MONOCAB - Feasibility Study with Test Drive Event

Kleve, Oktober 2024

The MONOCAB is an innovative rail technology designed to provide customizable mobility solutions for rural areas through autonomous “rail taxis.”

The “MONOCAB-Kleverland” initiative aims to investigate the practical applicability of this technology along the German-Dutch rail bike route from Kleve to Kranenburg and Groesbeek (NL).

A feasibility study will be conducted to define key research priorities and estimate expected costs.

Introduction

Rural public transportation faces significant challenges. The shortage of skilled bus and train operators is increasing, exacerbated by the retirement of the baby boomer generation. Families and retirees are moving from urban centers to rural areas to reduce rental or construction costs, while the ability of families to afford a second or third car is diminishing. In short, new transportation concepts are urgently required.

The MONOCAB represents an innovative rail transportation technology designed to offer customizable mobility solutions for rural areas through autonomous “rail taxis.” This technology is currently being developed under the leadership of Technische Hochschule Ostwestfalen-Lippe (TH OWL). https://www.youtube.com/watch?v=w8b8avaq1yY

Micromobility in Rural Areas

Providing high-quality, frequent micromobility options in rural areas is not only a social imperative but also an important economic factor. Enhanced micromobility options strengthen social cohesion in rural areas.

Regions with well-developed micromobility networks exhibit significantly higher employment rates within lower-income groups and greater attractiveness for individuals and families in higher-income groups. Furthermore, such services support social inclusion for individuals from migrant backgrounds, people with disabilities, and those affected by poverty.

Promoting micromobility in rural areas is a critical step toward equitable mobility and fosters equivalent living conditions across urban and rural settings. The reactivation of rail lines using lightweight rail vehicles forms an essential component of this concept, enhancing rural connectivity to regional and interregional transportation networks.

Driverless Micromobility Services

Given the increasing shortage of bus and rail operators, high-quality and frequent personalized public micromobility services can only be achieved by decoupling the operation of public transit vehicles from the availability of human drivers.

Driverless micromobility services offer numerous advantages:

- Reduced Personnel Costs: Costs per passenger-kilometer are dramatically reduced as personnel can manage overall traffic flow rather than individual vehicles.

- Vehicle Size and Frequency: The reduced size of rail vehicles allows for higher service frequency.
- 24/7 Availability: Driverless micromobility services can operate continuously, with scheduled frequency during peak times and app-based on-demand service during off-peak hours.
- Dynamic Capacity Scaling: Using driverless rail vehicles allows for flexible capacity management, replacing “batch processing” by high-capacity, infrequent trains with a scalable fleet of cabins that adjust automatically based on demand.
- Energy Efficiency: The smaller vehicle size and on-demand operation significantly reduce empty runs per seat and lower energy consumption per passenger-kilometer.

Technology

The MONOCAB technology is based on British patents from 1906-1910, rediscovered and adapted to the modern context by the Lippe Railway Association under Thorsten Försterling, current spokesperson and marketing director of the MONOCAB project. In 2018, Försterling and the Lippe Railway Association received the German Mobility Award in the “Open Innovation” category for the MONOCAB concept. Since then, the concept has evolved into a research consortium involving various universities, Fraunhofer institutes, and industry partners.

A MONOCAB unit “balances” on a single rail, enabling bi-directional rail traffic on a single-track railway. Each unit is autonomously controlled by AI, continuously monitoring its surroundings via optical and radar sensors to detect potential obstacles. https://www.youtube.com/watch?v=w8b8avaq1yY

MONOCAB lines are designed for continuous 24/7 operation, combining scheduled service during the day with on-demand service at night. The concept incorporates cloud-computing paradigms—small, numerous standard modules with scalable capacity—into the management of rail vehicles.

A single MONOCAB cabin can accommodate up to six passengers. For individuals with specific safety needs, private cabins can be requested at night, allowing non-stop travel to the desired destination. The cabin detects critical safety situations and autonomously alerts the police and fire department if necessary. Passengers can also initiate voice-activated connections with emergency services as needed.

Unlike conventional rail infrastructure that requires tracks to support axle loads of at least 20 tons, a MONOCAB cabin exerts only about 1.8 tons per axle, significantly reducing construction costs for MONOCAB-compatible rail routes, particularly along existing bike paths.

Consortium

The MONOCAB consortium comprises universities, research institutions, and industry partners (https://www.monocab-owl.de/) from East Westphalia-Lippe, the German center of excellence for rail vehicle technology. The project's technological leadership lies with TH OWL's Department of Electrical Engineering and Computer Science, where the core technology is being developed. Key consortium members include:

- Technische Hochschule Ostwestfalen-Lippe
  https://www.th-owl.de/eecs/fachbereich/informationen/nachrichten/artikel/detail/probefahrt-in-der-montagehalle-gewaehrt-einblick-in-die-zukunft-der-mobilitaet-1/
- Fraunhofer-Institut – Fachbereich industrieelle Automation
  https://www.iosb-ina.fraunhofer.de/
- Hochschule Bielefeld
  https://www.hsbi.de/forschung/forschungsprojekte/aktuelle-projekte-fb-3/naumann-monocab
- RailCampus OWL
  https://railcampus-owl.info/
- DB-Systemtechnik
  https://www.db-systemtechnik.de/dbst-de
- Various companies in electronics, automotive supply, and rail technology sectors, notably the rail construction company Albert-Fischer-GmbH https://www.albert-fischer.de/

Funding for MONOCAB Consortium Research Activities

The research activities of the MONOCAB Consortium are funded by:

- The Ministry for Environment, Nature Conservation, and Transport of North Rhine-Westphalia, and
- Co-financing by the European Union.

MONOCAB Kleverland - Objectives and Stakeholders

In the 1860s, Kleve was a hub of rail innovation in Germany. In 1863, the first railway line in the Rhineland was inaugurated between Cologne and Kleve. Only two years later, the line was extended to Nijmegen in the Netherlands, providing the city of Nijmegen—at the time not yet connected to the Dutch rail network—with access to the German rail system. That same year, the "Spoy-Welle Trajectory" began operation, offering a ferry connection for rail vehicles across the Rhine at the German-Dutch border.
(https://de.wikipedia.org/wiki/Trajekt_Spyck%E2%80%93Welle#Die_Trajektanstalt).

Previously, horse-drawn carriages were the primary mode of transportation, but the railway facilitated the efficient transport of regionally produced goods to the Rhine and Ruhr metropolitan areas.

The “MONOCAB-Kleverland” feasibility study aims to build on the historical role of Kleve in the establishment of railway transportation in the Rhineland and the Dutch province of Gelderland by developing a MONOCAB research line on the disused Kleve-Kranenburg-Groesbeek (NL) railway route.

The economic and scientific leadership of the MONOCAB-Kleverland feasibility study lies with the Faculty of Society and Economics at Hochschule Rhein-Waal (HSRW), led by Prof. Dr. Ralf Klapdor. Loendersloot Consultancy, a bike infrastructure planning firm based in Nijmegen, brings the Dutch perspective. The feasibility study is supported by a German-Dutch MONOCAB support team consisting of volunteer mobility planners from Kleve, Kranenburg, and Berg en Daal (NL). Event coordination for the test drive is led by Andreas Lietschulte, who also contributes substantially to other project areas.

MONOCAB-Kleverland Feasibility Study

The primary goal of the feasibility study is to evaluate the technical and economic feasibility of establishing a MONOCAB research line on the Kleve-Kranenburg-Groesbeek (NL) route. Additionally, the study will assess social acceptance of the route and identify cross-border mobility needs between Kleve, Kranenburg, and Groesbeek (NL).

Beginning in the winter semester of 2024/2025, HSRW will initiate an interdisciplinary research project to assess the feasibility of a MONOCAB research line. As part of this study, HSRW will conduct a “before-and-after acceptance study” and organize a test drive event in Kranenburg in the spring of 2025 for local residents, providing participants the opportunity to experience MONOCAB technology firsthand. Information needed for an application for financial support of the research line from the EUREGIO Rhein-Waal will be collected and prepared.

The event will feature an exhibition titled “When the Railway Came to Kleve,” organized by the local history associations of Kranenburg and Nütterden, allowing event visitors to experience both the historical and future aspects of rural mobility.

Research Objectives of MONOCAB-Kleverland

TH OWL uses sections of the old Extertalbahn railway in East Westphalia-Lippe to conduct research on MONOCAB's foundational technology. A second MONOCAB research line is to be installed on the rail route from Kleve to Groesbeek, NL, parallel to the existing rail bike service, to investigate the following topics:

- **Social Acceptance**: How should AI-based micromobility services be organized to integrate them into the daily mobility needs of residents along future MONOCAB lines?
- **Technical Challenges:** What technical challenges can future operators of MONOCAB lines expect?
- **Economic Framework:** What costs can future operators expect for the various components of a MONOCAB line?
- **Planning and Implementation of a MONOCAB Line:** The planning and implementation cycles for establishing a second MONOCAB research line will be documented and analyzed to serve as a blueprint for future MONOCAB operators.
- **Operation of a MONOCAB Line:** What are the ongoing requirements for staffing, energy, and maintenance for future operators?
- **Tourism Potential:** How can MONOCAB lines contribute to the touristic development of a region?
- **Impact on Property Values:** What influence might future MONOCAB lines have on the property values within their service areas?
- **MONOCAB-based Municipal Traffic Concepts:** How should templates and text modules for future MONOCAB-based municipal transport concepts be designed to enable quick and easy adoption by other municipalities?
- **Safety Inside and Outside a MONOCAB Cabin:**
    - What design features are required for secure trips for vulnerable individuals, such as uninterrupted journeys without intermediate stops?
    - How can MONOCAB cabins safely navigate pedestrian zones without posing risks to crossing pedestrians?
    - What safety mechanisms are required at intersections between MONOCAB lines and motor vehicle roads to ensure safe passage?

Additional research topics will be developed within the feasibility study.

Feasibility Study and Test Drive Event

A funding application for €50,000 has been approved by the EUREGIO Rhein-Waal to support the feasibility study and partially cover the test drive event costs. HSRW will invest €25,000 in staff costs for the study, with five professors contributing research expertise in AI acceptance, transportation economics, sustainability transformation, and finance. A doctoral candidate from the Faculty of Society and Economics will oversee operational project management.

A MONOCAB test drive event is scheduled for Saturday, March 29, 2025, at the former German-Dutch border station in Kranenburg. Over a 390-meter stretch of track at Kranenburg station, local residents, mobility enthusiasts, researchers, and politicians will have the opportunity to experience MONOCAB technology firsthand. EUREGIO Rhein-Waal is providing €35,000 in funding for this event.

TH OWL will transport a “tech demonstrator” (as seen in the previously linked video) to Kranenburg, where it will be mounted on the track for test drives. A design prototype will also be available, showcasing the interior of future MONOCAB cabins.

The MONOCAB test drive event on March 29, 2025, will be opened by Oliver Krischer, NRW Minister of Transport. Other confirmed participants include:

- Dr. Lars Müller, Board Member of DB Systemtechnik and Deputy CEO of RailCampus OWL
- Jürgen Tuscher, CEO of RailCampus OWL
- Prof. Dr. Stefan Witte, Vice President of TH OWL, responsible for research and knowledge transfer
- Prof. Dr. Thomas Schulte, Head of the Institute for Energy Research at TH OWL and MONOCAB project leader
- Thorsten Försterling, MONOCAB project initiator
- Dr. Anne-Monika Spallek, rapporteur on “Rural Areas” for the parliamentary group of Alliance 90/The Greens
- NRW Cities and Municipalities Association Mobility Committee
- Peter Gießen, CEO of Niederrheinische Verkehrsbetriebe AG (NIAG)

University Partnerships

In August 2024, TH OWL and HSRW agreed on a research partnership to address the aforementioned research topics. During these discussions, a potential MONOCAB research operation was considered for the Kleve 2029 State Horticultural Show, connecting the show's two locations in downtown Kleve and the Kleve Zoo.

In addition, researchers in mobility from Arnhem-Nijmegen University have expressed strong interest in joining this research collaboration to explore how MONOCAB technology could be adapted to Dutch micromobility needs.

Role of Grenzland-Draisinen-GmbH

Grenzland-Draisinen-GmbH, based in Kranenburg, has operated a section of the old "Kaiserbahn" route between Kleve and Nijmegen for approximately 20 years, providing a tourist rail bike service with stops in Kleve, Kranenburg, and Groesbeek (NL). The railway is owned by the cities of Kleve, Kranenburg, and Groesbeek and is leased long-term to Grenzland-Draisinen-GmbH. The MONOCAB research activities will be conducted alongside the rail bike service.

Grenzland-Draisinen-GmbH is expected to play a central role in the practical implementation of research trips with and without passengers. Planned roles include:

- Serving as the leaseholder and operator of the Kleve-Kranenburg-Groesbeek (NL) line throughout the research period.
- Maintaining the MONOCAB research cabins and supporting infrastructure at a depot and workshop in Kranenburg.
- Leasing MONOCAB cabins to HSRW for research purposes.
- Conducting regular maintenance and repair of MONOCAB cabins and the research line.
- Supporting the setup of a control center and providing personnel for monitoring and control as automation of research trips progresses.
- Offering tourist rides as additional MONOCAB cabins become available to meet growing interest in test drives.

This arrangement provides Grenzland-Draisinen-GmbH the opportunity to be the first commercial entity to organize a MONOCAB research or commercial research operation. The company could later leverage this expertise to advise on future MONOCAB line projects.

Further Information

- https://www.monocab-owl.de/
- https://lwz24.de/2024/08/01/millionen-foerderung-projekt-monocab-nimmt-fahrt-auf/
- https://www.dwih-newyork.org/en/2022/06/27/monocab-owl/
- https://blog.frankfurt-holm.de/beitrag/thorsten-foersterling-ueber-monocab
- https://www.albert-fischer.de/

Additional videos on MONOCAB can be found on YouTube.

The feasibility study is funded by: