Interreg North-West Europe

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# AMOD USE CASE READINESS MATRIX REPORT D.1.2.1

## A strategic tool for assessing readiness and milestones for AMoD deployment

### EXECUTIVE SUMMARY

Public Transport Authorities (PTAs) and Public Transport Operators (PTOs) in North West Europe are looking for innovative solutions for today's mobility challenges. Automated Mobility on Demand (AMoD) is one such solution. This transport solution poses new challenges for Public Transport Authorities and Public Transport Operators in terms of planning and implementation. This is the focus of the Interreg North-West-Europe CAMINO project, in which the Belgian Public Transport Operator De Lijn and the Dutch Public Transport Authority Almere, together with the Swiss research centre ROSAS, are developing two implementation strategies, one for PTAs and one for PTOs in North-West Europe, on how to implement automated transport.

The AMoD Use Case Readiness Matrix Report has been developed as part of the project and highlights implementation milestones and readiness for AMoD use cases based on the De Lijn use case. AMoD readiness refers to the ability to categorise an individual use case in order to make organised and effective decisions about the implementation of automated transport. By assessing readiness in several areas, such as technical, market, regulatory, user and organisational, with the different levels of innovation readiness (IRL1-9), the framework enables stakeholders to identify gaps, address challenges and define strategies for successful integration into public transport networks.

## DOCUMENT TITLE:

AMoD Use Case Readiness Matrix Report

## SUBTITLE:

A strategic tool for assessing readiness and milestones for AMoD deployment

## LEAD AUTHOR:

## IN COLLABORATION WITH BAX

## CONTRIBUTING PARTNERS:

Gemeente Almere

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# WHAT ARE READINESS LEVELS?

**General Definition**
Readiness levels are structured scales used to **assess the maturity**, readiness and ability of, for example, a system, technology or product to transition successfully from one stage to another. These levels assist in **decision making, risk assessment** and **implementation planning.**

Readiness levels are tracked on a **9-point Innovation Readiness Level (IRL) scale.** The IRLs are based on the Technology Readiness Levels (TRLs), which are industry standards across Europe.

The **9 specific readiness levels**, each describing a tangible step in the innovation process, are divided into three phases: low readiness (development), medium readiness (demonstrate) and high readiness (deliver).

- The **development phase** involves early exploration and fundamental studies to understand the core principles of AMoD. It includes basic research, hypothesis formulation and initial proof-of-concept experiments.
- The **demonstration phase** focuses on the refinement and development of concepts into practical applications. It includes detailed design, prototyping and iterative testing, typically conducted in controlled AMoD demonstration sites.
- The **delivery phase** finalises and integrates the AMoD vehicles into real-world environments. It includes large-scale production, full-scale implementation, user training and operational support.

The following table provides a better overview and understanding of the different levels of readiness:

| Phase | | Level | Description |
|---|---|---|---|
| Develop | 1 | Challenge observed | A challenge is observed in multiple geographies and conditions. Agreement articulated amongst industry practitioners and expert |
| | 2 | Idea described | A solution concept is described by technical experts in sufficient detail to set a clear plan to validate the solution's viability is articulated |
| | 3 | Concept articulated | A solution articulated as a proof of concept, validated with key stakeholders within immediate network. |

| Phase | | Level | CAMINO Description |
|---|---|---|---|
| Demonstrate | 4 | Concept validated | A proof of concept passes testing in a theoretical (non-operational) setting. Solution validated with non-technical experts within the wider innovation ecosystem, including end users. |
| | 5 | Prototype tested | A prototype is shown to be technically competent (but not yet commercially or politically viable) when tested in conditions that resemble the real-world application. Conditions may be highly controlled and interaction without outside stakeholders is not anticipated |
| | 6 | Prototype demonstrated | A first of a kind project supported with public funds that tests a small-scale version of a scalable technology in a controlled environment. Policy or business environment conditions may be artificially controlled to enable testing |
| Deliver | 7 | Solution demonstrated | Repeated pilot demonstrations show buy-in from key stakeholders and a track record of positive technical, market , regulatory, user and organisational readiness. Public subsidy may still be used at this stage. |
| | 8 | Solution scaled | Widespread deployment across multiple geographies, replicated by partners and funding instruments beyond the project scope. |
| | 9 | Solution standardised | Solution is mature and treated as part of standard operating practice. Where equity is needed, solution is considered bankable by mainstream finance institutions. |

Another aspect of readiness levels is the **technical, market, regulatory, user and organisational** aspects of an AMoD use case, for which readiness levels can be used to categorise the readiness of each of these 'pillars'.

**1) Technical Readiness:**

Technical Readiness refers to the **maturity and ability of AMoD technology and systems** to perform as intended under real-world conditions. It assesses aspects such as development progress, validation, reliability and integration feasibility. This includes assessing the readiness of vehicle automation systems, sensors, infrastructure, technical integration with existing public transport, and overall technical performance and complexity.

Readiness levels:

- **1-3:** Simulations, pre-feasibility studies
- **4-6:** Implemented pilot projects: evaluated for economic viability, etc.
- **7-9:** Full system demonstration, real-life integration into PT

### 2) Market Readiness:

Market Readiness evaluates the **viability of AMoD solutions** to ensure that the technology and services can be successfully deployed and sustained. It assesses how well the offering aligns with market needs and the competitive landscape.

The assessment includes

- **Market readiness:** Understanding demand, customer adoption and competitive positioning.
- **Product Availability:** Assessing whether AMoD solutions, including autonomous vehicles and supporting technologies, are ready for large-scale deployment.
- **Financial Viability:** Examining cost structures, funding models and long-term economic sustainability.
- **Scalability of solutions**: Determining the potential for expansion, integration with existing transport networks and adaptability to different urban and rural environments.

Milestones of the readiness levels:

- **1-3:** Niche companies (expensive prototypes)
- **4-6:** Technology leaders (per-commercial availability)
- **7-9:** Wide availability of different solutions (economies of scale achieved)

### 3) Regulatory Readiness:

Regulatory Readiness assesses whether the legal frameworks, regulations and policies required for AMoD in public transport are in place. This includes evaluation of existing legislation, approval processes, and compliance with national and international mobility standards to ensure smooth and compliant implementation.

Milestones of the readiness levels:

- **1-3:** No legislation in place: work with your policy department to create legislation
- **4-6:** Possibility to test with reference cases, deployment including security operator (SAE3)
- **7-9:** Legislation in place, approved by government (permission to operate AMoD vehicles in public transport)

### 4) User Readiness:

User Readiness is a key aspect of AMoD planning and includes **public acceptance, understanding and willingness to adopt AMoD technology in public transport.** It assesses whether passengers are prepared and equipped to use AMoD vehicles effectively, taking into account factors such as awareness, trust, accessibility and ease of use. Understanding user perceptions and addressing potential concerns is critical to ensuring a smooth transition to automated mobility solutions.

Milestones of the readiness levels:

- **1-3:** No acceptance of users
- **4-6:** Workshops, seminars to inform users
- **7-9:** Full user acceptance, studies and workshops deployed

### 5) Organisational Readiness:

Organisational Readiness assesses **the ability of public transport authorities and operators to successfully implement, manage and maintain AMoD solutions**. It assesses key factors such as leadership commitment, resource availability, workforce skills and the infrastructure required for seamless integration into existing transport systems. Ensuring that organisations are prepared to adapt and scale these innovations is essential for long-term success.

Milestones of the readiness levels:

- **1-3:** Small team working on AMoD within an organisation (PTA/PTO)
- **4-6:** Medium team working on AMoD within an organisation (PTA/PTO)
- **7-9:** Large team working on AMoD within an organisation (PTA/PTO)

# USE CASE DE LIJN

## About De Lijn

De Lijn is the state-owned operator of the public bus and tram network in Flanders, Belgium, and plays a key role in shaping the region's transport landscape. Serving some 300 million passengers a year and managing a turnover of €1.1 billion, De Lijn is responsible for a wide range of transport activities, including network planning, service operation, customer communication, and infrastructure and maintenance management. These responsibilities are carried out through a hybrid model, with 50% of the services operated in-house by over 8,000 employees and the remaining 50% outsourced to private operators.

## Leuven use case and vision

One of De Lijn's main areas of operation is the city of Leuven, which covers urban, suburban and rural areas and includes more than 900 bus and tram lines. While traditional fixed-route services form the backbone of the network, certain regions - such as the Antwerp port area and peripheral urban areas - face challenges due to dispersed demand and varying passenger needs. In addition, like many EU countries, De Lijn is experiencing a severe shortage of bus drivers (currently estimated at 150), which limits the ability to expand and optimise services.

The city of Leuven has been designated as part of the EU Mission on Climate Neutral and Smart Cities and aims to achieve net-zero emissions before 2030. De Lijn actively supports this ambition and is committed to reducing CO2 emissions by 35% by 2030 compared to 2005 levels and to achieving emission-free public transport throughout Flanders by 2035. To achieve these goals, De Lijn has adopted an ambitious agenda focused on implementing innovative and transformative mobility solutions that reduce reliance on private vehicles, lower greenhouse gas emissions and improve accessibility for all citizens.

Recognising that conventional public transport systems alone cannot fully address modern mobility and environmental challenges, De Lijn is exploring and planning for automated transport solutions with 1 FTE in the company. The next step in 2026-2027 is the testing of the first larger automated vehicles in Leuven, followed.

# USE CASE READINESS MATRIX

The Use Case Readiness Matrix is designed to help public transport authorities and operators understand, manage and assess the readiness maturity of their AMoD scenarios across multiple dimensions. It outlines the key stages of development, demonstration and deployment, guiding the transition from initial concept to full integration into public transport systems. By systematically tracking progress, this framework enables stakeholders to identify challenges, refine strategies and ensure the successful deployment of AMoD solutions. Through this structured approach, the matrix helps public transport authorities and operators to scale up effective innovations into mainstream practice.

As mentioned and defined earlier in the *What are Readiness Levels* chapter on pages 4-7, **the matrix is divided into three main phases:**

- **Develop** - The initial stage where challenges are identified, solutions are formulated and a proof of concept is established.
- **Demonstrate** - Moving beyond proof of concept, this phase includes pilots, prototype testing and controlled demonstrations.
- **Deliver** - The final stage, focused on scaling up demonstrations and achieving full integration into the transport ecosystem.

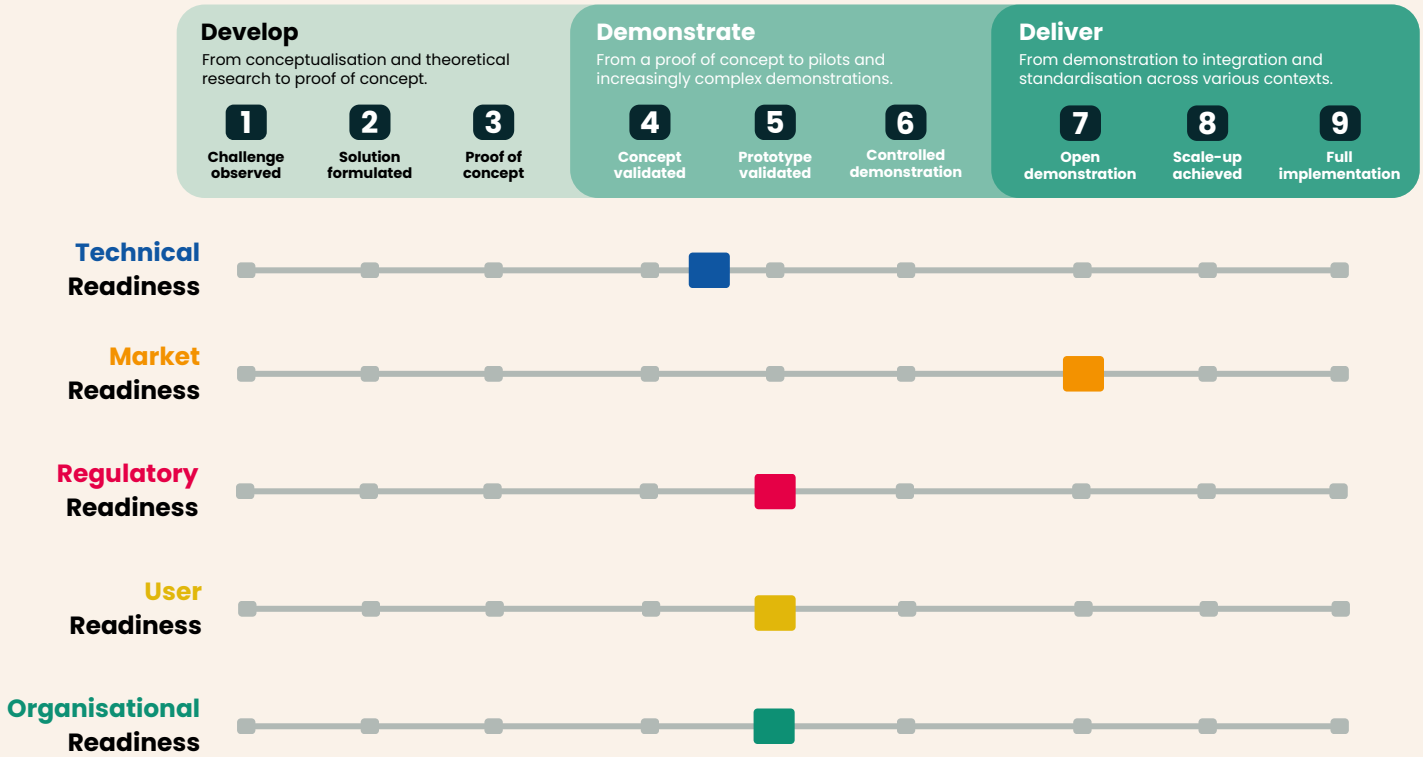
Each readiness category is rated on a scale of **1 to 9**, ensuring a comprehensive assessment of progress.

The matrix assesses **five areas** that contribute to the successful deployment of AMoD:

1. **Technical Readiness**
2. **Market Readiness**
3. **Regulatory Readiness**
4. **User Readiness**
5. **Organisational Readiness**

The Readiness Matrix serves as a strategic guide for tracking the implementation of automated mobility. By identifying gaps and highlighting progress in key areas, this framework helps public transport operators and authorities to ensure a smooth and effective transition to automated public transport. As the AMoD scenarios evolve, continuous assessment and adaptation will be essential to achieve full deployment and sustainable integration.

# Evaluation of De Lijn's use case with the readiness matrix




As described above, public transport operator De Lijn is actively working on the integration of automated transport into its public transport system. The Readiness Matrix is used to evaluate their progress, ensuring that all 5 dimensions are considered.

## Technical readiness

Technical Readiness reflects the maturity of the technology used in automated public transport. There are currently no fully automated public transport vehicles operating in complex traffic without a steward, meaning that De Lijn is still in the early stages of deployment. **Today**, the project is at Intermediate Readiness Level **(IRL) 4-5**, with projections to reach **IRL 6-7 by 2026-2027** as technology advances andpilot projects expand. Continued improvements in vehicle automation, traffic integration and system reliability will be essential to achieve this goal.

## Market readiness

For AMoD to succeed, the market must provide viable, scalable solutions that meet the needs of public transport. With high selection criteria, only a handful of efficient solutions are expected to meet the functional requirements. Currently, De Lijn is not integrating automated technology into its fleet, but market readiness remains high at IRL 7, indicating that suitable technologies exist and are being evaluated for future deployment.

### Regulatory readiness

Automated transport requires strong regulatory support to ensure safety, compliance and public confidence. To date, Belgium has established a framework that allows for small-scale SAE Level 4 pilot projects, placing regulatory readiness at IRL 5. Looking ahead to 2026, the aim is to introduce a comprehensive framework for large-scale commercial applications, enabling the widespread deployment of automated mobility solutions. Achieving this will require close collaboration between policy makers, transport authorities and industry stakeholders.

### User Readiness

Public acceptance plays a crucial role in the uptake of AMoD. While high quality pilots have already demonstrated strong user acceptance, continued collaboration with cities and effective communication strategies remain essential to build long-term trust. Today, user readiness is at IRL 5, indicating that while initial concerns are minimal, continued efforts to engage and educate the public will be necessary as autonomous transport expands

### Organisational Readiness

Successful integration of AMoD requires internal organisational alignment and dedicated resources. Currently, De Lijn has one full-time equivalent (FTE) dedicated to AMoD, supported by other teams, but no formal organisational plan has been put in place. Instead, the company is using pilot projects to gain insight into the challenges of large-scale implementation, operational impacts and necessary adaptations. Organisational readiness is currently at IRL 5, highlighting the need for a structured approach to future scaling efforts.

The De Lijn AMoD Readiness Matrix provides a clear roadmap for assessing and advancing the deployment of automated mobility solutions. While significant progress has been made in terms of market readiness, key challenges remain in terms of technology maturity, regulatory frameworks and internal organisational alignment. By systematically tracking readiness across these areas, De Lijn can anticipate barriers, refine its approach and move towards full AMoD integration.

# CONCLUSION

The AMoD Use Case Readiness Matrix report serves as a strategic tool for Public Transport Authorities and Public Transport Operators to navigate the complexities of Automated Mobility on Demand integration. By providing a structured framework for assessing technical, market, regulatory, user and organisational readiness, the report enables stakeholders to categorise their individual use cases and identify potential challenges and barriers.

**Public transport authorities can use the Readiness Matrix to:**

- **Assess** the maturity of AMoD solutions within their jurisdiction.
- **Align** policy and regulatory frameworks with evolving automated mobility standards.
- **Develop** strategic deployment roadmaps for seamless integration into existing networks.
- **Engage** with policy makers, industry partners and communities to build public trust and acceptance

**Public transport operators can use the framework to:**

- **Assess** technology readiness and identify appropriate AMoD solutions for their fleets
- **Plan** pilot and demonstration initiatives to validate automated transport concepts
- **Address** organisational challenges related to staff adaptation and operational integration
- **Scale** up successful solutions to full commercial deployment with financial and regulatory support

By systematically tracking progress through the Innovation Readiness Levels (IRL 1-9), PTAs and PTOs can ensure that AMoD initiatives move from early-stage development to full-scale, sustainable deployment. This report serves as a guide to foster innovation and improve public transport services. The implementation of AMoD requires strong collaboration between PTAs and PTOs.

# FURTHER READING

The report is based on the sources of the Bax's Innovation Readiness Levels, 2024, Bax Innovation