CCAMERAS
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D5.3 Recommendations and conditions for success and further exploitation outside the context of the use cases

June 2026

Deliverable No. 5.3 Recommendations and conditions for success and further exploitation outside the context of the use cases

Project Acronym	Grant Agreement	Project Title	Deliverable Reference	Deliverable Title
CCAM-ERAS	101147129	CCAM Employment Realisation through Acquisition of Skills	5.3	Recommendations and conditions for success and further exploitation outside the context of the use cases

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Funded by the European Union

This project has received funding from the European Union's Horizon Europe programme, under grant agreement No 101147129.

Abbreviations

Abbreviation	Definition
CCAM	Cooperative, Connected and Automated Mobility
C-ITS	Cooperative Intelligent Transport Systems
ICT	Information and Communication Technology
AI	Artificial Intelligence
VET	Vocational Education and Training
AV	Automated Vehicles
KPIs	Key Performance Indicators
OEMs	Original Equipment Manufacturers
SDS providers	Self-Driving System providers
HEIs	Higher Education Institutions
ADS	Automated Driving System
SDS	Self-Driving System
EQF	European Qualifications Framework
TRL	Technology Readiness Level

Executive summary

Cooperative, Connected and Automated Mobility (CCAM) is expected to play a transformative role in the future of European transport by improving safety, efficiency, sustainability and accessibility across a wide range of mobility services. While technological advances in automation, connectivity and digitalisation continue to accelerate the development of CCAM solutions, their successful deployment depends on much more than technological progress. It requires a coordinated transition that prepares organisations, workforces, regulatory frameworks and governance systems to support the widespread adoption of automated mobility.

Deliverable 5.3 “Recommendations and Conditions for Success and Further Exploitation Outside the Context of the Use Cases” constitutes the final output of Work Package 5 of the CCAM-ERAS project. Building on evidence generated throughout the project, the deliverable synthesises findings from the representative use cases, stakeholder engagement activities, socio-economic analyses, workforce assessments, and educational recommendations into a coherent set of strategic recommendations to support the wider deployment of CCAM beyond the project context.

Rather than presenting new empirical research, the deliverable integrates knowledge generated from project activities, especially those undertaken within Work Package 5 to identify common deployment challenges, enabling conditions, and strategic priorities. In doing so, it adopts a cross-sectoral perspective that extends beyond individual use cases, highlighting recurring patterns observed across different operational environments and transport domains.

The report demonstrates that the transition towards CCAM should be understood as a socio-technical transformation involving technological innovation, organisational adaptation, workforce evolution and institutional change. Across the representative use cases, automation consistently reshapes occupational roles, organisational processes and stakeholder interactions while increasing the importance of digital competencies, interdisciplinary collaboration and continuous learning. At the same time, the project identifies workforce readiness, organisational capacity, regulatory certainty and stakeholder cooperation as critical factors influencing the successful deployment of automated mobility systems.

Building upon these findings, the deliverable identifies the key conditions that enable successful CCAM deployment and formulates strategic recommendations for the principal stakeholder groups involved in the European mobility ecosystem. These include European institutions, national governments, industry and technology providers, transport operators, education and training providers, and the research community. The recommendations emphasise the importance of coordinated action that aligns technological innovation with workforce development, regulatory evolution, organisational preparedness and knowledge exchange.

The deliverable also highlights the central role of education and lifelong learning in supporting the future CCAM workforce. Building on the educational recommendations developed within Work Package 5, it recognises that preparing current and future professionals requires flexible learning pathways, continuous competence development, and close collaboration among education providers, employers, and policymakers.

Overall, Deliverable 5.3 provides an integrated perspective on the conditions necessary to support the successful, scalable and socially responsible deployment of Cooperative, Connected and Automated Mobility across Europe. By translating the evidence generated throughout CCAM-ERAS into practical recommendations for policy, industry, education and research, the deliverable contributes to the wider exploitation of the project's results and supports Europe's transition towards a connected, automated and human-centred mobility system.

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1 Introduction

1.1 Background

Cooperative, Connected and Automated Mobility (CCAM) is expected to play a central role in the transformation of Europe's transport systems, contributing to safer, more efficient, sustainable and inclusive mobility services. Advances in vehicle automation, connectivity, artificial intelligence and digital infrastructure have accelerated the development of automated mobility solutions across passenger and freight transport. However, experience from pilot projects and large-scale demonstrations has shown that technological maturity alone is insufficient to ensure successful deployment. The transition towards CCAM requires significant organisational, institutional and societal adaptation, including the evolution of occupations, the development of new competencies, supportive regulatory frameworks and effective collaboration between public authorities, industry, education providers and social partners.

Recognising these challenges, the CCAM-ERAS project adopts a socio-economic perspective on automated mobility. Rather than focusing solely on technological innovation, the project investigates how CCAM will transform labour markets, occupational structures, education and training systems, and stakeholder ecosystems. Through a combination of representative use cases, stakeholder engagement activities, impact assessments and occupational analyses, CCAM-ERAS generates evidence to support the successful and socially responsible deployment of automated mobility across Europe.

Within this context, Deliverable 5.3 represents the final output of the activities carried out under Work Package 5. While previous deliverables focused on analysing workforce impacts, identifying emerging occupations and sketching possible further steps in education, the present deliverable integrates these findings to identify the conditions required for successful deployment and to formulate recommendations that support the wider implementation and exploitation of CCAM beyond the specific project use cases. The objective of Deliverable 5.3 is to provide recommendations and conditions for success and further exploitation outside the context of the representative use cases.

1.2 Objectives of Deliverable 5.3

The primary objective of Deliverable 5.3 is to identify the strategic conditions required to support the successful deployment of Cooperative, Connected and Automated Mobility from a workforce, organisational and governance perspective, while formulating recommendations that facilitate the transfer of knowledge generated within CCAM-ERAS to broader European deployment contexts.

Using evidence from Work Packages 3, 4, and 5, this deliverable goes beyond looking at single jobs or cases. It brings together findings from different settings to highlight common challenges, lessons that can be shared, and key priorities for policymakers, transport operators, industry, educators, and social partners.

More specifically, Deliverable 5.3 aims to:

- synthesise the principal findings emerging from the six representative CCAM use cases;
- identify common barriers and helpful factors that affect workforce changes and CCAM deployment;
- present recommendations for skills development, education and workforce preparation based on the analyses carried out in Work Package 5;
- identify the conditions required to support sustainable and scalable deployment of CCAM technologies; and

- develop strategic recommendations to support the implementation, governance, and further use of CCAM across Europe.

Rather than introducing new empirical evidence, the deliverable integrates knowledge generated throughout the project into a coherent implementation-oriented report capable of supporting future policy development, educational planning and industrial deployment.

1.3 Scope of the Deliverable

This deliverable outlines the key conditions and strategic recommendations necessary for the successful deployment of CCAM beyond the representative use cases developed within the CCAM-ERAS project. It synthesizes evidence from Work Package 5, together with relevant findings from previous work packages, to formulate recommendations for policymakers, transport operators, industry, education and training providers, research organizations, and other relevant stakeholders.

The deliverable addresses the workforce, organizational, educational, and regulatory dimensions of CCAM deployment, emphasizing the enabling conditions required to support long-term implementation and exploitation. Instead of presenting new empirical research, it translates project-generated knowledge into practical guidance intended to inform future policy, education, research, and deployment activities across Europe.

1.4 Relationship with Previous CCAM-ERAS Deliverables

Deliverable 5.3 builds upon the cumulative evidence on skills, occupations and educational recommendations generated throughout CCAM-ERAS, with particular emphasis on the outputs of Work Package 5. Rather than repeating the findings of previous deliverables, it consolidates them into a coherent set of strategic recommendations and enabling conditions that support the successful deployment and further exploitation of CCAM beyond the representative use cases.

The deliverable draws upon the representative use cases developed in Deliverable 3.3, the stakeholder and societal analyses presented in Deliverable 4.6, the workforce impact assessment undertaken in Deliverable 5.1, and the occupational profiles and educational recommendations developed in Deliverable 5.2. Together with additional insights gathered during the final consultation round, these outputs provide the evidence base for identifying the enabling conditions and recommendations presented in this deliverable.

Table 1 summarises the principal CCAM-ERAS deliverables and their contribution to the development of Deliverable 5.3.

Table 1: Evidence base underpinning Deliverable 5.3

Previous deliverable	Primary contribution to D5.3
D3.3	Representative deployment contexts and use cases
D4.6	Stakeholder expectations, societal impacts and deployment barriers
D5.1	Workforce transformation, labour market impacts and skills gaps
D5.2	Occupational profiles, learning outcomes and educational approaches
Grant Agreement	Strategic objectives and expected outcomes of WP5

1.5 Methodological Approach

Deliverable 5.3 employs an evidence synthesis methodology, integrating principal findings from Work Package 5 with complementary evidence from related CCAM-ERAS deliverables. Instead of conducting new empirical research, this deliverable consolidates validated project results to identify recurring patterns, enabling conditions, and strategic recommendations that facilitate the broader deployment of CCAM.

The analysis proceeds through four sequential stages. Initially, findings from six representative use cases are synthesised to identify common patterns in workforce transformation, organisational adaptation, and deployment challenges. Subsequently, stakeholder perspectives gathered through interviews, workshops, and citizen engagement activities are used to contextualise and validate these findings. Occupational analyses and educational recommendations from Work Package 5 are then integrated to determine future competence requirements and workforce development priorities. Finally, the consolidated evidence is translated into strategic recommendations and conditions for success to support the broader implementation of CCAM beyond the initial use cases.

This methodological approach ensures that the recommendations in this deliverable are evidence-based, grounded in validated project outputs, and applicable across a wide range of future CCAM deployment contexts.

1.6 Structure of the Deliverable 5.3

Section 2 synthesises the principal findings from six representative CCAM use cases, identifying common workforce transformation patterns, deployment barriers, and strategic lessons that define the transition to CCAM across various transport domains.

Section 3 builds on these findings by translating identified competence needs into recommendations for education, vocational education and training, lifelong learning, and workforce development. Developed by CINOP, this section complements the occupational profiles and educational instruments presented in Deliverable 5.2, offering practical guidance to address identified skills gaps.

Section 4 examines the broader conditions necessary for successful deployment. By focusing on workforce readiness, skills availability, and regulatory preparedness, it identifies the enabling factors and risks that affect the implementation and scaling of CCAM across Europe.

Finally, Section 5 consolidates the findings from previous chapters into a coherent set of strategic recommendations for policymakers, industry, transport operators, educational institutions, and research organisations. This section highlights the contribution of CCAM-ERAS to Europe's transition toward safe, inclusive, and sustainable automated mobility.

Table 2 identifies the sections of the report most pertinent to each stakeholder group, thereby facilitating navigation for readers.

Table 2:How to read this deliverable

If you are	Read
Policymaker	Sections 4 and 5
Education provider	Section 3
Transport operator	Sections 2, 4 and 5

Industry	Sections 2 and 5
Researcher	Entire report

2 Synthesis of Findings Across the Six Use Cases

The six representative use cases developed within the CCAM-ERAS project serve as the empirical foundation for understanding the anticipated transformation of transport systems, occupations, and workforce requirements across Europe. These use cases were intentionally selected to encompass a diverse range of operational environments, automation levels, and mobility services, thereby enabling the investigation of workforce transformation under varying deployment conditions.

Deliverable 5.1 examined each use case individually, analysing the expected impacts of CCAM deployment on operational processes, occupational structures, and labour market dynamics. In addition, Deliverable 5.2 translated these findings into occupational profiles, competence requirements, and educational recommendations. Collectively, these deliverables established a comprehensive evidence base describing how automation is expected to reshape work within various transport domains. However, their primary objective was to analyse each use case separately. In contrast, the purpose of this chapter is fundamentally different.

Instead of revisiting the individual characteristics of the six use cases, this chapter synthesises the evidence generated throughout the project to identify common patterns that emerge across them. The analysis focuses on workforce transformations that are consistently observed regardless of operational context, recurring barriers to deployment, and lessons that can inform the broader implementation of CCAM beyond the specific project pilots. This synthesis establishes the analytical foundation for the educational recommendations in Section 3, as well as the deployment conditions and strategic recommendations presented in subsequent sections of this deliverable.

Although the operational characteristics of the six use cases differ considerably, their comparative assessment demonstrates that CCAM deployment is characterised by a limited number of recurring transformation mechanisms. Across freight transport, public transport, logistics, ports, and specialised mobility services, automation consistently shifts the role of human workers from direct vehicle operation to supervision, coordination, and decision support. Simultaneously, organisations encounter similar challenges in adapting operational structures, recruiting personnel with appropriate competences, and navigating evolving regulatory environments. These recurring patterns indicate that successful CCAM deployment depends more on a common set of organisational, workforce, and governance conditions than on the specific characteristics of individual transport sectors.

Consequently, the analysis in this chapter adopts a cross-sectoral perspective, identifying the principal strategic lessons emerging from the project rather than comparing the use cases independently. This approach aligns with the overarching objective of Deliverable 5.3, which is to formulate recommendations that are transferable beyond the original project contexts and support the broader European transition towards Cooperative, Connected and Automated Mobility.

2.1 Cross-use Case Comparison

The six representative use cases identified within CCAM-ERAS span a wide range of operational environments, such as freight transport, logistics, public transport, shared mobility, road infrastructure, and governance-related functions. Although each use case addresses different mobility services and technological applications, comparative analysis reveals significant convergence in how CCAM is anticipated to transform organisations, occupations, and workforce requirements. Instead of producing isolated, sector-specific challenges, the use cases collectively indicate that the shift toward automated mobility is driven by a limited set of recurring transformation mechanisms applicable across various transport domains.

To enable this comparison, the findings have been synthesised into five operational domains that reflect the diversity of the project and highlight the similarities emerging across different deployment contexts:

- Freight transport and logistics;
- Public and shared passenger mobility;
- Infrastructure and traffic management;
- Governance, regulation and compliance;
- Cross-cutting support and digital services.

This thematic organisation redirects attention from individual project demonstrations to the broader operational environments where CCAM technologies are expected to be implemented. This approach enables the identification of common workforce challenges and transferable lessons.

2.1.1 Freight Transport and Logistics

The freight and logistics sector represents a leading application of CCAM technologies, with automation primarily motivated by efficiency, operational continuity, and the optimisation of logistics processes. Use cases examined within CCAM-ERAS indicate that automation is gradually reducing the necessity for repetitive operational tasks while concurrently increasing the demand for personnel skilled in supervising automated fleets, coordinating logistics operations, and addressing exceptional situations.

In these environments, workforce transformation is defined more by the evolution of existing professional roles than by the elimination of traditional occupations. Drivers, dispatchers, and operational coordinators are increasingly responsible for remote monitoring, fleet orchestration, operational planning, and data-driven decision making. As a result, the required competency profile now encompasses digital literacy, systems thinking, communication, and problem-solving skills in addition to conventional transport expertise.

The analysis further demonstrates that technological deployment alone is insufficient to ensure operational success. Organisations in the freight and logistics sector must redesign workflows, establish new operational procedures, and integrate automated systems within existing organisational structures. Therefore, organisational change management is as critical as technological innovation in achieving successful deployment.

2.1.2 Public and Shared Passenger Mobility

Public and shared passenger mobility differs from freight applications due to the continued centrality of human interaction in service delivery. While automation increasingly supports vehicle operation, personnel remain essential for passenger assistance, accessibility, incident management, and maintaining service continuity.

Evidence from Deliverables 5.1 and 5.2 demonstrates that occupations in this sector are evolving into hybrid roles that integrate operational supervision with customer-facing responsibilities. Safety drivers, customer service agents, fleet orchestrators, and remote operators now supervise automated services, support passengers, and ensure operational continuity. As a result, future competence requirements encompass not only technical expertise but also communication skills, situational awareness, problem-solving abilities, and the capacity to manage unexpected operational situations.

Stakeholder consultations further underscore that public acceptance is essential for the deployment of automated passenger mobility. Citizens consistently identified safety, accessibility, and trust as prerequisites for adopting automated mobility services. Transport operators emphasized the need for personnel who can serve as effective intermediaries between

automated technologies and passengers. These findings suggest that successful deployment relies not only on technological performance but also on the provision of high-quality, human-centred services that build public confidence.

2.1.3 Infrastructure and Traffic Management

The implementation of CCAM extends beyond vehicles and necessitates substantial adaptation of both physical and digital infrastructure. Use cases related to infrastructure and traffic management indicate that road infrastructure specialists, traffic managers, and transport planners increasingly require expertise in connected infrastructure, digital communication systems, and automated traffic management.

In contrast to other occupational domains, workforce transformation within infrastructure-related professions primarily involves expanding existing engineering and planning competencies rather than establishing entirely new occupations. Traditional expertise in civil engineering, transport planning, and infrastructure management remains essential, but must be supplemented with knowledge of digital infrastructure, sensor technologies, Cooperative Intelligent Transport Systems (C-ITS), and data integration.

The comparative analysis further demonstrates that infrastructure adaptation represents one of the most prolonged components of CCAM deployment. Although vehicle technologies may advance rapidly, modifications to transport infrastructure require extended planning horizons, significant investment, and coordination among multiple public authorities. As a result, infrastructure readiness constitutes both a technical and institutional challenge that necessitates long-term strategic planning.

2.1.4 Governance, Regulation and Compliance

A recurring theme identified in the project is the growing significance of governance-related occupations in supporting CCAM deployment. Policy officers, compliance specialists, insurance professionals, and regulatory experts play a critical role in the transition to automated mobility by translating technological innovation into operational frameworks that align with legal, safety, and societal requirements.

Analysis of use cases demonstrates that workforce transformation in these occupations occurs mainly through the expansion of interdisciplinary responsibilities, rather than technological substitution. Professionals in governance-related roles increasingly need expertise in automated driving systems, cybersecurity, artificial intelligence, liability frameworks, and European regulatory developments, in addition to their traditional knowledge of law, public administration, or risk management.

Stakeholders consistently identify regulatory uncertainty as a principal constraint on broader CCAM deployment. Fragmented legislation, evolving certification procedures, and unresolved liability issues generate uncertainty for both public authorities and industry. As a result, governance-related occupations serve as essential facilitators of CCAM implementation by ensuring that technological innovation advances in parallel with regulatory adaptation.

2.1.5 Cross-cutting Support and Digital Services

Across all operational domains, the project identifies an expanding ecosystem of cross-cutting occupations that support automated mobility. These roles include remote operations specialists, cybersecurity professionals, software developers, systems engineers, and other digital specialists who are responsible for maintaining, monitoring, and securing increasingly interconnected transport systems.

These occupations differ from traditional transport professions because they are inherently multidisciplinary. Rather than being confined to the transport sector, they integrate expertise

from information technology, telecommunications, systems engineering, and cybersecurity. As CCAM deployment advances, these professionals are essential for ensuring the reliability, resilience, and continuous operation of automated mobility services.

A key finding from the comparison is that digital competencies are no longer limited to specialized ICT occupations. Digital literacy, data interpretation, and systems awareness are increasingly baseline requirements across nearly all occupational categories analysed in the project. This finding demonstrates that digital transformation is a systemic characteristic of CCAM deployment, rather than a feature affecting only technical professions.

The comparative assessment indicates that the future deployment of CCAM should be regarded as a systemic transformation of the entire mobility ecosystem, rather than a series of sector-specific transitions. Despite differences in operational contexts, organisations consistently face similar challenges, including workforce adaptation, organisational change, regulatory evolution, and stakeholder collaboration. This convergence implies that many recommendations developed within CCAM-ERAS are applicable across various transport domains and can facilitate broader European deployment beyond the project's representative use cases.

Table 3 presents an overview of the principal workforce transformations, competence shifts, deployment challenges, and strategic implications identified across the five operational domains.

Table 3: Comparative synthesis of operational domains

Operational domain	Principal workforce transformation	Main competence shift	Key deployment challenge	Strategic implication
Freight and logistics	Operators become supervisors of automated operations	Digital coordination, remote supervision, data interpretation	Organisational adaptation	Automation reshapes operational roles rather than replacing them
Public and shared mobility	Hybrid operational and customer-oriented roles	Human-machine interaction, accessibility, incident management	Public trust and service continuity	Human-centred service delivery remains essential
Infrastructure and traffic management	Expansion of engineering responsibilities	Digital infrastructure, C-ITS, systems integration	Long-term infrastructure investment	Infrastructure readiness determines deployment scalability
Governance and compliance	Increasing interdisciplinary responsibilities	Regulation, AI governance, cybersecurity, liability	Regulatory uncertainty	Governance evolves alongside technological innovation
Cross-cutting digital services	Emergence of multidisciplinary support roles	Systems engineering, cybersecurity, remote operations	Availability of specialised expertise	Digital competences become transversal across the CCAM ecosystem

2.2 Strategic Lessons for Future CCAM Deployment

The comparative analysis in the previous section indicates that, despite the varied operational environments within CCAM-ERAS, the deployment of CCAM exhibits a consistent pattern of technological, organisational, and workforce transformation. The evidence produced throughout the project extends beyond individual use cases and offers insights into the broader factors shaping the future implementation of CCAM across Europe.

Instead of analysing the findings for each transport domain individually, this section synthesises the project's evidence into strategic lessons that characterise the broader transition to automated mobility. These lessons draw upon the operational analyses from Deliverable 5.1, stakeholder perspectives from Deliverable 4.6, and occupational analyses from Deliverable 5.2. Collectively, they establish a conceptual link between the project's empirical findings and the educational, organisational, and policy recommendations presented in the remainder of this deliverable.

2.2.1 Workforce transformation should be understood as occupational evolution rather than workforce replacement

A key conclusion from CCAM-ERAS is that automation does not merely replace existing occupations; rather, it fundamentally transforms the organization and execution of work. In all operational domains examined, technological innovation primarily alters the allocation of tasks within occupations instead of eliminating professional roles. As routine operational activities become automated, human responsibilities shift towards supervision, coordination, decision support, and exception management.

This trend is consistently observed in freight transport, public passenger mobility, infrastructure management, and governance-related occupations. Professionals continue to play a central role in ensuring the safe and reliable operation of automated transport systems, although the competencies required for these responsibilities evolve significantly. Accordingly, workforce transformation should be understood as a process of occupational evolution that requires continuous adaptation rather than large-scale workforce replacement.

This finding challenges the common perception that automated mobility will inevitably lead to widespread job losses. Instead, the project demonstrates that technological innovation results in a gradual redistribution of responsibilities between humans and automated systems. This process creates demand for new competencies while maintaining the significance of human expertise in managing complex operational environments.

2.2.2 Human expertise remains central to increasingly automated mobility systems

A recurring finding addresses the evolving role of human expertise in highly automated operational environments. Contrary to the assumption that automation gradually eliminates human involvement, the project demonstrates that the quality of human decision-making becomes increasingly significant as technological complexity rises.

In all operational domains, employees are expected to intervene primarily during exceptional situations, monitor system performance, coordinate automated operations, and ensure compliance with safety and operational procedures. These responsibilities require judgment, contextual understanding, and interdisciplinary collaboration, which currently exceed the capabilities of automated systems.

Stakeholder consultations support this conclusion. Transport operators consistently emphasized the necessity of maintaining human oversight throughout automated operations,

while representative organizations highlighted the ongoing responsibility of human personnel for accountability, safety, and public trust. Educational providers similarly recognized that future competence development should prioritize not only technical knowledge but also analytical thinking, communication, and decision-making under uncertainty.

Rather than reducing the role of humans, CCAM changes the nature of human contribution from direct control towards strategic supervision and operational governance.

2.2.3 Skills shortages may become a greater barrier than technological maturity

Although technological innovation is progressing rapidly, evidence from CCAM-ERAS indicates that workforce preparedness may emerge as a primary constraint on large-scale deployment. Stakeholder groups consistently report challenges in recruiting professionals who possess operational knowledge alongside digital competencies, systems thinking, and interdisciplinary collaboration skills.

This challenge is not limited to highly specialised technical occupations. As demonstrated in Deliverable 5.2, digital competencies are increasingly baseline requirements across diverse professional profiles, including transport operators, infrastructure managers, planners, policy specialists, and customer-oriented roles. Therefore, labour market preparedness should be regarded as a systemic issue impacting the entire CCAM ecosystem rather than isolated occupational groups.

The project further demonstrates that addressing this challenge requires a combination of formal education, vocational training, lifelong learning, and continuous professional development. Educational recommendations based on these findings are provided in Section 3 of this deliverable.

2.2.4 Organisational readiness determines deployment success

The analyses conducted during the project consistently indicate that technological capability alone does not guarantee successful implementation. Organisations deploying CCAM technologies must also redesign operational procedures, redefine professional responsibilities, and establish governance structures that support increasingly automated operations.

Across the operational domains examined in the project, organisations face similar challenges related to organisational change, employee engagement, integration of automated systems into existing workflows, and coordination among multiple professional disciplines. These organisational adaptations often require longer implementation periods than the technological deployment itself.

Stakeholders consistently emphasised that successful implementation depends on leadership commitment, organisational flexibility, and effective change management, in addition to technological investment. As a result, organisational readiness is a critical determinant of deployment success across all transport sectors.

2.2.5 Successful deployment requires coordinated governance and stakeholder collaboration

The final strategic lesson addresses the governance structures necessary to enable large-scale deployment. The project consistently demonstrates that implementing CCAM relies on coordinated efforts among policymakers, transport operators, technology developers, educational institutions, social partners, and citizens.

Stakeholder consultations indicate a broad consensus on the necessity of regulatory clarity, interoperability, shared standards, and ongoing dialogue among various actors. While

stakeholders approach automated mobility from diverse institutional perspectives, they acknowledge that successful deployment cannot be accomplished by individual organizations acting alone.

This finding is significant as it redirects the focus from technological advancements to governance considerations. Scaling CCAM across Europe necessitates coherent regulatory frameworks, coordinated workforce development, shared educational initiatives, and sustained stakeholder engagement. These governance mechanisms gain importance as automated mobility transitions from isolated demonstrations to widespread operational deployment.

Table 4 summarises the strategic lessons identified across the representative cases, along with supporting evidence from the CCAM-ERAS deliverables.

Table 4:Strategic lessons emerging from the CCAM-ERAS project

Strategic lesson	Supporting evidence	Implication for deployment
Workforce transformation primarily reshapes occupations	D5.1, D5.2	Prioritise workforce transition over workforce replacement
Human expertise remains indispensable	D4.6, D5.1	Design systems supporting human-machine collaboration
Skills shortages may constrain deployment	D4.6, D5.2	Invest in continuous competence development
Organisational readiness is essential	D5.1, stakeholder interviews	Combine technological and organisational transformation
Governance determines scalability	D3.3 (representative use cases), D4.6 (stakeholder and societal analysis), D5.1 (workforce impact assessment), D5.2 (occupational profiles and educational recommendations)	Strengthen coordination among stakeholders

2.3 Deployment Cross-cutting Barriers to CCAM Deployment

Analyses conducted within CCAM-ERAS indicate that, despite the diversity of operational environments represented by the six use cases, organisations face a consistent set of barriers that affect the pace and effectiveness of CCAM deployment. These barriers extend beyond specific technologies or transport sectors and reflect broader organisational, institutional, and societal challenges related to the introduction of increasingly automated mobility systems.

These barriers should not be viewed as insurmountable obstacles to deployment. Instead, they represent critical areas that require coordinated attention from policymakers, industry, transport operators, educational institutions, and other stakeholders to enable CCAM to progress beyond pilot projects toward large-scale operational implementation.

The following sections synthesise the principal barriers identified throughout the project and examine their implications for future deployment.

2.3.1 Workforce preparedness and skills availability

Consultations with all stakeholder groups within CCAM-ERAS identified workforce preparedness as a significant barrier to successful CCAM deployment. While stakeholders acknowledged the potential benefits of automation, many raised concerns about the availability of personnel with the necessary combination of technical, operational, and transversal competencies to support increasingly automated transport systems.

The findings indicate that this challenge extends beyond specialised engineering roles. Transport operators, infrastructure managers, planners, public authorities, and customer-facing personnel are all expected to acquire new competencies related to digital technologies, data interpretation, automated system supervision, and interdisciplinary collaboration. Therefore, workforce preparedness should be regarded as a systemic issue impacting the entire mobility ecosystem rather than isolated professional groups.

Stakeholders further emphasised that educational provision frequently lags behind technological innovation, increasing the risk of temporary mismatches between labour market demand and workforce supply. Although educational responses are addressed in detail in Section 3, the current findings indicate that the availability of appropriately skilled personnel is a principal factor influencing the pace of CCAM deployment.

2.3.2 Workforce preparedness and skills availability

The transition to CCAM necessitates that organisations implement more than just new technologies. The project identifies organisational adaptation as essential for successful deployment across all operational domains, requiring significant changes in work organisation, management practices, and operational procedures.

Stakeholders consistently report that the introduction of automated systems challenges established organisational structures and professional responsibilities. Existing workflows require redesign, interactions between automated systems and human operators must be redefined, and new governance arrangements are necessary to maintain operational continuity and accountability.

These organisational challenges are often more complex than the technological implementation itself. Therefore, successful deployment depends not only on technological investment but also on the organisational capacity to manage change, engage employees, and promote continuous learning.

2.3.3 Regulatory uncertainty and governance complexity

A consistent finding from both stakeholder consultations and use case analyses is the evolving regulatory environment for automated mobility. Despite significant progress at the European level, stakeholders continue to report uncertainty regarding liability, certification, operational approval, data governance, and cross-border interoperability.

These uncertainties affect deployment decisions by increasing investment risks and complicating long-term organizational planning. Public authorities also encounter challenges in adapting legislative frameworks to accommodate rapidly evolving technologies while ensuring safety, accountability, and public confidence.

The project demonstrates that regulatory development must progress in parallel with technological innovation. Delays in regulatory adaptation may hinder deployment, even when technological solutions have achieved sufficient maturity.

2.3.4 Public acceptance and stakeholder confidence

The successful deployment of CCAM depends not only on technological performance but also on the confidence of those expected to operate, regulate and use automated mobility services. Throughout the stakeholder consultations, participants consistently recognised the importance of maintaining public trust through transparent communication, clear governance arrangements and demonstrable safety performance.

Despite variations in perspectives among stakeholder groups, shared concerns included operational safety, employment impacts, ethical issues, accessibility, and accountability for decision-making within automated transport systems. These concerns indicate that deployment should be regarded not only as a technological advancement but also as a societal transition that necessitates ongoing stakeholder engagement.

The findings indicate that public acceptance cannot be secured through technological maturity alone. Rather, confidence is fostered through inclusive governance, effective communication, and opportunities for stakeholder participation in shaping the transition to automated mobility.

2.3.5 Interdisciplinary coordination across the CCAM ecosystem

The final barrier identified in the project concerns the increasing complexity of stakeholder interactions required for the deployment of CCAM. Automated mobility encompasses a diverse array of actors, including transport operators, vehicle manufacturers, technology providers, infrastructure managers, educational institutions, regulators, insurance organisations, and social partners.

Although each stakeholder offers unique expertise, variations in institutional priorities, organizational cultures, and regulatory responsibilities often hinder effective coordination. Stakeholder interviews indicate that successful deployment relies on ongoing collaboration among these groups, especially in areas such as workforce development, regulatory adaptation, and the establishment of operational standards.

Therefore, the transition to CCAM represents a collaborative governance challenge that necessitates mechanisms to support dialogue, knowledge exchange, and coordinated decision-making throughout the deployment process.

2.4 Implications for Workforce Transformation

Evidence synthesised from Deliverables 4.6, 5.1 and 5.2 indicates that the transition to CCAM encompasses more than the adoption of new vehicle technologies. It constitutes a fundamental transformation in work organisation, distribution of professional responsibilities, and competency development across the European transport ecosystem. The implications of this transition affect the entire workforce, influencing both emerging occupations and established professional roles that will increasingly function within digitally connected and highly automated environments.

A key implication involves the evolving relationship between humans and technology. Across all operational domains examined in the project, automation increasingly takes over routine and repetitive tasks, while human workers focus on supervision, coordination, decision-making, and managing exceptional situations. This redistribution of responsibilities fundamentally alters the nature of work but does not reduce the value of human expertise. In fact, the project shows that human judgement becomes more critical as automated systems gain greater operational autonomy.

This evolution also redefines the concept of professional competence. As digital technologies integrate functions once performed separately, traditional occupational boundaries become less distinct. Future transport professionals will require a blend of technical knowledge,

operational understanding, digital literacy, and transversal skills to collaborate effectively across disciplines. Communication, analytical thinking, adaptability, and systems awareness are emerging as core competencies that support occupational resilience across job titles and transport sectors.

Another significant implication relates to the pace of workforce transformation. CCAM-ERAS findings indicate that occupational change will likely occur progressively rather than through sudden disruption. Existing occupations are expected to evolve incrementally as automated technologies are integrated into operational environments, enabling organisations and employees to adapt over time. This gradual transition creates opportunities for workforce development through continuous learning, reskilling, and upskilling, rather than necessitating wholesale replacement of personnel. Simultaneously, it increases the responsibility of organisations to anticipate competency needs and invest proactively in workforce development before shortages become critical constraints.

The project also underscores the increasing importance of interdisciplinary collaboration. Future CCAM deployment will require closer cooperation among transport professionals, digital technology specialists, infrastructure managers, policymakers, educators, and regulatory authorities. Therefore, workforce transformation should be regarded as a shared responsibility across the broader CCAM ecosystem, not solely as an issue for employers or education providers. The capacity to collaborate across organisational and disciplinary boundaries becomes a strategic capability that supports innovation, operational efficiency, and public trust.

Workforce transformation extends beyond the development of technical competencies. Organisational culture, leadership, and employee engagement are equally significant factors influencing the successful integration of automated mobility technologies. Organisations that foster continuous learning, encourage innovation, and support employees during technological transitions are more likely to adapt effectively to evolving operational requirements than those focusing solely on technological investment.

The project demonstrates that workforce transformation is not merely a consequence of technological innovation but is a principal enabler of successful CCAM deployment. The presence of well-prepared professionals directly affects organisational readiness, operational safety, public confidence, and the long-term sustainability of automated mobility services. Therefore, investment in human capital should complement investment in technology, with both advancing together throughout the deployment process.

These findings provide the foundation for the educational recommendations in the following section. While this chapter has identified the main implications of workforce transformation, the next section translates these insights into practical recommendations for education, vocational training, and lifelong learning to support the development of the future CCAM workforce.

2.5 Summary

A comparative analysis of six representative CCAM use cases demonstrates that CCAM deployment constitutes a socio-technical transformation extending beyond technological innovation. Although these use cases represent diverse operational environments, they consistently reveal common patterns of occupational evolution, organisational adaptation, and competence development that characterise the broader European transition towards automated mobility.

The project yields five strategic lessons. First, workforce transformation is primarily characterised by the evolution of existing occupations rather than widespread workforce replacement. Second, human expertise remains central to increasingly automated mobility systems, with responsibilities progressively shifting towards supervision, coordination, and

decision-making. Third, workforce preparedness and skills availability are strategic prerequisites for deployment. Fourth, organisational readiness is as important as technological maturity in determining implementation success. Finally, effective governance and stakeholder collaboration are essential for scaling CCAM beyond individual demonstration projects.

The project also identifies recurring barriers to future deployment, including workforce preparedness, organisational adaptation, regulatory uncertainty, public acceptance, and stakeholder coordination. Although the significance of these barriers varies across operational contexts, they collectively indicate that successful CCAM deployment requires coordinated action addressing technological, organisational, and societal dimensions simultaneously.

Collectively, these findings provide the analytical foundation for the remainder of this deliverable. The next section builds upon the identified workforce implications by presenting recommendations for education, vocational training, and lifelong learning to support the development of the future CCAM workforce. Subsequent sections examine the broader conditions required for successful deployment and formulate strategic recommendations to support the wider implementation of CCAM across Europe.

3 Skills, Education & Workforce Recommendations

3.1 Introduction: the role of an occupational structure

Through the development of CCAM, new demand for labour will emerge. This development has not been extensively described so far and can therefore be considered as a rather unexplored field.

Several steps in curriculum development in formal or non-formal VET can be distinguished. These steps outlined apply not only to the development of new profiles and qualifications, but also to the maintenance of existing ones:[1]

1. Identifying labour market needs by investigating occupational practice, with occupational (competency) profiles as a result. The set of profiles form an occupational structure. The profiles and structure normally are validated by sector representatives (social partners).
2. The next step is to move from occupational profiles to qualifications. Qualifications can be based on one of more occupational profiles. They contain learning outcomes. Here usually labour market representatives cooperate with education providers.
3. In the third step curricula and assessment tools are developed. It differs per country which parties are at stake. In some countries educational institutions develop their own curricula and assessment tools, based on the qualification structure. In other countries curricula are developed at national level.

An important result of the CCAM-ERAS project is a sound sketch of an occupational structure where needs have occurred. This occupational structure covers to a large extent the first of the above-mentioned steps. This serves as a starting point for education and labour market stakeholders in cooperating on the further development of solutions for labour market needs. Next steps for stakeholders include the following.

- Labour market stakeholders, like employer organisations, social partners or individual companies, can further concretise and prioritise their needs. Stakeholders should concretise the identified competencies in the context of the specific occupations (e.g.: the meaning of the communication competency in different contexts, the expected level of technical depth) and to what extent are they transferable professional competencies that could apply across a number of operational professions on the one hand and distinguishing different operational tiers within each profession on the other.
- Assessing the robustness of the labour market needs (rapidly changing or structural needs), the timeframe in which the needs become apparent would provide valuable information to determine whether the needs should be covered with solutions in different forms of non-formal training, and/or if adaptations in formal education would be needed.
- Roles are not entirely unprecedented but rather sit at the intersection of several existing professions. By involving educational authorities, the step to qualifications can be made how does the occupational structure relate to current and future educational offer.
- It is the role of educational institutions to further develop the practical pedagogical layer underneath the role. This includes the question how someone becomes qualified for this role, what foundational education is required, how competencies are learned and assessed, and what institutional pathway would realistically produce these workers at

[1] This three-step classification is based on Hermanussen, J. et al. (2013) Leerplanontwikkeling in het middelbaar beroepsonderwijs. ECBO. A more detailed classification can be found via https://www.cedefop.europa.eu/en/tools/vet-glossary/glossary/curriculumontwikkeling.

scale. Together with labour market stakeholders' educational providers can decide upon best fitting educational pathways, training methods and credentialing structures. Employers and educational providers can also cooperate in creating valuable training environments, using for example apprenticeships, simulator-based exercises, edge-case drills.

3.2 Approach of the last validation round

In two webinars some of the results of Deliverable 5.2 were further deepened. In these webinars we focussed on challenges in finding personnel with the required skills and educational solutions to overcome the skills gap. Both webinars consisted of a presentation of the findings, followed by an interactive session in which the 14 participants validated and further elaborated on the outcomes using a dedicated online tool (MIRO-board).[2]

Reading guide

This project resulted in descriptions of profiles of twelve CCAM occupations. For two of these profiles development of educational solutions was most urgent. For these occupations core tasks and learning outcomes were developed more in detail. The twelve general profiles and the two detailed profiles can be found in Deliverable 5.2.

These general profiles contained some generic challenges and general solution approaches. These challenges and solutions were further elaborated in two webinars. For ten occupations this led to further valuable extra information, which is included in this section. This is complementary information to the profiles in Deliverable 5.2.

Table 5: Overview of CCAM job profiles and corresponding sections in D5.2 and D5.3

Profile	Content of the profile	Challenges and solutions	Learning outcomes & EQF level indication
Customer Service Agents	D5.2, §3.2.1	D5.3	–
Remote Operations Specialist	D5.2, §3.2.2	D5.3	D5.2, §4.3
Fleet Orchestrator	D5.2, §3.2.3	D5.3	–
AV Mechanics & Technicians	D5.2, §3.2.4	D5.3	–
Safety Driver	D5.2, §3.2.5	D5.3	–
AV Road Infrastructure	D5.2, §3.2.6	D5.3	–

[2] Experts who contributed to the CCAM report through webinar, sessions/workshops, and/or written feedback by mail include William Riggs (University of San Francisco), Christine Witte (cnfpc), Anne Patricio (Maaslab), Maria Paipai (Maaslab), Matheus Gomes Correia (Maaslab). Other experts did not consent to being listed, or their consent was not received in time.

Profile	Content of the profile	Challenges and solutions	Learning outcomes & EQF level indication
Policy and Regulations Officer	D5.2, §3.2.7	D5.3	D5.2, §4.4
Insurance Underwriters	D5.2, §3.2.8	D5.3	–
App Interface Developers & Analysts	D5.2, §3.2.9	D5.2, §3.2.9	–
AV Systems Engineers	D5.2, §3.2.10	D5.2, §3.2.10	–
Compliance Officers	D5.2, §3.2.11	D5.3	–
AV Cybersecurity Specialists	D5.2, §3.2.12	D5.3	–

3.2.1 Customer Service Agents

Consultation responses confirmed that this profile requires general technical literacy, familiarity with connected systems and AV behaviour rather than deep technical expertise, sufficient to answer passenger questions and manage incidents.

Across different countries no dedicated training pathway for this occupation was identified; relevant skills are currently picked up through customer service, tourism, transport and digital skills programmes, with most specialised knowledge acquired on the job.

This confirms that non-formal, on-the-job training remains the most suitable route. Concretely, short practical courses combining customer service, digital communication, accessibility awareness and basic AV systems understanding were recommended, complemented by scenario-based exercises and incident-management simulations. Materials should add more real-world case studies from AV pilots and guidance on handling service disruptions and accessibility situations to increase effectiveness.

3.2.2 Remote Operations Specialist

The acute shortage of remote operation specialists with high-level situational awareness, combined with uneven cybersecurity awareness among applicants, was confirmed as a structural skills gap.

Consultation responses show no dedicated training pathway exists yet; the profile is close to several existing operational professions, like air traffic operations, dispatch, fleet logistics, emergency response coordination, industrial process monitoring, and safety-critical systems management. There may be lessons from those pedagogical and certification models that could be considered as valuable inputs for new training solutions. Within the profession different operational tiers could be distinguished (e.g., fleet monitoring, remote assistance/intervention, senior systems operations and optimization).

Relevant competences are currently scattered across engineering, ICT, telecommunications and transport programmes. The reviewers see the following important competences:

communications, technical writing, mathematics and logic, digital literacy, transportation systems, emergency management, operations management, human factors, cybersecurity basics, AV systems fundamentals, working with remote operations interfaces, customer interaction and accessibility. Training could involve applied scenario/simulation training fatigue and stress management, incident-response exercises, and supervised operational practicums.

This reinforces the call for accredited training schemes, in line with international (European) safety and quality certification procedures used in comparable sectors (e.g. aviation, military). Concretely, training should combine technical knowledge, situational awareness, cybersecurity and incident management with practical teleoperation exercises, ideally through hands-on simulation environments. Clear, EQF-aligned certification pathways were highlighted as key to making the profile more attractive and consistent across providers.

3.2.3 Policy and Regulations Officer

Even though applicants generally meet most required competences, remote coordination skills, multimodal transport integration and specific AV/ITS systems knowledge remain hard to find for this profile.

Stakeholders' consultation feedback confirms a significant gap: traditional transport engineering and urban planning curricula do not yet address CCAM governance or multi-level legal frameworks, and no dedicated degree programmes exist; current knowledge mostly stems from EU-funded research projects.

This supports prioritising non-formal solutions: training and learning on the job were again identified as the most effective approach for developing AV-specific and coordination competences, with participatory workshops noted as a particularly useful format for understanding the everyday impact of automated mobility.

3.2.4 Fleet Orchestrator

Fleet orchestrators face fragmented responsibilities across operators and cities, immature and not-yet-interoperable technology, and evolving regulatory and procurement frameworks; AV-specific competences for this role currently have no established training guidelines.

Input from consultation confirms this: existing VET logistics tracks and transport/operations management programmes only partially cover the role, and CCAM-specific fleet orchestration content is largely absent, meaning most specialised skills are still acquired through industry training and practical experience.

This confirms that formal education alone is insufficient. On-the-job training (AV behaviour, remote supervision, incident response, fleet dashboards and KPIs), cross-disciplinary upskilling (cybersecurity basics, automated depot/charging systems, risk assessment) and soft-skill development (coordination, adaptive decision making, crisis escalation) remain the preferred route, with case studies and real-time disruption-management exercises highlighted as most effective.

3.2.5 AV Mechanics and Technicians

This profile shows large competence gaps, with shortages in AV electronics knowledge, sensor-calibration experience and the shift from mechanical to digital/software-driven systems.

Consultation responses point to existing VET mechatronics training combining electronics and mechanics, as a usable base on which to build specialised AV content, though no dedicated programme currently is present.

This supports the dual approach proposed earlier: formal education to build a strong foundational base in AV electronics, sensors and digital diagnostics, complemented by non-

formal education, training to reskill the existing workforce. Consultation participants placed particular emphasis on the formal-education component as the priority starting point for AV mechanics and technicians.

3.2.6 Safety Drivers

Re-educating existing bus drivers for this role proved difficult, particularly due to the software component, while age and country specific requirements (e.g. health standards or criminal-record checks) add further complexity for companies operating internationally.

No establishing CCAM-specific training programmes were identified; existing offers remain limited to professional driver licensing, road safety and public transport operations, with the recommendation to build CCAM modules on top of these.

This confirms and further concretises the staged solution proposed in report Deliverable 5.2: an advanced driving course (defensive driving, emergency manoeuvres, vehicle control, awareness of vulnerable road users), followed by a dedicated CCAM module (automated driving system behaviour, operational design domain limits, manual takeover, anomaly recognition and incident reporting), and finally a supplier-certified course combined with simulation and supervised real-vehicle testing. To remain effective across audiences, materials should be modular and competence-based, offering different entry points for experienced drivers, job seekers and technicians, and combining formal vocational education and training, supplier-led training, supervised practice and periodic re-certification.

3.2.7 Insurance Underwriters

Insurance underwriters generally possess solid analytical and legal skills but adapting these to AV system-level risks remains a challenge, particularly around evolving liability frameworks (shifting from OEMs/SDS providers to operators), access to software and operational data for risk modelling, and contractual cybersecurity arrangements, especially with non-European software.

Consultation feedback confirms only partial alignment: existing insurance, finance, law and risk management programmes provide a foundation, but no specialised AV-related training currently exists, so most knowledge is gained through professional, continuous education.

This supports the combined approach proposed in report Deliverable 5.2: adaptations within formal education to build fundamentals in risk modelling, algorithmic pricing and liability law, complemented by non-formal education such as on-the-job training and learning-by-doing to keep pace with fast-changing AV context. Short, targeted courses building on existing insurance and legal expertise, combining modules with AVs, data-driven risk modelling, cybersecurity and liability frameworks, illustrated with real-world case studies were considered effective formats, with continuous professional development needed as regulation evolves.

3.2.8 AV Cybersecurity Specialists

The dual nature of this role's skills gap was confirmed: professionals with a technical/engineering background often lack legal and regulatory knowledge, while those with a legal/governance profile lack in-depth understanding of AV systems, against a backdrop of a broader shortage of cybersecurity engineers trained in mobility applications.

Consultation responses show relatively good alignment with existing cybersecurity, computer science and engineering programmes, but confirm that dedicated training for AV and connected mobility cybersecurity is still missing.

This reinforces on-the-job training as the primary route to closing the gap, complemented by specialised modules on vehicle communication systems, connected infrastructure, threat

detection and AV-specific risk assessment. Practical exercises, cybersecurity simulations and real-world incident-response case studies were highlighted as most effective, and clear certification pathways were suggested to improve uptake and recognition of the profile

3.2.9 Compliance officer

For compliance officers, a moderate skills gap (compared to other CCAM-occupations) was reported. This includes technical AV-systems literacy, knowledge of international standards and the ability to shift from conventional automotive risks to AV-specific risks (agility).

Anecdotical evidence in the last consultation shows that in a diversity of existing programmes the topics mentioned above are touched upon, for example courses in law, public administration, business and risk management. However, no dedicated courses that cover compliance issues related to autonomous vehicles and connected mobility systems are known.

This creates a gap between existing educational offer and current and future labour market demands. Continuous developments in technology and, consequently, in rules and regulations, require education to be constantly updated. In the earlier stage especially (on-the-job) training was mentioned as a solution to overcome this gap, after having received a stable basis in formal higher education. Training should include autonomous vehicle regulations, data protection, cybersecurity compliance, AI governance, liability frameworks, and practical case studies from the transport sector. In regulatory case studies legal and compliance knowledge could be combined with the understanding of emerging technologies. Trainings should contain practical exercises and real-world compliance challenges, with updates reflecting evolving European legislation, including autonomous vehicle regulation, AI governance, cybersecurity compliance.

3.2.10 AV road infrastructure specialist

The first phase of the research has shown that professionals working in road infrastructure have an important role in enabling CCAM deployment as the need to adapt infrastructure to the usage of AVs. These specialists do not only have a role in designing road infrastructure, developing traffic management systems and AV-friendly urban designs, but also in training public authorities and stakeholders in AV interaction and operational procedures.

Relevant current education for these roles can be found mainly in civil engineering and secondly transport engineering and urban planning programmes. The existing education system provides a good foundation, but new requirements resulting from CCAM development are not yet covered in these traditional curricula. In formal education specialised modules or short courses on CCAM infrastructure would be needed.

Targeted in-house training programmes were, in the first part of the study, considered to be most fitting for the developments of AV-specific knowledge and skills, once individuals are operating in planning, organisational and policy-related positions. On-the-job methods like mentoring were mentioned in this respect.

These findings were confirmed in the last consultation. One of the participants in this stressed the importance of practical orientation by using real CCAM pilot examples and practical design scenarios. And secondly, the importance of modularisation, as potential learners have will probably have very diverse backgrounds (engineering, planning, public authorities). Separate modules could cover for instance AV-ready design, digital infrastructure, traffic management and stakeholder coordination.

3.3 General remarks and overall conclusions

The educational recommendations outlined in this section were further supported by pilot educational activities conducted within Work Package 5. Specifically, the seminar organized by SAAM for representatives of Swiss public administrations facilitated the presentation of key

CCAM concepts related to governance, regulation, and deployment, while also enabling the collection of feedback on competence gaps and future training needs. The seminar validated the relevance of the educational framework developed within CCAM-ERAS and underscored a sustained demand for structured learning opportunities that enhance workforce preparedness, regulatory implementation, and organizational readiness. These results provide further evidence of the applicability of the project's educational recommendations beyond the representative use cases. The complete seminar report is provided in Appendix A.

Across the ten profiles discussed in this section, the consultation surfaces a consistent pattern rather than profile-specific exceptions:

- None of the profiles pointed to a dedicated CCAM/AV training pathway in their country, confirming Deliverable 5.2's conclusion that CCAM is best understood as a competence layer added to existing occupations rather than a set of new professions requiring new degrees.
- This split held along technical/non-technical lines: technical roles (AV mechanics, AV systems engineers, road infrastructure engineers) still relied on formal education as their foundation, while customer-facing, policy, and compliance-type roles relied almost entirely on non-formal, on-the-job training layered onto existing backgrounds.
- Several respondents described the gap not as wholly new knowledge but as converting an existing conventional framework into an AV-specific one: compliance officers shifting from conventional to AV-specific risk, insurance underwriters from driver-based to system-based liability, mechanics from mechanical to digital diagnostics, and safety drivers from driving to supervising. This suggests training should be designed as targeted conversion modules for adjacent professionals rather than built from scratch.
- Cybersecurity recurred as a shared gap well beyond the Cybersecurity Specialist profile itself (remote operations, app development, insurance, compliance), pointing to one reusable module rather than profile-by-profile duplication.
- Pedagogical preferences were strikingly uniform across profiles: practical case studies, simulations, and scenario-based exercises were named as most effective across the board.
- Repeated calls for certification, accreditation, and modular materials with differentiated entry points across multiple profiles pointed towards micro-credentials as a promising delivery format, allowing professionals from different backgrounds to acquire and formally validate specific CCAM competences without requiring full programme enrolment.

Finally, the speed of technological developments and, consequently, changing regulations, challenges the robustness of developed structures. This is a further reason why short training courses are likely to be more effective than structural changes to the curricula of formal education programmes.

4 Conditions for Successful CCAM Deployment

4.1 Introduction

The effective deployment of CCAM relies on factors beyond technological advancement. Although automation and digital technologies enhance the capabilities of future mobility systems, large-scale implementation necessitates an enabling environment that supports organizations, workers, and public authorities during the transition.

Analyses from previous chapters indicate that common challenges arise across various transport domains, regardless of operational context diversity. Addressing these challenges requires conditions that enable organizations to adopt CCAM technologies effectively, manage workforce transformation, and function within a supportive regulatory environment.

This chapter focuses on two key conditions identified throughout the project: **workforce readiness** and **skills availability**, and **regulatory readiness**. These conditions form the foundation for sustainable, scalable, and socially responsible CCAM deployment and support the strategic recommendations outlined in the final chapter.

4.2 Workforce Readiness and Skills Availability

A skilled and adaptable workforce constitutes a fundamental prerequisite for successful CCAM deployment. As transport systems advance in automation, organisations require professionals who can operate within digitally connected environments, collaborate across disciplines, and respond effectively to evolving operational requirements. Consequently, workforce readiness encompasses not only technical expertise but also the organisational capacity to attract, develop, and retain appropriately qualified personnel.

The transition to CCAM is anticipated to increase demand for professionals possessing combined technical, operational, and transversal competencies. Although Section 3 presents educational pathways that address these emerging requirements, successful deployment ultimately depends on the ability of organisations to recruit, integrate, and continuously develop such expertise within their operational environments.

Workforce readiness further requires organisations to anticipate future competence needs, rather than merely responding to labour shortages after deployment has commenced. Strategic workforce planning, continuous professional development, and knowledge transfer mechanisms are essential components of organisational resilience. These measures enable organisations to adapt progressively as technologies and operational models evolve.

An additional consideration is the uneven distribution of specialised expertise across regions and transport sectors. Variations in labour market capacity, educational provision, and organisational maturity may affect the pace of CCAM implementation. Therefore, workforce readiness should be regarded not only as an organisational responsibility but also as a broader ecosystem challenge that requires collaboration among employers, education providers, and public authorities.

In summary, workforce readiness constitutes a long-term investment rather than a short-term deployment activity. Organisations that continuously develop their workforce will be better positioned to integrate technological innovation while maintaining operational performance, safety, and service quality.

4.3 Regulatory Readiness

A supportive and coherent regulatory environment is essential for the successful deployment of CCAM. As automated mobility systems become increasingly integrated into public transport and

logistics operations, regulatory frameworks must evolve to provide clarity regarding safety, liability, operational approval, and data governance. Regulatory readiness enables organisations to plan investments with greater confidence and ensures that technological innovation develops within a transparent and accountable framework.

A principal challenge in automated mobility is the pace at which regulation adapts to technological change. Although innovation progresses rapidly, legislative processes require thorough evaluation to ensure that new mobility services maintain high standards of safety, interoperability, and public protection. Achieving a balance between innovation and regulatory certainty is critical to sustaining deployment.

Successful implementation also depends on consistency across governance levels. Alignment among European initiatives, national legislation, and local implementation facilitates interoperability and reduces barriers to cross-border deployment. At the organisational level, clear regulatory guidance supports decision-making, risk management, and operational planning, enabling organisations to introduce new technologies within well-defined governance structures.

Regulatory readiness should be understood as an enabling condition that provides confidence to all actors within the CCAM ecosystem. It supports innovation while ensuring that deployment remains safe, transparent, and aligned with broader public policy objectives.

4.4 Summary of the Conditions for Successful CCAM Deployment

The effective deployment of CCAM depends on the interplay between technological capability, workforce readiness, and supportive governance. Although technological innovation forms the basis for automated mobility, successful implementation requires organisations to have access to skilled professionals within a well-defined and supportive regulatory framework.

The analysis in this chapter demonstrates that workforce readiness and regulatory preparedness are complementary conditions for deployment. Focusing on one without the other is unlikely to result in sustainable implementation. Coordinated advancement in both areas enables organisations to adopt automated mobility solutions more effectively while preserving operational performance, safety, and public trust.

Collectively, these conditions establish the basis for the strategic recommendations outlined in the subsequent chapter. They convert the evidence synthesised in Deliverables 4.6, 5.1, and 5.2 into actionable measures for policymakers, industry representatives, transport operators, education and training providers, and other stakeholders facilitating Europe's transition to CCAM.

Table 6 provides an overview of the key conditions identified in this chapter, outlines their significance for successful CCAM deployment, and specifies the stakeholder groups primarily responsible for supporting their implementation.

Table 6:Conditions for Successful CCAM Deployment

Deployment condition	Why it matters	Key actors
Workforce readiness	Ensures organisations have the capacity to deploy and operate CCAM solutions	Employers, education providers, public authorities
Skills availability	Reduces competence shortages and supports organisational resilience	Employers, VET providers, HEIs

Regulatory readiness	Provides certainty for investment and deployment	European institutions, national governments, regulators
Organisational adaptability	Facilitates integration of new technologies into existing operations	Transport operators, industry
Stakeholder collaboration	Supports coordinated implementation across the CCAM ecosystem	All stakeholders

5 Conclusions and Final Recommendations

The analyses presented in this deliverable indicate that the successful deployment of CCAM depends on the integrated advancement of technology, workforce capabilities, organisational practices, and regulatory frameworks. Although technological innovation remains a primary driver of automated mobility solutions, large-scale implementation is contingent upon the ability of institutions, organisations, and individuals to adapt to evolving operational requirements.

The recommendations in this chapter convert the evidence generated throughout CCAM-ERAS into actionable measures to support future deployment. Instead of advocating for a single implementation pathway, these recommendations acknowledge that various stakeholder groups hold distinct responsibilities within the CCAM ecosystem. Therefore, the recommendations are structured according to the principal actors responsible for enabling workforce transformation, enhancing organisational readiness, and supporting the sustainable deployment of automated mobility across Europe.

Collectively, these recommendations serve as a practical reference for policymakers, transport operators, industry representatives, education providers, and research organisations aiming to facilitate the transition toward safe, efficient, and socially inclusive CCAM systems.

5.1 Recommendations for European Institutions

European institutions play a critical role in shaping the strategic environment within which CCAM can be deployed consistently across Member States. In addition to supporting technological innovation, European policy should further promote an integrated approach that aligns research, regulation, workforce development, and industrial competitiveness.

A primary priority is the ongoing harmonisation of regulatory frameworks governing automated mobility. While significant progress has been made through European legislation and standardisation initiatives, variations in national implementation can create uncertainty for organisations planning long-term investments in automated transport systems. Sustained efforts toward regulatory convergence, common technical standards, and interoperable operational procedures will facilitate cross-border deployment and enhance confidence among public and private stakeholders.

European institutions should continue to support interdisciplinary research and innovation programmes that integrate technological, organisational, and socio-economic perspectives. Evidence from CCAM-ERAS indicates that successful deployment depends not only on technological advances in automation but also on workforce preparedness, organisational adaptation, and public acceptance. Future research initiatives should therefore promote collaboration among engineering, transport, social sciences, education, and public policy disciplines.

Another key area is the promotion of knowledge exchange among Member States. Experiences from pilot projects, living laboratories, and demonstration activities provide valuable practical knowledge that should be systematically shared across Europe. Enhancing cooperation among research projects, transport authorities, educational institutions, and industry will support the dissemination of best practices and minimize duplication of effort.

Analysis of six representative CCAM use cases indicates that workforce shortages, organisational readiness, and skills availability are more significant barriers to large-scale CCAM deployment than technological maturity. Therefore, it is recommended that European institutions continue to support initiatives to enhance workforce mobility, lifelong learning, and competence development throughout the Union. The promotion of common competence frameworks, mutual recognition of qualifications, and increased cooperation among education

providers will help develop a workforce capable of supporting the deployment of automated mobility across Member States, while also improving labour mobility and facilitating the broader adoption of CCAM technologies.

5.2 Recommendations for National Governments

National governments are tasked with establishing institutional and policy frameworks that facilitate the effective deployment of CCAM within their transport systems. Although European initiatives offer overarching strategic guidance, national authorities are essential in translating these objectives into practical measures that align with national priorities and operational contexts.

Developing national workforce transition strategies that anticipate evolving competence requirements associated with automated mobility should be a strategic priority. These strategies must foster collaboration among public authorities, employers, education providers, and social partners to ensure workforce development progresses in parallel with technological deployment, rather than reacting to skills shortages after they arise.

National governments should invest in large-scale reskilling and upskilling initiatives for the existing transport workforce. Although preparing future professionals through formal education is important, the successful deployment of CCAM will depend primarily on the capacity of current employees to adapt to new technologies and operational practices. Continuous professional development, short modular training programmes, and targeted reskilling initiatives should complement formal education policies to ensure that experienced workers remain engaged in the transition to automated mobility.

Governments must continue to adapt legislative and regulatory frameworks to accommodate technological innovation while upholding high standards of safety, accountability, and public trust. Regulatory frameworks should remain flexible enough to respond to technological developments without imposing unnecessary barriers to innovation or investment.

Investment in enabling infrastructure is another critical priority. Digital connectivity, communication systems, and intelligent transport infrastructure are essential components of future automated mobility services and require long-term planning supported by sustained public investment.

Finally, national authorities should also promote collaboration across the CCAM ecosystem by establishing coordination mechanisms that facilitate dialogue among transport operators, technology providers, educational institutions, research organizations, and representative bodies. This collaboration can enhance policy coherence and support more coordinated deployment strategies.

5.3 Recommendations for Industry and Technology Providers

Industry and technology providers are essential in transforming technological innovation into operational mobility services. Their responsibilities encompass not only the development of automated systems but also the support of organisations, employees, and users during the transition to more automated transport operations. Evidence from the CCAM-ERAS project indicates that successful deployment relies on both technological excellence and the capacity of organisations to prepare their workforce, adapt operational processes, and collaborate with the broader CCAM ecosystem.

Therefore, technology development must be integrated with workforce planning and organisational adaptation from the outset of innovation. Early identification of future competence requirements and the incorporation of workforce development into innovation strategies can facilitate smoother deployment and reduce the risk of operational disruptions

caused by emerging skills shortages. Workforce development should be regarded as a strategic investment that advances in parallel with technological maturity, rather than as a reactive measure to deployment challenges.

The project further underscores the necessity of designing technologies that facilitate effective collaboration between humans and automated systems. Applying human-centred design principles, transparent user interfaces, and operational support tools can enhance usability while promoting safety, trust, and acceptance among employees and end users. As automation shifts human responsibilities toward supervision, coordination, and decision-making, technologies should be developed to complement human expertise, ensuring that operators retain the ability to maintain safe and effective control in complex operational contexts.

Strengthening collaboration with educational institutions and research organisations should remain a strategic priority. By contributing practical expertise, operational knowledge, and technological advancements, industry can help ensure that educational programmes align with evolving labour market needs and facilitate the transfer of innovation into professional practice. Establishing long-term partnerships with universities, vocational education and training providers, and research organisations will support the ongoing evolution of educational programmes as CCAM technologies advance.

Industry should assume a more active role in workforce development by supporting internships, apprenticeships, industrial placements, and other forms of work-based learning. Offering learners opportunities to gain practical experience in authentic operational environments will bridge the gap between education and industrial practice and enhance graduates' readiness for employment. Additionally, providing education providers with access to simulation environments, demonstrators, operational datasets, and representative deployment scenarios can significantly increase the practical relevance of teaching and training activities. Such collaboration will help produce graduates with both theoretical knowledge and practical experience in emerging CCAM technologies.

Finally, industry should maintain active participation in collaborative pilot projects, living laboratories, and demonstration activities that allow organisations to evaluate technological solutions under realistic operational conditions and generate evidence to inform future deployment. Sharing operational experience, lessons learned, and best practices across projects and sectors will further enhance the collective capacity of the European CCAM ecosystem to deploy automated mobility safely, efficiently, and at scale.

5.4 Recommendations for Transport Operators

Transport operators are expected to be among the organisations most directly affected by the deployment of CCAM technologies. The capacity to integrate automation into daily operations while maintaining safety, efficiency, and service quality will significantly influence the pace and success of future implementation.

Organisations should therefore adopt proactive transition strategies that combine technological investment with organisational development. The preparation of operational procedures, redefinition of professional responsibilities, and support for employees throughout the transition should be considered essential elements of deployment planning, rather than actions taken after technological implementation.

Continuous professional development must be established as a strategic priority. As operational requirements change, employees should have access to opportunities to update their knowledge and acquire new competencies throughout their careers. This investment supports workforce readiness, enhances organisational resilience, and facilitates the adoption of new technologies.

Transport operators are encouraged to foster a culture of innovation and continuous improvement by involving employees in implementation processes, promoting interdisciplinary collaboration, and sharing operational experience with other organisations engaged in automated mobility initiatives.

Participation in pilot projects and collaborative demonstration activities should be maintained wherever feasible, enabling organisations to gain practical experience and contribute to the broader development of the European CCAM ecosystem.

5.5 Recommendations for Education and Training Providers

Education and training providers are essential in equipping the current and future workforce for the transition to CCAM. As technological innovation transforms transport systems, educational approaches must adapt to ensure that graduates and professionals acquire the knowledge, skills, and competences necessary to operate, manage, and support increasingly automated mobility services. Workforce preparation should be regarded as an ongoing process that responds to technological, organisational, and regulatory developments, rather than as a singular educational event.

Work Package 5 has established a comprehensive foundation for workforce preparation by developing occupational profiles, competence requirements, learning outcomes, indicative EQF levels, and educational pathways for emerging CCAM-related occupations. These research outcomes serve as practical resources for education and training providers in designing new curricula or updating existing programmes. Education providers are advised to utilize these outputs to achieve greater alignment between educational provision and the evolving competence needs of the European mobility sector.

Education providers should promote flexible learning opportunities that support both new entrants to the labour market and the existing workforce. As technologies evolve, lifelong learning, modular education, and stackable micro-credentials enable professionals to update their competences throughout their careers and allow organisations to respond more effectively to changing workforce requirements. These flexible learning pathways should complement traditional higher education and vocational programmes, supporting continuous professional development across all career stages.

Sustained collaboration with industry, transport operators, and research organisations should remain a strategic priority. Employers should be actively engaged in curriculum development, guest lecturing, work-based learning activities, and the regular review of educational programmes to ensure that learning outcomes align with operational practice. Strengthening these partnerships facilitates knowledge exchange between education and industry and enhances graduate employability and workforce readiness.

Increased emphasis should be placed on practical and interdisciplinary learning approaches. Simulation-based training, challenge-based learning, multidisciplinary project work, and exposure to real-world deployment scenarios strengthen learners' technical, operational, and problem-solving capabilities while enhancing familiarity with automated mobility systems. These learning environments more accurately reflect the interdisciplinary nature of CCAM and better prepare graduates for collaborative professional contexts.

Education providers should continue to promote interdisciplinary programmes that integrate transport engineering, digital technologies, artificial intelligence, cybersecurity, data analytics, public policy, and social sciences. Future CCAM professionals will increasingly operate across disciplinary boundaries, requiring both technical expertise and an understanding of organisational processes, regulatory frameworks, and societal implications. Educational

programmes should be reviewed regularly to ensure that curricula remain aligned with technological developments, labour market needs, and evolving European policy priorities.

The practical relevance of these educational recommendations was demonstrated through pilot educational activities conducted within Work Package 5. Specifically, the seminar organised by SAAM for representatives of Swiss public administrations introduced key CCAM concepts in governance, regulation, and deployment, and collected feedback on competence gaps and future training needs. The seminar identified sustained demand for structured learning opportunities in areas such as regulatory implementation, operational readiness, and organisational capability, thereby further validating the educational framework developed within CCAM-ERAS. The complete seminar report is provided in Appendix A.

The educational recommendations in Section 3 offer detailed guidance on curriculum design, learning pathways, and competence development. The current recommendations should be regarded as complementary, emphasising the strategic role of education providers in supporting the long-term deployment of CCAM across Europe.

5.6 Recommendations for Future Research

Despite notable advancements in understanding the workforce implications of CCAM, several critical areas warrant further investigation to enable large-scale deployment across Europe. Ongoing research should examine the dynamic interplay among technological innovation, workforce transformation, organisational adaptation, and regulatory development as automated mobility systems advance.

A primary priority is the longitudinal assessment of workforce impacts as CCAM transitions from pilot demonstrations to operational deployment. Future studies should evaluate the evolution of emerging occupations, changes in competence requirements across transport domains, and the contribution of education and training initiatives to workforce preparedness. Ongoing monitoring is also essential to assess the effectiveness of reskilling and upskilling strategies and to identify new competence gaps arising from technological and organisational change.

Further research should investigate the organisational and governance implications of CCAM deployment, including changes in operational responsibilities, human oversight, remote operations, liability allocation, and collaboration among public authorities, transport operators, and technology providers. Comparative analyses across European regions and operational contexts would offer valuable evidence to inform the development of harmonised implementation strategies, while accounting for national and sectoral differences.

Future research should also build upon the occupational profiles, competence frameworks, and educational recommendations developed within Work Package 5 to evaluate their long-term applicability, identify emerging professional roles, and support the ongoing adaptation of education and training systems. This work will help ensure that workforce development remains aligned with the evolving needs of the European CCAM ecosystem.

Collectively, the recommendations presented in this chapter establish a coordinated framework to support workforce preparedness, organisational adaptation, and the broader deployment of CCAM across Europe. To facilitate implementation, Table 7 provides a consolidated overview of the recommendations and the primary stakeholder groups they address.

Table 7: Strategic Summary of the strategic recommendations and the stakeholder groups responsible for their implementation

Stakeholder	Strategic recommendation	Expected outcome	Priority	Time horizon
European Institutions	Promote harmonised regulatory frameworks and interoperability across Member States.	Greater regulatory consistency and accelerated cross-border deployment.	High	Medium–Long term
European Institutions	Continue supporting interdisciplinary CCAM research integrating technological and socio-economic dimensions.	Sustained innovation and stronger evidence for future deployment.	High	Continuous
National Governments	Develop national workforce transition strategies aligned with CCAM deployment.	Better alignment between labour market needs and technological implementation.	High	Short–Medium term
National Governments	Invest in enabling digital and transport infrastructure.	Increased deployment readiness and operational resilience.	High	Medium–Long term
Industry & Technology Providers	Integrate workforce planning into technology deployment strategies.	Improved organisational readiness and smoother workforce transition.	High	Short term
Industry & Technology Providers	Adopt human-centred system design principles.	Increased usability, safety and user confidence.	Medium	Continuous
Transport Operators	Develop organisational transition plans alongside technology adoption.	More effective integration of CCAM into operational environments.	High	Short term
Transport Operators	Invest in continuous professional development.	Higher workforce resilience and operational capability.	High	Continuous

Education & Training Providers	Implement the educational recommendations presented in Section 3.	Workforce better prepared for emerging CCAM occupations.	High	Medium term
Education & Training Providers	Strengthen collaboration with industry and transport organisations.	Better alignment between education and labour market needs.	Medium	Continuous
Research Organisations	Continue monitoring workforce, societal and organisational impacts of CCAM.	Evidence-based policy development and continuous improvement.	Medium	Long term

5.7 Conclusions

5.7.1 Key Messages from CCAM-ERAS

The CCAM-ERAS project shows that successful deployment of CCAM relies on more than advances in vehicle automation and digital technologies. Although technological innovation forms the basis for future mobility systems, effective implementation also requires organisations, workforces, education systems and regulatory frameworks to evolve together. Therefore, the transition to CCAM should be viewed as a socio-technical transformation in which technological progress and human preparedness advance in tandem.

A key finding from the project is that automation mainly transforms occupations instead of replacing them. In the use cases studied, professional roles shift as routine tasks become automated and human responsibilities move toward supervision, coordination, decision-making and managing complex situations. These changes highlight the growing importance of digital literacy, interdisciplinary collaboration, systems thinking and ongoing competence development, while reaffirming the central role of human expertise in future automated mobility systems.

In addition to identifying these transformation patterns, CCAM-ERAS has developed a comprehensive knowledge base to support preparation of the future CCAM workforce. By creating occupational profiles, competence requirements, learning outcomes, indicative EQF levels and educational pathways, the project offers practical resources for education and training providers, policymakers, transport operators, industry and future research. These outputs provide a structured foundation for aligning education, training and workforce development with the evolving needs of the European CCAM ecosystem.

The project also shows that successful deployment requires an enabling environment beyond technology. Workforce readiness, organisational adaptability, regulatory clarity and stakeholder collaboration are all essential factors influencing the pace and sustainability of deployment in various contexts. Addressing these areas together is crucial to ensuring that automated mobility develops safely, efficiently, inclusively, and responsibly.

Ultimately, CCAM-ERAS underscores the need for an integrated approach to automated mobility. Technological innovation, education, governance, labour market development and organisational transformation should be addressed as interconnected elements of a shared transition. The findings in this deliverable show that sustainable deployment relies on coordinated action across the European CCAM ecosystem.

5.7.2 Looking Ahead

Although significant progress has been achieved in advancing automated mobility technologies, the transition towards widespread CCAM deployment remains an ongoing process that will continue well beyond the lifetime of the project. As technologies mature and operational experience increases, organisations, policymakers and education providers will need to continuously adapt to evolving competence requirements, regulatory developments and organisational practices.

The outputs developed within CCAM-ERAS provide a valuable starting point for this next phase. The occupational profiles, competence frameworks, learning outcomes and educational pathways established within Work Package 5 can support future curriculum development, workforce planning, policy design and industrial implementation activities. Future European initiatives are encouraged to build upon these outputs rather than developing new frameworks independently, thereby ensuring continuity, reducing duplication of effort and accelerating the uptake of common approaches to workforce development across Europe.

Looking ahead, continued collaboration between European institutions, national governments, industry, transport operators, education providers, research organisations and social partners will remain essential. Strengthening these partnerships will facilitate knowledge exchange, support the continuous evolution of education and training systems and promote evidence-based policymaking capable of responding to future technological developments.

Future research should continue monitoring the long-term impacts of CCAM deployment on occupations, organisations and society while evaluating the effectiveness of workforce development strategies and educational interventions. Maintaining an interdisciplinary perspective that combines engineering, transport, social sciences, education and governance will remain essential for ensuring that technological innovation continues to generate broad societal benefits.

5.7.3 Final Remarks

Deliverable 5.3 completes Work Package 5 by transforming the knowledge gained in CCAM-ERAS into practical guidance for expanding Cooperative, Connected and Automated Mobility across Europe. Drawing on use cases, stakeholder input, socio-economic analysis, workforce assessments and educational recommendations, this deliverable offers an integrated framework linking evidence, deployment conditions and strategic recommendations.

Importantly, the project delivers tangible resources that will remain valuable beyond the duration of CCAM-ERAS. The occupational profiles, competence requirements, learning outcomes, educational pathways and strategic recommendations from Work Package 5 are practical tools for education providers, policymakers, industry and transport organisations preparing for automated mobility. These outputs support broader use of the project's results by enabling consistent education, training and workforce policies across Europe.

CCAM-ERAS shows that the future success of CCAM depends not only on technological innovation, but also on Europe's ability to prepare the people, organisations and institutions involved in these systems. The project highlights that technological progress, workforce development, organisational adaptation and effective governance must advance together for Europe to achieve the full societal and economic benefits of automated mobility.

Ultimately, CCAM represents more than a transport technology innovation; it is an opportunity to create a mobility system that is safer, more efficient, inclusive and resilient. Through evidence-based recommendations and practical resources, CCAM-ERAS helps strengthen Europe's ability to deploy Cooperative, Connected and Automated Mobility in a way that is both technologically advanced and human-centred.

Appendix A

Seminar Report: Public Administration

Organised by SAAM, supported by the Horizon Europe Project CCAM-ERAS

Date & Location	25 June 2026, 10:00–16:00 – Welle7, Bern
Format	In-person seminar
Participants	23 representatives from German-, French- and Italian-speaking Swiss cantons
Speakers	Oliver Nahon (SAAM) · Lorenz Stalder (ASTRA) · Stefanie Berliner (Holo) · Caroline Bethmann (SAAM) · Lara Amini (LOXO)
Event Managers	Oliver Nahon (SAAM) · Caroline Bethmann (SAAM) · Stefanie Berliner (Holo)
Framework	CCAM-ERAS Work Package 5 — D5.2 Educational Instruments

Executive Summary

On 25 June 2026, SAAM organised the first Seminar-Training Course under CCAM-ERAS D5.2, bringing together 23 representatives from cantonal, municipality and federal authorities across German-, French- and Italian-speaking Switzerland. The four goals of the day were to help participants understand the opportunities and challenges at the end of automated mobility; to give them an overview of the regulatory, operational, safety and economic aspects of AV deployment; to identify the competencies and organisational capabilities public administrations need; and to assess their readiness for autonomous mobility. Running from 10:00 to 16:00, the day covered five modules:

- Module 1: Use Cases & Technology
- Module 2: Regulation Ordinance & Directives
- Module 3: Operational Readiness & Safety
- Module 4: Business & Sustainability
- Module 5: Acceptance and Adoption
- Seminar conclusion: A Public Administration Readiness Self-Assessment session.

The day opened with a Mentimeter baseline: when asked how ready their canton would be to authorise an approved autonomous vehicle today, 18 participants averaged 2.7 out of 10. Asked what is missing, 23 responses converged on the same themes across all language regions: absent processes, unclear legal frameworks, insufficient internal know-how, unclear responsibilities, no political vision, and no practical experience with real deployment cases.

All five modules generated active discussions. The Swiss AV landscape and LOXO's operational depth (Module 1) made the technology tangible. The ASTRA presentation (Module 2) helped cantons answer many of their open questions on the federal/cantonal split, while also surfacing, through the resulting discussion, how many topics still remain to be addressed. Holo's detailed operational framework (Module 3) provided participants with a concrete picture of what supervising an AV service entails. The economic and sustainability content (Module 4) and concrete Swiss examples sparked reflection on authorities' role as market shapers. The Adoption module (Module 5) showed that concrete data, acceptance figures, and policy numbers drive better questions than abstract frameworks, while also highlighting the competences cantons still need to acquire to effectively deploy AVs.

The Authority Readiness Self-Assessment revealed a significant challenge: many participants struggled to rate themselves because they lacked sufficient knowledge to know where they stood. This finding is itself an important take-away.

Post-seminar, 13 participants completed a competency self-assessment (on a scale of 1 to 5). The overall average was 2.38/5, with 57% of responses at 1 or 2. The Seminar satisfaction and enjoyment was high (4.4/5); how well the day met professional needs scored 3.5/5 — a score that reflects the breadth of remaining learning needs. Open feedback confirmed demand for a series of more focused seminars: participants wish for deeper dives into the authorisation process, inter-cantonal coordination models, and more applied technical content.

Measured against these four goals, the day achieved what it set out to do: participants left with a shared overview of the technology, regulation, operations, economics and public acceptance of AVs; the baseline and competency self-assessment gave organisers and participants a clear map of where public administrations currently stand; and the readiness exercise — together with the strong demand for follow-up events — confirmed that the introductory objectives were met, while pinpointing exactly where the next, deeper seminars should focus.

1. Context and Objectives

CCAM-ERAS — CCAM Employment Realisation through the Acquisition of Skills — is a Horizon Europe project funded by the European Commission to prepare Europe for the transition to connected, cooperative and automated mobility, with a focus on the skills deployment will require. Work Package 5 (D5.2, Educational Instruments) mandates concrete training tools for the actors who will enable responsible AV deployment. As the Swiss consortium partner, SAAM organised this training as part of its project role. The cantons were addressed directly because Switzerland's new legal framework makes them the decisive actors: under the Ordinance on Automated Driving (VAF), the canton of registration authorises operational zones and supervises driverless operation. They hold the authorisation competence, and — as the opening baseline confirmed — their readiness gates every real deployment.

The CCAM-ERAS D5.2 Seminar builds the competencies public authorities and operational specialists need for responsible AV governance. This first seminar was a broad introductory overview — the first in a series, with future events exploring each topic in greater depth. It was offered free of charge (value approximately CHF 500 per person), organised by SAAM and supported by the CCAM-ERAS EU project.

Presentations were delivered in speakers' native languages (German, French, English), with automatic German and French subtitles and slides distributed in both languages beforehand — a trilingual format reflecting the diversity of the Swiss cantonal audience.

The day was built as five sequential modules — Use Cases & Technology; Regulation; Operational Readiness & Safety; Business & Sustainability; and Acceptance & Adoption — closing with an Authority Readiness Self-Assessment. This sequence mirrors the reasoning a canton must perform to authorise a deployment: understand the technology, then the rules that govern it, then what supervising it in practice demands, then its economics and public acceptance — and only then judge its own readiness.

The four stated objectives for the day were:

- Understand the opportunities and challenges of automated mobility
- Gain an overview of regulatory, operational, safety, and economic aspects of AV deployment
- Identify the competencies and organisational capabilities needed within public administrations
- Assess readiness for autonomous mobility

2. Context and Objectives Programme

Seminar Introduction and Objectives | Oliver Nahon (SAAM)	10:00 – 10:15
Module 1: Use Cases & Technology | Oliver Nahon (SAAM)	10:15 – 10:45
Module 2: Regulation, Ordinance & Directives | Lorenz Stalder (ASTRA)	10:45 – 11:30
Module 3: Operational Readiness, Safety & Data | Stephanie Berliner/Andres Toft (Holo)	11:30 – 12:15
Module 4: Business & Sustainability | Caroline Bethmann (SAAM) & Lara Amini (LOXO)	13:15 – 14:15
Module 5: Acceptance & Adoption | Caroline Bethmann (SAAM)	14:15 – 14:45
Authority Readiness Self-Assessment	14:45 – 15:15

3. Opening Baseline Assessment

Before the first module, participants completed two Mentimeter questions. 18 of 20 participants responded.

Asked “If approved autonomous vehicles existed today, to what extent would your canton be ready to authorise them?” on a 0–10 scale, the average was 2.7 out of 10. This result set the tone for the day: it confirmed that most cantons lack the governance frameworks, processes, and legal bases to act on a real authorisation request, even as the technology approaches readiness.

Asked what is missing, 25 open responses revealed a consistent picture across all language regions: absent authorisation processes, unclear legal and regulatory frameworks (particularly on the cantonal side), lack of internal know-how on AV technology and governance, unclear organisational mandates and responsibilities, absence of political vision, and no practical experience with real deployment cases. (see Annex1)

4. Module Summaries

Module 1 — Use Cases & Technology | Oliver Nahon (SAAM)

Oliver Nahon opened with a panoramic introduction to the AV landscape: use case categories (personal cars, shuttles, buses, robotaxis, teleoperation, logistics, delivery, trucks), the Swiss context (33 automated vehicles operating since 2015, with 100 expected by end of 2028 across different use cases), and a tour of technology generations, from Generation 1 industrial robotics on wheels (Navya, Easymile) through Generation 2 modular AI stacks (Waymo, Mobileye) to Generation 3 end-to-end AI systems (Wayve) that learn driving policy directly from data.

The presentation included an overview of past and ongoing autonomous mobility projects in Switzerland, each illustrated with video footage of the deployed systems in operation — bringing the technology to life for participants and demonstrating the breadth of real-world CCAM activity already underway in the country:

- **LOXO/Planzer ("Matilda")** — Bjorn Linder: Autonomous last-mile parcel delivery on public streets in Bern since September 2024, in partnership with Planzer. Switzerland's first dynamic micro-hub. No safety driver; received L4 certification in May 2026.
- **Embotech** — Fabien Kritter: L4 autonomous vehicle marshalling deployed at five BMW factories; 600,000 vehicles moved autonomously with a 99%+ success rate. Also operates an autonomous tractor at the Port of Rotterdam.
- **ARTOUR** — Hans-Ruedi Bruderer and team: Full-size autonomous bus on a nine-stop route through the narrow streets of Arbon, running 365 days a year on a half-hourly service. Over 3,000 passengers carried, with remote driving handling the 5% of edge cases.
- **PostAuto AMIGO** — Martin Neubauer: 25 Apollo Go vehicles ordered for on-demand ride-pooling in Eastern Switzerland (approx. 80 km^2). Target: remove the safety driver by 2027.
- **ULTIMO** — €50M EU-funded L4 on-demand project launching in the Geneva cross-border area (France/Switzerland) in mid-September 2025, with 15 vehicles.
- **Swiss Transit Lab** — Matthias Rödter: Focused on building the business case and operational model for AV integration in public transport, including ride-pooling, on-demand, and fixed-line evaluation.
- **ARRIVE** — Cross-border AV project in the Basel tri-border region (CH/FR/DE), serving as a blueprint for harmonised cross-border autonomous mobility in Europe.
- **Zurich Airport** — Raphaël Glaesener: Two autonomous shuttle buses (Nimbus & Stratus) operating on a 6.5 km airfield route since April 2025. Received L4 certification in May 2026.

The presentation then turned to a deep dive into the Swiss start-up LOXO (a CCAM-ERAS partner): one of Europe's most experienced urban logistics robot, in the process of obtaining one of Europe's first type approval for autonomous driving. This section made the business case for autonomous last-mile delivery concrete: although the last mile accounts for only 10–15% of total vehicle kilometres in a delivery journey, it is responsible for up to 25% of associated CO_2 emissions: a disproportionate environmental cost driven by inefficient routing, frequent stop-start driving, and underutilised vehicles on the final, most fragmented leg of delivery. At the same time, this last mile represents 53% of total shipping costs, making it both the most expensive and the most polluting segment of the delivery chain, and therefore the segment where autonomous, optimised, electric delivery robots can have the greatest combined economic and environmental impact. The presentation went on to cover the Digital Driver™ technology stack (cameras, LiDAR, and radar fused with precision localisation), LOXO Remote AR-enabled supervision, the micro-hub model in Bern, and performance monitoring through KPIs. Both the broader Swiss AV landscape and the LOXO case generated active discussions. Participants responded particularly well to the combination of strategic context and operational depth, seeing real deployed systems, real performance data, and a clear business rationale made the technology tangible in a way that abstract descriptions do not.

Module 2 — Regulation, Ordinance & Directives | Lorenz Stalder (ASTRA)

Lorenz Stalder (ASTRA) presented the Swiss regulatory framework in detail. The core legal basis is the amended Road Traffic Act (SVG, Article 25c, in force since 1 March 2025) and the new Ordinance on Automated Driving (VAF), which establish the conditions for the operation of driverless vehicles: approved operational zones and operator supervision. The framework adopts a principle of dynamic legislation; use cases are regulated at ordinance level to allow rapid and flexible adaptation as technology evolves.

Three conditions must be met for authorisation: compliance with construction and equipment requirements (type approval); demonstrated liability insurance; and approval of the operational zone (Einsatzbereich). Type approval requires EU whole-vehicle type approval, referencing UNECE technical regulations and EU Implementing Regulation 2022/1426, with harmonised global technical regulations expected from UNECE starting in approximately 2027. On liability, the holder bears strict liability for damage caused during operation; insurers may seek recourse against manufacturers under product liability law, and potentially against the approving canton under state liability law, a point that drew significant attention.

The operational zone approval process is handled by the canton of registration. The canton must verify that the vehicle can travel safely without impeding traffic flow and may reject an application based on local conditions — a broad discretion that gives cantons genuine scope to shape mobility. To support cantons, the Federal Council has issued directives (in force since January 2026) including a three-step assessment instrument: Step 1 assesses operational and technical preconditions (documentation completeness, operational concepts, Operational Design Domains (ODD) boundaries); Step 2 analyses the specific routes; Step 3 assesses manageability. The Federal Council has also established a support group to support cantons through this process.

> *Notably, the module also surfaced what is not covered by the current framework: connectivity and data management, regulation of business models, and authorisation/concession for passenger transport services remain outside the VAF scope, areas that participants flagged as important open questions.*

Module 3 — Operational Readiness, Safety & Data | Stephanie Berliner / Andres Toft (Holo)

Andres Toft (Holo) - replacing Stephanie Berliner (Holo) - delivered a technically detailed presentation structured in five parts. Part 1 introduced the eight-phase AV deployment journey, from concept through to sustained operations, with the key message that authorisation is not a one-time act at the start but accompanies every phase.

Part 2 addressed safety as a system: the fundamental shift from conventional traffic, where a driver decides in the moment, to AV operations, where safety responsibility moves from the individual to the organisation. This means cantons must now assess two things simultaneously: technical approval and organisational capability.

Part 3 introduced the Safety Management System (SMS), the organisational answer to that responsibility shift, with six concrete building blocks including change management (every software or infrastructure update triggers a reassessment). The 18-step incident management lifecycle was presented in detail: from detection through containment, investigation, reporting, and systematic improvement, a closed loop that is granular and auditable. Part 3 also mapped these steps to the three concrete blocks of legal requirements in the Swiss VAF regulation. Part 4 showed how data (six source categories including safety KPIs, weather, and ODD data) flows into consolidated operational insights, and how KPIs function as control mechanisms rather than reporting metrics, with Holo's own operational dashboards as examples. Part 5 addressed scaling from pilot to sustained operations.

The module was absorbed with strong interest across all participants. The level of technical and operational detail was new to most and valuable precisely because it gave a concrete picture of what supervising an AV service requires of a canton. The session closed with five questions every canton should ask of an operator: Is the operational model clearly defined? Are responsibilities assigned? Is safety managed systematically? Are incidents traceable and manageable? Are KPIs available to demonstrate safe operations? These questions serve as an immediately usable reference.

Module 4 — Business & Sustainability | Caroline Bethmann (SAAM) & Lara Amini (LOXO)

The post-lunch module examined AVs through economic and sustainability lenses. The session opened with a contrast between today's transport operations, which are labour-intensive with clearly defined roles, and the emerging model, which is software- and data-driven, relies on hybrid roles and continuous system monitoring, demands new digital skills, and shifts costs from labour to digital infrastructure. This contrast framed the session's core argument: authorities are not passive observers of this transition, but active shapers of it.

The economic pathways section presented CCAM-ERAS' WP4 Analysis of the effects of CCAM scenario findings across three use cases:

- **Warehousing and logistics:** fastest adoption, up to 934k job changes by 2050 in high-uptake scenario;
- **Road freight:** moderate innovation, 65–90k fewer workers by 2050, losses concentrated in early-adopter member states;
- **Passenger transport:** highest barriers, delayed adoption, but the only scenario with potential net employment gains under high uptake, +165k EU workers by 2050, driven by investment stimulus and growing ICT roles.

The consistent societal readiness finding is that long-term growth trends are gradual, not abrupt, and that governance, inclusive design, and trust-building are prerequisites for shared benefits.

Business models were introduced through three relationships:

- B2C: direct to user: ride-hailing, on-demand shuttles, MaaS,
- B2B: service or licence to another company), SaaS (fleet contracts, technology licensing to OEMs,
- B2G: contract with public authorities: EU project grants, subsidy models with cantonal authorities, as in the TPG Geneva example.

The sustainability section addressed three dimensions:

- **Economic** (high upfront capex, long approval timelines, unit economics only at scale, helped by SaaS models, EU grants, public subsidy, and hybrid revenue);
- **Environmental** (EV rebound effects and data centre energy costs as challenges; electric powertrains and route optimisation as solutions);
- **Social** (digital exclusion and job displacement as risks; on-demand accessibility and reskilling as responses).

A dedicated section showed how authorities are market shapers, not just regulators:

- Regulation and permit design (setting what operators must build),
- Financing and subsidies (de-risking pilots and extending coverage),
- Social equity mandates (requiring accessibility for vulnerable groups and rural areas), and
- Urban planning integration (enabling operator viability through infrastructure investment).

Concrete Swiss examples: the ULTIMO Geneva mandate, the LOXO–Bern micro-hub, the TPG pilot, grounded these principles in familiar local contexts and drove the most animated discussion of the module.

Module 5 — Acceptance & Adoption | Caroline Bethmann (SAAM)

The final module opened by presenting a survey that was asked to the Artour automated bus's passengers in Arbon: would you still use the Artour bus if it were driving fully autonomously, with no driver on board? With 86% respondents answering "yes", the result shows that the public who have experienced AVs mainly accept it.

The module then introduced six new roles and competences needed within public administrations for AV adoption:

- policy and regulatory literacy (AV regulations, data frameworks, cross-border harmonisation);
- permit management and ODD assessment (evaluating and approving AV operation zones);
- infrastructure and digital readiness (integrating AV infrastructure into planning);
- safety and risk oversight (data interpretation, continuous risk monitoring, operational safety validation);
- data management and sovereignty (handling operational data, ensuring privacy and public ownership);
- public communication and acceptance (explaining AV operations, managing transparency and trust).

Policy recommendations from the CCAM-ERAS Final Event (Brussels, 9 June 2026) were presented:

- covering governance and institutional coordination;
- skills, education and training; employment and labour-market transition;
- equity, accessibility and inclusion; funding and financing;
- data, digital infrastructure and cybersecurity; public trust and engagement;
- and regulation, procurement and deployment frameworks.

The module confirmed that concrete numbers and specific data, acceptance rates, employment scenarios, and policy evidence consistently generated more engagement and better questions than abstract frameworks. Participants connected the acceptance and institutional capacity themes to their own experience managing public resistance to infrastructure changes, making the session highly applicable.

5. Authority Readiness Self-Assessment

The self-assessment asked participants to rate their personal confidence across six pillars: Regulation & Governance, Deployment, Competences, Infrastructure, Business Models, and Acceptance & Transition. The scale ran from from 1 to 5 (1 = not confident ; 5 = fully confident)

The dominant experience was one of difficulty: many participants found it hard to rate themselves, since they didn't yet know enough to recognise their own gaps. This is itself a significant finding, a level of uncertainty that goes beyond identifying weaknesses and reflects an earlier stage of awareness. The self-assessment was most useful as a starting point for peer conversation rather than as an individual scoring exercise, and the comparison between colleagues surfaced differences in perspective that participants found valuable.

> *The self-assessment difficulty confirms that the training series is needed not only to fill specific gaps but to give public administrations a working map of the domain, so they can begin to locate themselves within it.*

The results provide an evidence base for the design of follow-up training seminars.

5.1. Competency Results by Theme

Overall mean across all 22 competencies: 2.38/5. 57% of all responses scored 1 or 2 (low confidence). No respondent scored 5 on any item.

Regulation and legal frameworks scored highest (2.73/5), reflecting the grounding provided by the ASTRA presentation. Business and adoption topics (2.58/5) also benefited from concrete examples and data. The three lowest-scoring areas: infrastructure (1.96), operational readiness (1.98), and skills & organisation (2.27), represent the clearest priorities for follow-up training. (see Annex 3)

The three individual competencies with the lowest scores all relate to the core authorisation task:

- Assess operator safety measures, emergency protocols, and data protection: 1.77/5
- Formulate clear requirements to operators (data, reporting, liability): 1.85/5
- Make or recommend an authorisation decision based on a structured dossier: 1.92/5

These results point to a clear design brief for the next seminar: participants need practical, tool-based training on the authorisation process itself: what to ask, what to assess, and how to reach a decision and communicate it.

5.2. Event Satisfaction

The high enjoyment score (4.4/5) reflects the content's quality and relevance. The gap between enjoyment and ‘met professional needs’ (3.5/5) is expected for an introductory overview seminar

and reflects participants' recognition that the day provided valuable orientation while leaving significant learning needs unmet, which is consistent with the design intent of this first event. (see Annex2)

5.3. Event Satisfaction Participant Feedback and Suggestions

Open responses identified the following priorities for follow-up events:

- Step-by-step walkthrough of the cantonal authorisation process: application documents, review procedure, decision format, which internal services to involve
- Inter-cantonal coordination models, particularly for small cantons with limited capacity
- A dedicated public transport seminar with cantons, transport operators, and ASTRA (suggested for 2027)
- Close cooperation with A-LAUF
- More applied technical content to build understanding of AV systems as a basis for assessing applications
- Regulatory roadmap update: timeline for type approvals, public transport concessions
- New professions and training pathways in the AV domain

Additional comments: the LOXO example was highlighted as particularly inspiring; one summarised the day as: "There are still many questions, but now we first need to work on our foundations. A second day like this would be great."

6. Cross-Cutting Findings

- The federal/cantonal split is the most urgent clarification need. Module 2 revealed that many participants did not know that cantonal authorisation responsibility is already live under the VAF, or that ASTRA directives ("Weisung") to support them have been in force since January 2026. Ensuring this understanding reaches all relevant cantonal staff is a prerequisite for any further readiness-building.
- Operational depth builds confidence. Module 3's detailed treatment of Safety Management Systems, incident management, and KPIs was well received precisely because it provided participants with a concrete vocabulary and framework for assessing what they needed to assess. Abstract overviews are less useful than structured operational tools.
- Concrete examples and numbers drive better questions. Across Modules 1, 4, and 5, discussion was consistently richer when grounded in real Swiss cases (LOXO, TPG, Artour, iamo project) or concrete data (employment scenarios, acceptance figures, policy evidence). The next seminar should maximise this approach.
- The self-assessment revealed meta-uncertainty. Participants did not struggle to rate themselves because they were modest — they struggled because they did not yet have a clear enough map of the domain to locate themselves within it. This is a prior learning need that the training series must address.
- A series of seminar is needed and wanted. Multiple participants explicitly requested a follow-up. The competency data provide a clear brief: focus on the authorisation process, inter-cantonal coordination, and applied technical content. The introductory overview has done its work; the next event should go deeper.

Conclusions and Next Steps

The 25 June 2026 seminar successfully delivered a first, broad introduction to AV governance for Swiss cantonal authorities. The engagement was high, the content was relevant, and the day surfaced important clarifications, particularly on the regulatory framework, that participants had not previously had access to. The competency assessment and open feedback provide a solid evidence base for the next phase of the training series.

Recommended next steps

- Design a series of focused seminars centred on the cantonal authorisation process: a step-by-step walkthrough with templates, checklists, and a mock application exercise — directly addressing the three lowest-scoring competency areas.
- Develop inter-cantonal coordination guidance as a training output, addressing the repeated request for models that allow small cantons to pool capacity.
- Plan a dedicated public transport module for 2027 that brings together cantons, transport operators, and ASTRA.
- Coordinate and collaborate with ALAUF to support public administrations.
- Potentially broaden the format into a multi-stakeholder seminar over time — bringing in together public administrations, transport operators, AV suppliers, and other actors from across the mobility ecosystem.
- Make the course available to all CCAM-ERAS partners so that they can replicate it across national and regional contexts.

References

Annex 1: Participant Baseline Responses

Mentimeter question: “What is missing to be ready?” — 18 respondents, 25 answers, reproduced in original language.

Prozess

- Prozesse
- Les directives cantonales
- Anforderungen
- Organisation und Grundlagen
- Prozesse
- Les ressources pour traiter les demandes
- Une connaissance des règles applicables (à tout niveau)
- Gesetzliche Grundlagen (kantonal) Eingeführter Prozess
- Une vision politique et régler beaucoup de details pratiques
- Une organisation clair de qui s’occupe de quoi?
- Alles. Verantwortlichkeit des Prozess
- Kentnissen in Thema
- Prozess
- Know how
- Kriterien
- Klare Regeln,
- Gesuchsgrundlagen
- Wissen, Organisation, Zuständigkeiten, politischer Prozess

- Prozesse und Verantwortlichkeiten im Kanton und erste Praxiserfahrungen
- Anwendungsfälle
- Behördenkoordination
- Une acceptation politique
- Rechtsgrundlagen Prozess Kompetenzen

Annex 2: Satisfaction

	Enjoyed the day (/ 5)	Met professional needs (/ 5)
French-speaking participants (n=2)	**5.0**	**5.0**
German-speaking participants (n=11)	**4.3**	**3.3**
Overall (n=13)	**4.4**	**3.5**

Annex 3: Competency Results

Theme	Lowest-confidence competencies	Avg /5
Regulation & Legal Framework	*Distinguish cantonal vs federal competencies; explain pilot vs commercial differences*	2.73
Business, Economics & Adoption	*Understand AV business models; assess public authority's role beyond authorisation*	2.58
Skills & Organisation	*Identify training needs; assess employment/skills impacts*	2.27
Operational Readiness & Safety	*Assess operator safety measures; formulate requirements on data, reporting, liability*	1.98
Infrastructure Readiness	*Assess Level 4 infrastructure fit; understand V2X/digital infrastructure requirements*	1.96