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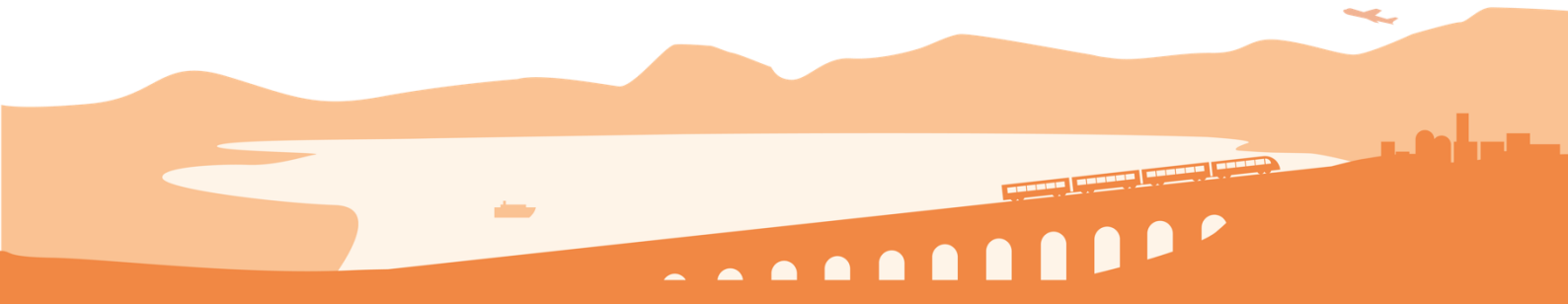

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1. Overview

This deliverable (D.3.1.2) provides the long-term sustainability guidelines for Solution No. 2 – Gates and Entry/Exit Tools and Procedures, jointly developed within the ACCESSMILE project.

The jointly developed solution focuses on improving entry and exit logistics processes through interoperable digital tools, automation and coordinated gate management. Building on the lessons learned from the pilot actions, the solution aims to optimise vehicle access procedures, reduce congestion, improve operational safety and efficiency, and enhance the reliability and predictability of freight movements at ports, terminals, freight villages and intermodal logistics hubs.

The solution has been jointly developed from the complementary pilot actions implemented by:

- PP2 – ZAILOG (Verona Freight Village) – Italy
- PP3 – Port of La Spezia / ADSPMLOR – Italy
- PP4 – Luka Koper – Slovenia
- PP8 – RSOE – Hungary
- PP9 – BCT Gdynia – Poland

Rather than replicating individual technological applications, the ACCESSMILE jointly developed solution defines a common approach to modern entry and exit management processes. It combines automated vehicle identification, digital pre-registration, real-time gate coordination, interoperable exchange of operational data and automated compliance controls to improve the efficiency and resilience of logistics operations while remaining adaptable to different operational contexts and levels of digital maturity.

The complementary pilot actions demonstrated how different technological solutions—including terminal operating system upgrades, optical character recognition (OCR), Weight-in-Motion (WIM) systems, real-time vehicle monitoring and digital pre-registration tools—can contribute to the same operational objectives. The lessons learned from these pilot actions have been consolidated into a transferable framework of improved logistics processes that can support ports, terminals and logistics hubs in reducing waiting times, increasing interoperability, lowering emissions generated by congestion and unnecessary vehicle movements, and strengthening the accessibility of rural and peripheral areas connected to the TEN-T network.

2. SWOT analysis of ACCESSMILE jointly developed solution and adopted technical measures

The SWOT analysis assesses the ACCESSMILE jointly developed solution for improving entry and exit logistics processes, which has been developed from the lessons learned of the complementary pilot actions implemented in Verona, La Spezia, Koper, Hungary and Gdynia. Rather than evaluating the individual pilot actions, the analysis focuses on the common operational approach combining interoperable digital technologies, coordinated gate management and improved logistics processes.

The jointly developed solution aims to optimise vehicle access and exit procedures through automated identification, digital pre-registration, real-time operational coordination, interoperable data exchange and automated compliance controls. These elements contribute to reducing congestion, increasing operational efficiency, improving safety and security, lowering the environmental impact of freight operations, and strengthening the accessibility of rural and peripheral areas connected to the TEN-T network.

The following SWOT analysis identifies the main Strengths (S), Weaknesses (W), Opportunities (O) and Threats (T) associated with the long-term deployment, transferability and scalability of the ACCESSMILE jointly developed solution.

Strengths	Weaknesses
• Significant reduction of truck waiting and processing times • Automated data capture (OCR, WIM, digital interfaces) • Improved accuracy and security of gate operations • Demonstrated interoperability between PCS and TOS systems • Functional in both large maritime ports and inland terminals • Modular and scalable architecture • Improved coordination of entry and exit logistics processes • Reduced congestion, idling and related emissions • Enhanced accessibility of rural and peripheral logistics nodes	• Heterogeneous digital maturity across sites • Need for staff training • Partial integration with customs systems in some contexts • Initial investment required for OCR and WIM equipment
Opportunities	**Threats**
• High replicability across TEN-T ports and inland nodes • Alignment with EU policies on digitalisation, decarbonisation, multimodality and sustainable freight transport • Potential integration with AI-based traffic forecasting • Improved regulatory enforcement (weight, safety, documentation	• Risk of fragmentation implementation without common standards • Resistance from operators accustomed to manual processes • Dependence on ICT vendors • Regulatory delays (e.g. WIM certification)

• Wider deployment across TEN-T corridors and logistics nodes serving rural and peripheral areas.	

Table 1 - SWOT analysis of Topic 2 – Gates and Entry/Exit Tools and Procedures

The lessons learned from the pilot actions confirmed that entry and exit procedures represent one of the most critical interfaces within the logistics chain.

The ACCESSMILE jointly developed solution demonstrates that improving these processes through interoperable digital technologies and coordinated operational procedures can generate significant benefits in terms of throughput, predictability, safety, environmental performance and accessibility. Rather than depending on a specific technological configuration, the solution combines different digital components into a common operational framework that can be transferred and adapted to different logistics environments.

The weaknesses and threats identified through the SWOT analysis should be addressed to support the long-term deployment, transferability and upscaling of the ACCESSMILE jointly developed solution. The following table identifies measures aimed at strengthening the improved entry and exit logistics processes, their interoperability and their adaptation to different operational contexts.

Key issues from the SWOT analysis		Potential measures to overcome weaknesses and threats	Expected effects
1.1.	Different IT maturity levels	Provide common API standards, shared protocol documentation, and modular deployment kits.	Higher interoperability; smoother gate automation.
1.2.	Training needs	Regular training sessions and ICT workshops for operators and SMEs.	Higher efficiency, fewer errors, stronger uptake.
1.3.	Limited integration with customs	Promote cross-agency data-sharing agreements and standardised e-documents.	Faster clearance and reduced queues.
1.4.	Initial investment for hardware	Seek EU/national grants and shared funding models.	Lower financial burden for smaller terminals.
1.5.	Risk of fragmentation	Establish shared governance and common technical guidelines.	Harmonised deployment across Central Europe.
1.6.	Resistance from operators accustomed to manual processes.	Implement structured change-management programmes, including awareness campaigns, hands-on training, and on-the-job coaching; involve frontline operators in the co-design of procedures; introduce phased deployment with pilot phases and feedback loops.	Higher user acceptance and trust in the new systems, smoother transition from manual to digital procedures, fewer operational errors, and a more stable use of automated gate tools.
1.7.	Dependence on external ICT vendors for updates	Promote the use of open standards and documented APIs; negotiate clear SLAs and long-term maintenance contracts; gradually build internal ICT capacity to manage basic configurations; diversify suppliers where possible to avoid single-vendor lock-in.	Reduced vulnerability to vendor lock-in, higher continuity of service, better control over lifecycle costs, and increased flexibility to

Key issues from the SWOT analysis		Potential measures to overcome weaknesses and threats	Expected effects
			adapt systems to evolving operational needs.
1.8.	Regulatory delays for certification of technologies (e.g., WIM).	Engage early with competent authorities and standardisation bodies; use pilot projects to generate evidence and share results with regulators; participate in national and EU working groups on WIM and digital enforcement; align project specifications with emerging legal and technical standards.	Shorter and more predictable certification processes, earlier large-scale deployment of WIM and related technologies, and greater legal certainty for operators and authorities using digital gate solutions.
1.9.	Environmental impacts not systematically monitored	Define common indicators for waiting times, idling, fuel consumption, congestion-related emissions and avoidable vehicle movements.	Clearer evidence of environmental benefits and stronger support for replication and investment decisions.
1.10.	Limited accessibility of rural and peripheral logistics nodes	Prioritise lightweight, modular and cost-effective tools such as digital pre-registration, interoperable data exchange and real-time driver information, adapted to smaller or less digitalised nodes	More reliable access to TEN-T corridors, reduced delays and improved integration of rural and peripheral areas into European logistics chains.

Table 2 - Possible measures to strengthen the transferability and long-term deployment of the ACCESSMILE jointly developed solution

3. Long-term sustainability goals and strategies of the jointly developed solution

Three long-term sustainability goals have been identified to support the continuation, transferability and progressive upscaling of the ACCESSMILE jointly developed solution for improved entry and exit logistics processes. Building on the lessons learned from the pilot actions, these goals aim to ensure that the solution remains operationally effective, interoperable and adaptable to different logistics environments while contributing to environmental sustainability and improved accessibility of rural and peripheral areas connected to the TEN-T network.

No.	Long-term sustainability goals	Proposed strategies for implementation of goals	Expected long-term impact
G1	**Maintain and further develop interoperable digital entry and exit management processes**	○ Continue integrating OCR, WIM, digital pre-registration and gate management functions into national and port digitalisation strategies. ○ Maintain interoperability between PCS, TOS, customs and traffic management systems. ○ Promote common operational standards and data models across logistics nodes.	Improved gate efficiency, safer operations, higher accuracy of data, reduced congestion-related emissions, more reliable access to TEN-T nodes
G2	**Promote the uptake of the jointly developed solution among logistics stakeholders**	○ Disseminate replication guidelines, documentation, and training modules. ○ Organise workshops within Central Europe for terminal operators and SMEs. ○ Encourage rural and peripheral transportation companies to adopt digital gate pre-registration. ○ Share operational guidelines and lessons learned.	Broader adoption of automated gate systems, improved accessibility, and fewer bottlenecks in rural areas, lower environmental impact.
G3	**Strengthen cross-border governance and interoperability**	○ Establish a coordinated forum for OCR, WIM, PCS, and TOS operators. ○ Promote alignment on safety, security, and digital data standards. ○ Develop shared KPIs (waiting time, throughput, CO_2 reduction) ○ Promote common governance principles derived from the ACCESSMILE jointly developed solution.	Reliable interoperability, harmonised digital gate management, increased resilience, and improved environmental and operational performance across borders.

Table 3 - Proposed strategies to provide long-term continuation of gate and entry/exit improvements

The three long-term sustainability goals should be considered as complementary dimensions of the ACCESSMILE jointly developed solution. Maintaining interoperable entry and exit management processes (G1), promoting their uptake among logistics stakeholders (G2), and strengthening cross-border governance and cooperation (G3) together ensure that the solution can continue evolving beyond the project lifetime. Their combined implementation will support more efficient and sustainable freight operations, reduce

congestion-related environmental impacts and improve the accessibility of rural and peripheral areas connected to the TEN-T network.

3.1. Hints for continuation & extension of the solution

The continuation and extension of the ACCESSMILE jointly developed solution should build upon the improved entry and exit logistics processes derived from the lessons learned from the complementary pilot actions. The long-term objective is not to replicate individual technological applications, but to progressively deploy interoperable and coordinated gate management processes that can be adapted to different operational environments, traffic volumes, infrastructure characteristics and levels of digital maturity.

The pilot actions demonstrated that effective entry and exit management can be developed through a modular approach combining several complementary operational components: digital and flexible gate management; real-time coordination of vehicle movements; automated vehicle and container identification; digital pre-registration and driver guidance; and automated compliance controls. The key principle for continuation is therefore not technological uniformity, but the interoperability, scalability and integration of these components within wider logistics, traffic management and governance frameworks.

The experience of the Verona Freight Village demonstrates how the digital optimisation of existing systems can support more flexible gate management without requiring major physical infrastructure investments. The upgrade of the I-TOS platform contributes to improved document handling, traceability and coordination of entry and exit procedures. The continuation of this approach should focus on progressively integrating these functions into the ordinary operations of inland terminals and freight villages, including logistics nodes located in rural or peripheral areas.

The La Spezia pilot highlights the importance of real-time coordination between ports, dry ports and hinterland logistics platforms. The integration between the Port Community System and the Trucking Federative Platform improves the visibility and coordination of shuttle movements between the maritime port and the dry port. This operational approach can be extended to other port–hinterland networks where more reliable information exchange is needed to reduce delays, improve the use of terminal capacity and strengthen connections with inland and peripheral territories.

At the Port of Koper, the automated OCR-based identification process at the Bertoki entrance provides evidence of how digital gate procedures can be integrated into a broader traffic reorganisation strategy. The Bertoki gate has been designated for container traffic redirected away from urban areas, in accordance with agreements between the port and local authorities. With daily peaks reaching up to 2,000 trucks, the automation of vehicle, container and cargo identification procedures is essential to prevent congestion and maintain reliable access to the port.

The comparison between OCR-based and traditional RFID-based procedures confirmed faster processing times, improved data accuracy, enhanced security controls and reduced operational burdens associated with badge management. The system is already installed and operational in one entrance lane and forms part of a wider infrastructure and traffic management upgrade. This experience demonstrates that automated identification processes are mature and scalable and can support both the operational development of TEN-T nodes and the reduction of heavy vehicle traffic impacts on neighbouring urban areas.

The lessons learned from the Danube-area pilot implemented by RSOE demonstrate that digital entry management can also be introduced through lightweight and scalable solutions. Truck pre-registration, digital invitations to port entry, real-time vehicle tracking and navigation guidance for drivers can improve the coordination of vehicle arrivals and reduce uncertainty before trucks reach the gate. Their integration into Hungary's national KIR platform provides a basis for possible wider deployment across inland and Danube ports, including smaller logistics nodes and terminals serving rural and peripheral regions.

The Gdynia experience demonstrates how automated vehicle and container identification can be combined with digital Weight-in-Motion controls at entry and exit points. These processes enhance safety, regulatory compliance and infrastructure protection without unnecessarily slowing down terminal operations. Their continuation and extension will require the progressive harmonisation of certification requirements and close coordination with the competent authorities, particularly where WIM data are intended to support official enforcement activities.

Taken together, these experiences provide a common reference for the continuation and possible replication of improved entry and exit logistics processes in other ports, terminals and logistics nodes. Rather than proposing a single technological system or a uniform implementation model, the ACCESSMILE jointly developed solution identifies a set of transferable principles and operational components based on:

- shared data and interoperability standards;
- interoperable PCS, TOS, customs and traffic management interfaces;
- modular deployment of digital gate management, OCR, WIM, pre-registration, real-time monitoring and vehicle tracking functions;
- real-time exchange of operational information among ports, terminals, drivers, transport operators and public authorities;
- appropriate governance arrangements and clearly defined institutional responsibilities;
- common KPIs for monitoring waiting times, throughput, safety, accessibility and environmental performance.

The continuation of the jointly developed solution should therefore focus on gradual scaling, interoperability and institutional coordination. Digital entry and exit management processes should be integrated into the ordinary digitalisation, traffic management and infrastructure development strategies of ports, terminals and public authorities rather than maintained as isolated technological applications.

From an environmental perspective, improved coordination of vehicle arrivals, faster identification and control procedures, real-time monitoring and better driver information can reduce gate queues, truck idling, unnecessary movements and traffic concentration during peak periods. These effects contribute to lower fuel consumption, greenhouse gas emissions, local air pollution and noise in and around ports, terminals and urban areas affected by heavy vehicle traffic. More efficient gate operations can also improve the use of existing infrastructure and support more reliable intermodal freight connections.

The jointly developed solution can also improve the accessibility of rural and peripheral regions by making access to TEN-T ports, inland terminals and multimodal hubs more predictable and reliable. Digital pre-registration, real-time monitoring and navigation guidance are particularly relevant for transport operators travelling over longer distances from peripheral territories, as they reduce uncertainty, avoid unnecessary waiting and improve coordination with port and terminal operating schedules.

The lessons learned therefore confirm that interoperability, modularity and stakeholder coordination are essential conditions for the long-term continuation and scalability of the solution. Future replication should follow a gradual and adaptive approach, combining the relevant technological components with the redesign of operational procedures, staff training and appropriate governance arrangements according to the needs, resources and digital maturity of each logistics node.

4. Financial indications related to the long-term sustainability

The long-term financial sustainability of the ACCESSMILE jointly developed solution depends on the progressive integration of improved entry and exit logistics processes into the ordinary ICT, infrastructure and operational investment plans of ports, terminals and public authorities. The objective is not to maintain a set of isolated technological applications, but to ensure the continued operation and development of interoperable gate management processes beyond the project lifetime.

The technological components tested within ACCESSMILE, including OCR systems, Weight-in-Motion equipment, TOS upgrades, PCS integrations, digital pre-registration, real-time vehicle monitoring and driver information tools, are not stand-alone experimental technologies. They support broader digitalisation, traffic management, safety and logistics strategies and can therefore be incorporated into existing investment and maintenance programmes.

The experiences of the participating organisations demonstrate different ways of embedding these components within long-term institutional strategies. At the Port of Koper, the OCR system installed at the Bertoki entrance forms part of a wider traffic reorganisation and infrastructure upgrade. While ACCESSMILE co-financed one OCR unit, the broader investment framework includes additional lanes and traffic management measures, supporting the continuation and possible extension of automated identification procedures beyond the project duration.

Similarly:

- in Verona, the I-TOS upgrade can be incorporated into the regular evolution and maintenance of the terminal operating system;
- in La Spezia, the integration between the Port Community System and the Trucking Federative Platform is aligned with the Port Authority's broader digital transformation and port–hinterland coordination strategy;
- in Hungary, the RSOE truck pre-registration, vehicle tracking and driver information functions are integrated into the national KIR platform, providing institutional support for their continued operation;
- in Gdynia, OCR and Weight-in-Motion functions contribute to a longer-term strategy for automated controls, infrastructure protection, safety and regulatory compliance at terminal gates.

The financial sustainability of the jointly developed solution should nevertheless be assessed at the level of the overall entry and exit management process, rather than solely at the level of individual technological components. Long-term expenditure may include:

- periodic maintenance and replacement of hardware components, including OCR portals, WIM sensors, cameras and communication devices;
- software updates, licences and cybersecurity management;
- maintenance of interfaces and adjustments required to preserve interoperability among PCS, TOS, customs, enforcement and traffic management systems;
- adaptation of operational procedures and data-exchange protocols;
- training and capacity building for operational and administrative staff;
- technical support, performance monitoring and evaluation of operational and environmental KPIs;
- stakeholder coordination and governance activities required to ensure the coherent evolution of the solution.

These expenditures are generally predictable and can be progressively incorporated into ordinary annual ICT, operational and infrastructure maintenance budgets. The modular nature of the jointly developed solution allows each organisation to prioritise the components that respond to its most urgent operational bottlenecks and to extend them gradually as financial resources become available.

This modular approach is particularly relevant for smaller terminals and logistics nodes serving rural and peripheral areas. Such organisations may initially adopt less investment-intensive components, such as digital pre-registration, interoperable data exchange, real-time vehicle information or driver guidance, before introducing more equipment-intensive functions such as OCR or WIM. This reduces initial financial barriers while allowing the gradual improvement of access to TEN-T ports, terminals and multimodal hubs.

Further replication and upscaling may be supported through a combination of funding sources, including:

- European programmes such as Interreg, the Connecting Europe Facility and Horizon Europe, particularly for investments supporting digitalisation, interoperability, sustainable mobility and environmental performance;
- national and regional funding schemes for port modernisation, logistics innovation, digital transition and transport infrastructure;
- ordinary investment budgets of port authorities, terminal operators and infrastructure managers;
- public-private co-financing models where the solution generates benefits for both public authorities and logistics operators;
- service-based contributions where additional value-added digital services are introduced for users.

The allocation of financial responsibilities should reflect the ownership of the systems and the distribution of the benefits generated by the jointly developed solution. A balanced model may foresee:

- terminal operators financing the operation and maintenance of equipment directly supporting terminal activities;
- port or infrastructure authorities financing shared digital infrastructure, system integration and interoperability improvements;
- national or regional authorities supporting components that generate wider public-interest benefits, including road safety, infrastructure protection, emissions reduction, regulatory enforcement and improved territorial accessibility;
- ICT providers contributing through appropriate maintenance agreements, service-level arrangements and lifecycle support.

Investment decisions should also consider the operational and environmental benefits generated by the solution. Faster and better-coordinated entry and exit procedures may reduce waiting times, truck idling, unnecessary movements and traffic concentration during peak periods. This can produce indirect savings through lower fuel consumption, more efficient use of staff and infrastructure and improved terminal capacity, while also reducing greenhouse gas emissions, local air pollution and noise.

Overall, the financial sustainability of the ACCESSMILE jointly developed solution is strengthened by its integration into existing port, terminal and public-sector strategies and by its modular and adaptive implementation model. Progressive investment makes it possible to maintain and extend improved entry and exit logistics processes without requiring a single disruptive or large-scale investment, supporting their economic viability in both major TEN-T nodes and smaller logistics facilities serving rural and peripheral regions.

5. Recommended jointly developed solution governance schemes

To support the long-term continuation and possible extension of the ACCESSMILE jointly developed solution, appropriate governance arrangements should accompany the implementation of improved entry and exit logistics processes. Digital gate management requires not only the maintenance of technological components, but also coordination among the organisations involved in gate operations, data exchange, traffic management, safety and regulatory controls.

At local level, governance arrangements should be adapted to the institutional and operational context of each port, terminal or logistics node. Depending on the specific solution implemented, relevant stakeholders may include port authorities, terminal operators, ICT providers, customs and enforcement bodies, traffic management authorities and transport operators.

Where possible, the coordination of digital entry and exit processes should be embedded within existing operational and institutional structures rather than entrusted to parallel arrangements created specifically for individual technological tools. This can help ensure continuity beyond the project lifetime and facilitate the alignment of digital systems with wider port, terminal and regional digitalisation strategies.

Local coordination may address:

- the consistency between digital tools and operational entry and exit procedures;
- the maintenance of interfaces among PCS, TOS and other relevant systems;
- data management, cybersecurity and access rights;
- staff training and technical support;
- the adaptation of procedures to operational, technological or regulatory changes;
- the involvement of transport operators and other final users when procedures are modified.

The lessons learned from the pilot actions indicate that entry and exit procedures should not be considered in isolation from the wider logistics process. Digital pre-registration, vehicle identification, document exchange, customs and security controls, driver information and traffic management are closely connected and may therefore require cooperation among different organisations.

The Port of Koper provides an example of how automated gate identification can be connected with a broader traffic reorganisation strategy involving the port and local authorities. In Verona, La Spezia, Hungary and Gdynia, the implemented tools are similarly linked to existing terminal, port or national digital environments. These experiences indicate that governance arrangements should reflect local institutional responsibilities and the wider operational context in which the technological components are used.

At transnational level, periodic exchanges among ACCESSMILE partners and other interested organisations may support the sharing of lessons learned, technical information and approaches to interoperability. Such exchanges could take place through existing European cooperation networks, project events or thematic working groups, without requiring the establishment of a new permanent governance structure.

Each organisation would retain responsibility for its own systems and operational procedures. Where appropriate, organisations may continue sharing technical documentation, interface specifications, implementation experience and information on regulatory developments in order to facilitate compatibility and future replication.

The governance of the jointly developed solution should be guided by a limited number of common principles:

- integration of digital tools into existing operational procedures;
- interoperability with relevant digital platforms;
- modularity and gradual implementation;
- clear allocation of local responsibilities;
- involvement of operational staff and final users;
- adaptation to local conditions and levels of digital maturity.

Where suitable data are available, governance arrangements may also support the monitoring of waiting times, congestion, vehicle idling and other operational indicators relevant to environmental performance. This can help ports and terminals assess whether changes to entry and exit procedures contribute to smoother traffic flows and lower congestion-related emissions.

Attention should also be given to the needs of logistics nodes and transport operators serving rural and peripheral areas. Flexible procedures, accessible digital tools, appropriate training and reliable information exchange can help ensure that digitalisation facilitates, rather than complicates, their access to ports, terminals and TEN-T corridors.

Overall, the experience of ACCESSMILE suggests that the long-term continuation of improved entry and exit logistics processes depends on a balanced combination of local responsibility, stakeholder coordination and exchange of experience. Governance arrangements should remain proportionate to the characteristics of each logistics node and should support the gradual adaptation and possible extension of the jointly developed solution.

6. Recommendations and suggestions for the replication of the jointly developed solution beyond the pilot area

The ACCESSMILE jointly developed solution may provide a useful reference for ports, dry ports, inland terminals, freight villages and multimodal hubs seeking to improve their entry and exit logistics processes. The lessons learned from the pilot actions indicate that elements of the solution may be adapted to logistics nodes facing gate congestion, manual verification procedures, limited interoperability among ICT systems, documentation delays, insufficient visibility of vehicle movements or the need for more efficient safety and compliance controls.

Replication should focus primarily on the transfer of the underlying operational principles rather than on the direct reproduction of individual technological configurations. These principles include advance exchange of information, coordinated vehicle arrivals, automated identification, real-time operational visibility, interoperable data exchange and the integration of control procedures into the ordinary flow of vehicles entering or leaving a logistics node.

Before selecting specific technological components, each organisation should carry out an assessment of its existing entry and exit processes. This assessment may consider:

- the main causes of congestion and waiting times;
- the sequence of vehicle identification, documentation and control procedures;
- the availability and quality of operational data;
- the level of integration among PCS, TOS, customs, traffic management and other relevant systems;
- traffic volumes and peak-time patterns;
- infrastructure constraints and available gate capacity;
- the digital maturity and organisational capacity of the logistics node;
- the needs of transport operators, drivers and other final users.

On the basis of this assessment, the relevant components of the jointly developed solution may be selected and adapted to local circumstances. Depending on the identified needs, these components may include digital pre-registration, more flexible gate management, real-time monitoring of vehicle movements, automated vehicle and container identification, interoperable data exchange, driver information and navigation guidance, or automated Weight-in-Motion controls.

The modular approach demonstrated through the ACCESSMILE pilot actions suggests that replication can take place gradually. An organisation does not necessarily need to implement all components simultaneously. Less complex or less investment-intensive functions may be introduced first and subsequently integrated with more advanced identification, monitoring or compliance-control systems.

The experience of Verona indicates that the optimisation of an existing Terminal Operating System may support more flexible gate procedures, improved document management and greater traceability without necessarily requiring extensive new physical infrastructure. This approach may be relevant for inland terminals and freight villages seeking to improve existing digital processes.

The La Spezia experience provides indications for ports and dry ports interested in improving real-time coordination of shuttle services and the visibility of vehicle movements along port-hinterland connections. Similar approaches could be considered where freight flows depend on the coordinated operation of maritime and inland logistics nodes.

The Koper experience demonstrates how OCR-based vehicle and container identification may support high-volume gate operations and broader traffic reorganisation measures. Its relevance for another port or terminal would depend on local traffic volumes, existing identification procedures, infrastructure configuration and the need to manage heavy vehicle flows in relation to surrounding urban areas.

The Danube-area experience implemented by RSOE shows that digital pre-registration, invitations to port entry, real-time vehicle tracking and navigation guidance may provide a comparatively lightweight approach for improving access management. Such components could be particularly relevant for inland and smaller logistics nodes, including those serving rural or peripheral territories, provided that they are adapted to the local digital environment and user capacity.

The Gdynia experience indicates that Weight-in-Motion and automated identification functions may contribute to safety, infrastructure protection and regulatory compliance at terminal gates. Their replication would, however, require consideration of the applicable legal framework, certification requirements, technical standards and the intended use of the collected data.

Successful replication should therefore be based on an adaptive rather than a uniform approach. The technological configuration and operational procedures selected for each logistics node should reflect local conditions, including traffic volumes, infrastructure characteristics, organisational responsibilities, regulatory requirements, available resources and levels of digital maturity.

Interoperability should be considered from the beginning of the replication process. Where relevant, new components should be capable of exchanging information with existing PCS, TOS, customs, enforcement or traffic management systems. The use of open standards and documented interfaces may facilitate integration, future adaptation and reduced dependence on individual technology providers.

Operator involvement and staff preparation are equally important. Transport companies, terminal staff, drivers, ICT personnel and relevant public authorities should, where appropriate, be consulted during the analysis and adaptation of entry and exit procedures. Training and gradual implementation can help identify operational difficulties and support the effective use of the introduced tools.

The effects of replication may be assessed through a proportionate set of indicators, depending on the available data and the objectives of the individual logistics node. Relevant indicators may include:

- vehicle waiting and processing times;
- queue lengths and traffic concentration at peak times;
- throughput and reliability of gate operations;
- data accuracy and reduction of manual interventions;
- safety or weight-compliance indicators;
- vehicle idling and avoidable movements;
- estimated fuel consumption and congestion-related emissions.

From an environmental perspective, the replication of improved entry and exit logistics processes may contribute to smoother vehicle flows, shorter queues and reduced idling. These effects can help lower fuel consumption, greenhouse gas emissions, local air pollution and noise. The scale of the benefit will depend on the local traffic conditions, the effectiveness of the implemented procedures and the degree of acceptance among users.

Replication may also be particularly relevant for logistics nodes serving rural and peripheral areas. More predictable gate procedures, advance information and real-time driver guidance can reduce uncertainty for transport operators travelling over longer distances and facilitate more reliable access to ports, inland terminals and TEN-T corridors. Lightweight and modular components may be especially suitable for smaller nodes with more limited financial or technical capacity.

Ports, terminals and multimodal hubs located along Central European transport corridors could therefore consider the ACCESSMILE jointly developed solution as a reference when reviewing their own entry and exit procedures. Nevertheless, the suitability of each component should be assessed individually, and replication should remain proportionate to the actual operational needs and framework conditions of the adopting organisation.

Overall, the ACCESSMILE experience suggests that the possible replication of the jointly developed solution depends not only on the transfer of technologies, but also on the adaptation of operational workflows, organisational responsibilities, staff competences and stakeholder cooperation. A gradual and context-sensitive approach can support the uptake of improved entry and exit logistics processes while reducing implementation risks and preserving flexibility for future development

7. Conclusion. ACCESSMILE jointly developed solution to be taken up / upscaled.

The ACCESSMILE jointly developed solution under Topic 2 consolidates the lessons learned from the complementary pilot actions implemented in Verona, La Spezia, Koper, the Danube area and Gdynia into a common reference for improving entry and exit logistics processes.

Although the pilot actions applied different technological components, they addressed a shared set of operational challenges, including gate congestion, manual identification and document checks, limited exchange of information among digital systems, insufficient visibility of vehicle movements and the need for more efficient safety and compliance controls.

The experience gained through the project indicates that these challenges can be addressed through a combination of digital pre-registration, more flexible gate management, real-time coordination, automated vehicle and container identification, interoperable data exchange, driver information and automated compliance controls. These elements should not be understood as a single technological package, but as complementary components that may be selected and adapted according to the needs and framework conditions of each logistics node.

The pilot actions provided practical evidence that improved entry and exit logistics processes can contribute to shorter and more predictable gate procedures, better data quality, reduced reliance on manual operations and improved coordination among the actors involved. The extent of these benefits may vary depending on traffic volumes, existing infrastructure, digital maturity, organisational arrangements and the level of integration with other operational systems.

From an environmental perspective, better coordination of vehicle arrivals and faster gate procedures may reduce queues, truck idling, unnecessary movements and traffic concentration during peak periods. These effects can contribute to lower fuel consumption, greenhouse gas emissions, local air pollution and noise in and around ports, terminals and neighbouring urban areas.

The jointly developed solution can also support the accessibility of rural and peripheral areas by making access to ports, inland terminals and TEN-T corridors more predictable and reliable. Advance information, digital pre-registration, real-time monitoring and driver guidance can be particularly useful for operators travelling over longer distances, reducing uncertainty and facilitating better coordination with gate and terminal schedules.

The lessons learned also confirm that digital tools should not be deployed as isolated applications. Their continuation and possible extension depend on their integration into existing logistics processes, PCS and TOS environments, traffic management systems and institutional arrangements. Staff training, appropriate technical maintenance, interoperability and stakeholder involvement remain important conditions for long-term use.

The ACCESSMILE Topic 2 solution therefore provides a practical and modular reference that may support the gradual improvement of entry and exit logistics processes in other ports, terminals and logistics hubs. Uptake and upscaling should remain adaptive and proportionate, with each organisation selecting the operational and technological components most appropriate to its needs, resources and level of digital maturity.

ACCESSMILE Solution Topic.2: Gates and Entry/Exit Tools and Procedures	
Final users/target groups	Terminal operators, port authorities, customs and other control or enforcement bodies, freight forwarders, trucking companies, railway undertakings, ICT providers, cargo owners and other logistics operators relying on efficient and predictable entry and exit procedures. Particular attention is given to operators and logistics nodes serving rural and peripheral areas and requiring reliable access to TEN-T ports, terminals and corridors.
Final user needs addressed	Faster, more reliable and transparent gate procedures; reduced waiting times, queues and manual interventions; improved data accuracy and interoperability; enhanced safety, security and regulatory compliance; better coordination of vehicle arrivals and movements; lower fuel consumption and congestion-related emissions; and more predictable access to logistics nodes for operators serving rural and peripheral territories.
Co-design process (involved partners and country involved)	The jointly developed solution draws on the complementary experience of PP2 ZAILOG in Italy, PP3 ADSPMLOR-La Spezia in Italy, PP4 Luka Koper in Slovenia, PP8 RSOE in Hungary and PP9 BCT Gdynia in Poland. Through project meetings, technical exchanges, peer-review activities and discussions among partners, the different operational experiences were compared and consolidated into a common set of lessons learned, transferable principles and possible measures for improving entry and exit logistics processes.
Uptake strategy	Uptake is supported by tangible benefits observed in all pilots, including reduced congestion, faster truck turnaround, improved coordination, and lower fuel consumption. The solutions are designed to be modular and cost-effective, enabling adoption in digitally advanced terminals as well as in rural and peripheral sites. Capacity-building activities, technical guidelines and dissemination actions will further encourage uptake across Central Europe.
Upscaling Strategy	The modular architecture of the Topic 2 solutions allows incremental expansion to additional gates or terminals. OCR systems can be deployed in multiple port gates, I-TOS upgrades replicated in inland freight villages, PCS-Trucking integration extended across port-hinterland corridors, and the RSOE pre-registration module adopted throughout the Danube network. The WIM solution offers a scalable model for weight enforcement in other TEN-T ports. Upscaling will rely on shared data standards, coordinated governance, and alignment with EU digital transport policies.

Table 4 - ACCESSMILE Topic 2. up-scaling strategy

Following the synthesis provided in the table, the Topic 2 solution demonstrates a high level of operational readiness and transferability. The pilots collectively confirmed that the challenges addressed—manual

verification at gates, congestion during peak hours, documentation inconsistencies, limited ICT integration and safety concerns—are common across European logistics nodes. This reinforces the relevance and replicability of the jointly developed solution.

The collaborative approach adopted within ACCESSMILE has ensured interoperability, technical robustness and adaptability to different operational scales. From high-volume maritime ports such as Luka Koper to inland terminals and Danube ports, the solution has proven capable of supporting both advanced digital environments and contexts with lower IT maturity.

The ability to combine OCR systems, WIM equipment, TOS upgrades, PCS integrations, and digital pre-registration tools under a shared governance and interoperability framework demonstrates that digital gate automation can become a structural component of modern logistics systems rather than a stand-alone technological upgrade.

Looking ahead, the continued alignment of standards, data models, and governance mechanisms will be essential to ensure coherent expansion across the Central European transport network. Under these conditions, the Topic 2 jointly developed solution is well positioned to contribute to the digital transformation of freight transport, strengthening efficiency, safety, environmental performance, and last-mile accessibility to the TEN-T corridors.