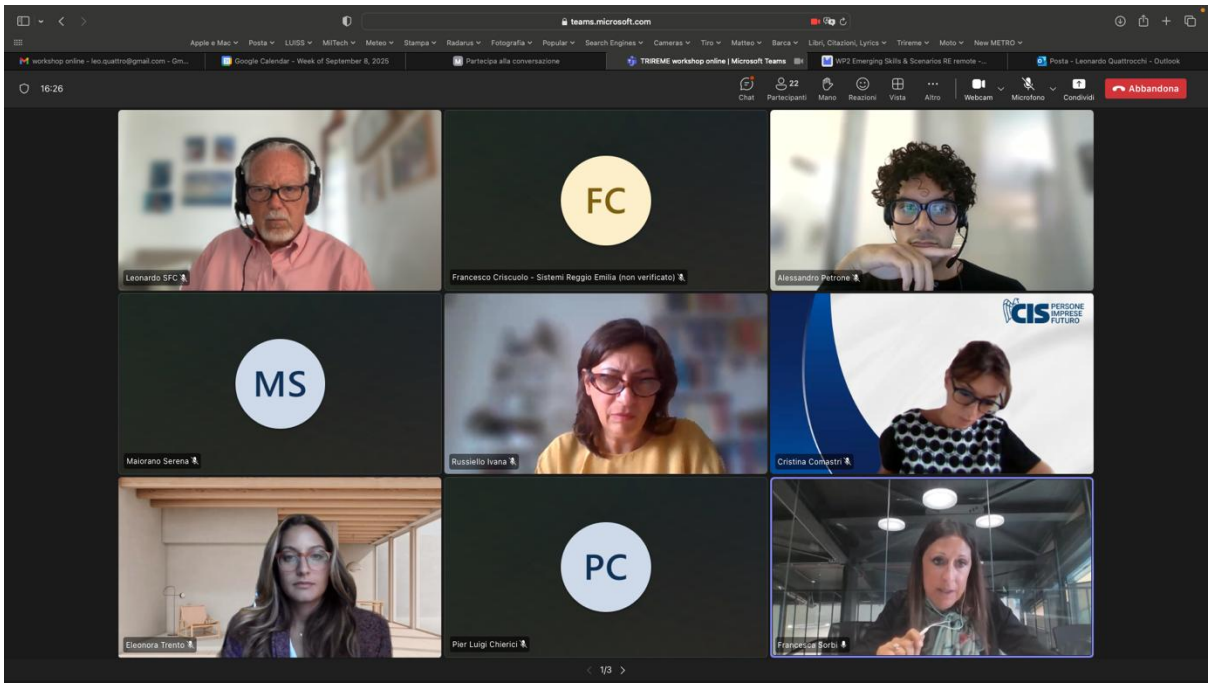

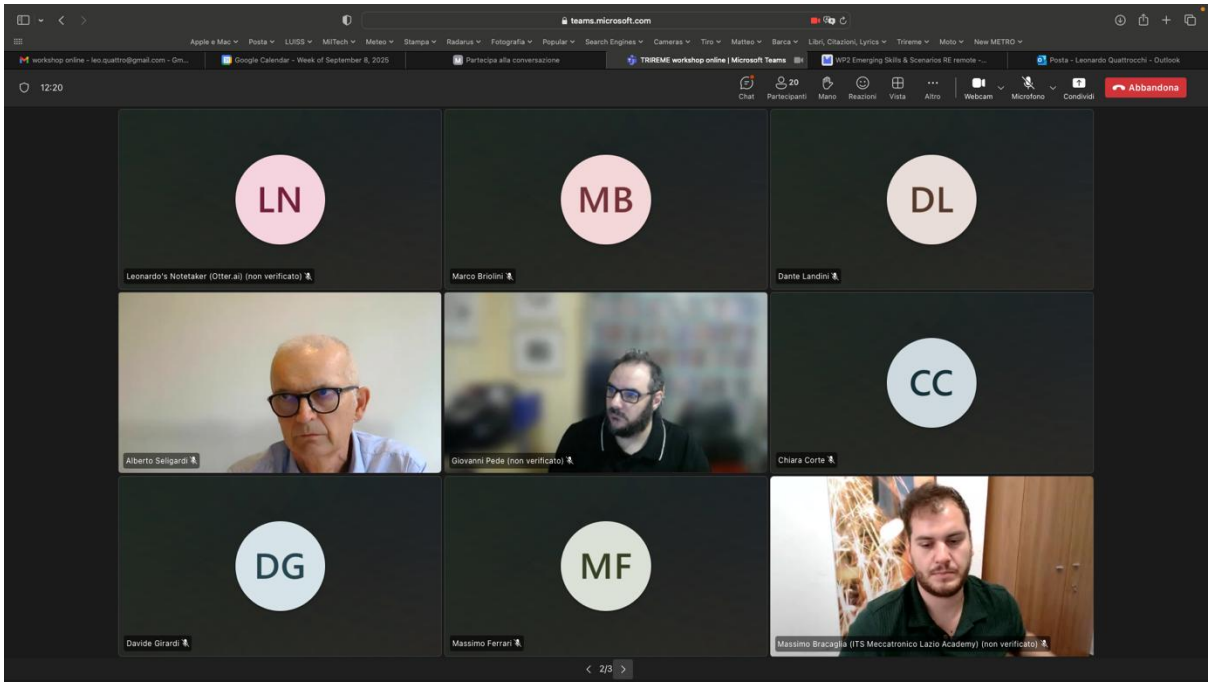

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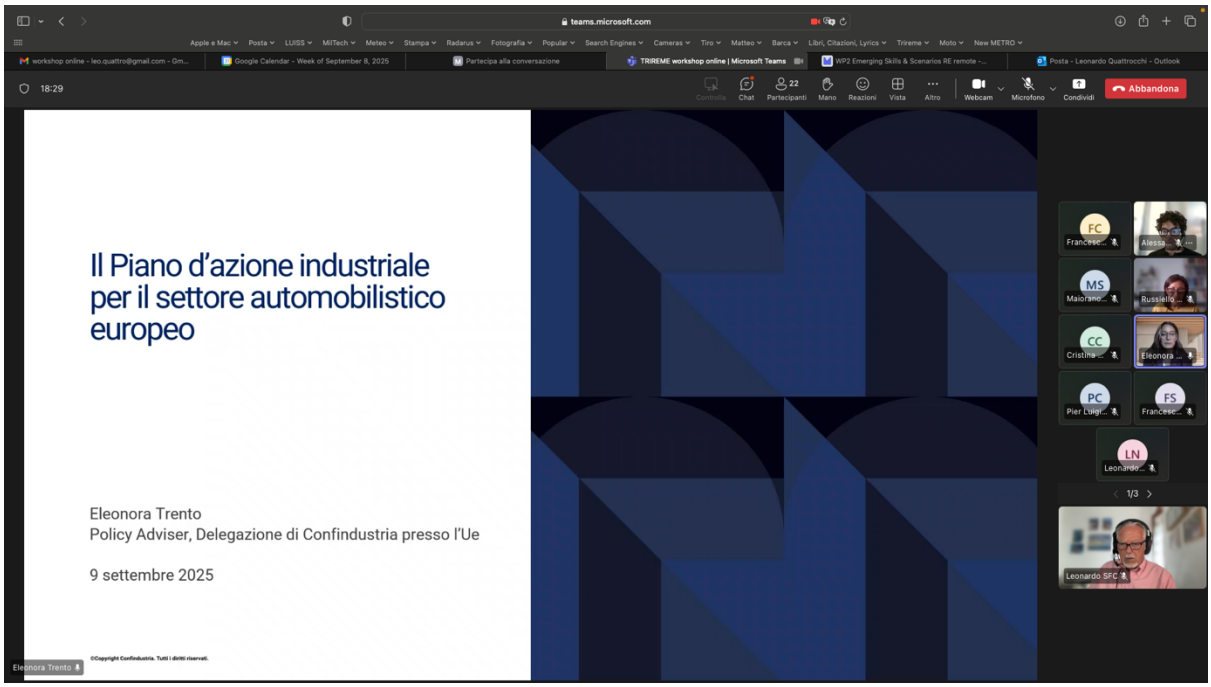

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