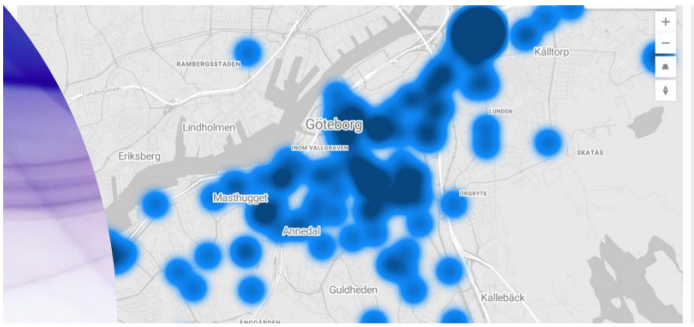
# VIASAFETY




**Road Traffic Safety for Electric Micro Vehicles (VIASAFETY)**
**Datum**: 2026-01-20
**Projektledare:** John-Fredrik Ehrenhofer Grönvall, Chalmers Industriteknik

VIASAFETY-projektet visar att uppkopplade fordonsdata från elektriska mikromobilitetsflottor är en värdefull bidragande datakälla för att identifiera och minska säkerhetsrisker i städer.

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# Swedish summary

VIASAFETY-projektet visar att uppkopplade fordonsdata från elektriska mikromobilitetsflottor är en värdefull bidragande datakälla för att identifiera och minska säkerhetsrisker i städer, särskilt med tanke på den ökande närvaron av elektriska tvåhjuliga fordon på europeiska vägnät. Med hjälp av telematiksensorer installerade på en centralt hanterad flotta av elmopeder som är i drift i Göteborg samlade projektet in stora volymer GPS- och accelerometerdata från verkliga leveransoperationer, utan att förlita sig på någon personlig information. Genom att analysera hårda inbromsningar, fortkörningar, väjningar och andra indikatorer på nära håll med avancerad databehandling, maskininlärning och kvalitetssäkringsmetoder identifierade projektgruppen ett antal "svarta punkter" och högriskzoner i hela stadsnätet.

Utöver att bevisa den tekniska genomförbarheten av denna metod klargör VIASAFETY hur operativt sammanhang, juridiska begränsningar och datarepresentativitet måste hanteras för att få fram meningsfulla säkerhetsinsikter. Projektet levererar en GDPR-kompatibel datapipeline, förfinade trafiksäkerhetsalgoritmer och bearbetade datamängder redo för vidare forskning via SAFER och CLOSERs nationella logistikdatalabb. Resultaten skapar en grund för städer och operatörer att gå från retrospektiv, kraschbaserad säkerhetshantering till mer proaktiv övervakning i nära realtid, vilket möjliggör riktade insatser som trafiklugnande åtgärder, infrastrukturjusteringar och hastighetshantering för oskyddade trafikanter och professionella kurirer.

# English summary

The VIASAFETY project demonstrates that connected vehicle data from electric micro-mobility fleets is a worthwhile contrinuting data source to identify and mitigate urban road safety risks, especially given the increasing presence of electric two-wheeled vehicles on European road networks. Using telematics sensors installed on a centrally managed fleet of electric mopeds operating in Gothenburg, the project collected large volumes of GPS and accelerometer data from real delivery operations, without relying on any personalised information. By analysing harsh braking, speeding, swerving and other near-miss indicators with advanced data processing, machine learning and quality assurance methods, the project team identified a number of "blackspots" and high-risk zones across the city network.

Beyond proving the technical feasibility of this approach, VIASAFETY clarifies how operational context, legal constraints and data representativeness must be handled to derive meaningful safety insights. The project delivers a GDPR-compliant data pipeline, refined road safety algorithms and processed datasets ready for further research via SAFER and CLOSER's national logistics data lab. The results create a foundation for cities and operators to move from retrospective, crash-based safety management towards more proactive, near-real-time monitoring, enabling targeted interventions such as traffic calming, infrastructure adjustments and speed management for vulnerable road users and professional couriers.

# Background

Beginning in the mid-2010´s, and exploding because of the global pandemic, the acceleration of app-based food delivery services and the broader delivery market has led to a fundamental shift in transportation. Typically relying on “micromobility” form factors such as electric bikes, e-scooters, and mopeds to make deliveries quickly and efficiently, the delivery industry has thus been a major factor in the growth of these form factors, particularly in urban areas in Europe, including Gothenburg. IAs a result, there is a need to better understand how these modes interact in urban landscapes, and how to adjust traditional traffic planning frameworks to deal with competing uses of the right-of-way. This need is particularly acute when it comes to traffic safety and Europe’s larger objectives to achieve Vision Zero- with zero road related fatalities or serious injuries. How should road safety planners reconsider prioritization and design because of these new form factors? This project aims to build upon the successful collaboration between partners and previous research initiatives, incorporating new data from micromobility vehicles to help better understand the safety of these new transport modes in Gothenburg.

The ongoing Drive Sweden project, CoMiMo (Connected Micro Mobility) has introduced a central fleet of vehicles for couriers connected to food deliveries in Göteborg. This provides an opportunity to track the movements of the vehicles and identify abnormal behaviours such as rapid braking, swerving, etc. and the indicators of "near misses" that this project wants to analyse. Normally, the independent drivers have their own vehicles, which does not give the possibility to follow these vehicles in such a way. The collaboration between GoCimo, which provides the electric mopeds, and Vialumina, which manages the control of the vehicles, gives an opportunity to follow vehicles and a professional body where more knowledge is needed to understand how they move in the city, what their working conditions are like and what they mean for the traffic safety of the micromobility in a city. In this project we attempt to investigate courier behaviour to provide new insights about their road safety and how a safe system approach can improve safety for both couriers and other road users.

The expansion of electric bikes and e-scooters in Europe and in Göteborg has created a need for central control to cope with the regulations, requirements, etc. of the cities and legislators. The partner Vianova operates within this new realm, providing a platform for the analysis of connected vehicle data and the management of connected vehicles through geofencing. Starting initially with shared mobility services such as bike-share and scooter-share and expanding into other connected vehicle classes such as cars and commercial trucks, Vianova builds data products which work with aggregated “FCD” (floating car data) to highlight actionable insights for cities.

Vianova's efforts to develop a road safety measure using connected vehicle data build upon previous work conducted in several other projects. These include a Drive Sweden-funded road safety Proof of Concept (POC) project in Helsingborg[1], the

[1] https://www.drivesweden.net/sites/default/files/2023-08/02022-02900-final-report-investigation-into-multi-modal-risk-assessment-in-helsingborg-1.pdf

ongoing Horizon Europe SOTERIA project[2], and additional POC projects in Zurich, Lyon and London. These initiatives have harnessed connected vehicle data from logistics vehicles and private cars to develop a measure for road safety which fuses multiple risk factors and normalizes across a broad road network.

The necessity to process large volumes of data has driven advancements in technology, such as software, machine learning, and AI processing. This development has been accelerated and refined by simultaneously analysing data from numerous European cities. In this project, we additionally aim to investigate whether applying advanced machine learning and AI processing techniques to vast quantities of micro mobility-connected vehicle data can identify valuable road safety metrics. These insights can potentially reveal where pre-emptive measures are required and enable the evaluation of outcomes and improvements after implementing such measures.

[2] SOTERIA project, Available at: https://soteriaproject.eu/, Accessed 2025-12-18

# Project overview

## Purpose

The project aimed to create knowledge about the working conditions and traffic safety situation for independent courier drivers through the possibility of following their movements via a central vehicle fleet. Movements that can be processed to create new knowledge about where the risks to them arise and hopefully what can be done to reduce them.

To investigate the behaviour of electric moped drivers in connection with goods deliveries in traffic, the project aimed to evaluate if it is possible to create traffic safety measures from connected vehicle (probe) data without personalized data. An important condition has been to make the collected data available for future research.

The project has studied how road safety in connection with the use of small vehicles, such as electric scooters, various types of cargo bikes, bicycles, electric mopeds, at low speed on the road, can be improved. The data that these vehicles generate has been used in the project, by processing, analysing and sharing with the project partners.

## Objective

Beskriv projektmålen med utgångspunkt i projektansökan. Om målen har ändrats förklara varför och vad ändringen innebär.

- *Establish a secure system to collect connected vehicle/telematics data from vehicles typically absent in safety analyses such as those used by delivery couriers and shared e-scooters.*
- *Visualize and improve traffic safety for independent Courier riders, electric scooters and other micro mobility through aggregated connected vehicle data in Gothenburg*
- *Detect "high-risk zones" for independent courier riders and e-scooter users by aggregating near-miss indicators such as heavy-breaking, high speeding as swerving, as well as usage patterns, trip densities, and other operations.*
    - *Identify the need for measures to increase traffic safety for new types of vulnerable road users: electric scooter riders and professional drivers*
    - *Evaluate the use of aggregated movement data as an indicator of road safety and for road safety measures*
    - *Locate areas that require changes to improve road safety for these vulnerable road users*
    - *Evaluate the scalability of new measures of road safety*
    - *Collect imagery from electric mopeds to help evaluate risk*
    - *Collect data for future research via SAFER*
    - *Collect data for future research to CLOSERs national logistics data lab. The national logistics data lab has the objective of increasing the potential for collaborations on sharing and using data. This will benefit the development of a sustainable transport system in the future.*

**Performance goals**

*Start mapping the road safety for urban Riders, cycle paths and for unprotected travellers*

- *Part of the work to test new measures of road safety through the technical possibility to process large amounts of data through machine learning and AI*
- *An opportunity to make visible the responsibilities and opportunities of cities and companies connected to independent couriers for a living and safe city.*

## Project duration

1 June 2023 – 31 December 2025

Regular project meetings have bene held to facilitate communication and collaboration among all partners. These meetings provided a platform for discussing project progress, addressing challenges, sharing knowledge, and making collective decisions.

## Partners

- **SAFER**

SAFER, hosted by Chalmers Tekniska Högskola AB, is a competence centre where 50 partners from the Swedish automotive industry, academia and authorities cooperate to create a centre of excellence within traffic safety research and safe mobility Research is conducted within 5 areas: Systems for accident prevention and automated driving, Road user behaviour, Human body protection, Post crash and Safety performance evaluation. SAFER gives Access - through projects - to SAFER's connected research resources: AstaZero real-world proving ground, Revere research lab for active safety and autonomous driving, SAFER Naturalistic Driving Data Platform and Data catalogue. SAFER is Located at Lindholmen Science Park in Gothenburg, Sweden. Chalmers Industriteknik and Svanberg & Svanberg AB has acted as resources for SAFER

- **GoCimo**

GoCimo (CellSwap AB) is committed to the safe and clean electric in micro mobility and will contribute to the project in the pilot with a MaaS service of electric mopeds with battery swap and have tracker and other equipment on the mopeds in order to detect and analyse traffic safety. The team has long experience of setting up pilots within e-mobility (+10 projects) and establishing charging infrastructure (InCharge Europe). GoCimo is convinced that the project outcome will contribute to a safe micro mobility service being rolled out over the EU and UK. Today GoCimo have operations in Göteborg, Stockholm, Malmö, Copenhagen, Amsterdam and will shortly launch Uppsala and Örebro.

- **Vialumina**

Vialumina was founded in 2020 by two EV-Charging Veterans who saw an urgent need for commercial fleets to operate more efficiently and accelerate the shift

towards fossil free vehicles in the transport sector. Vialumina´s solution lies in intelligent use of data from existing vehicles while at the same time starting the shift towards a fossil free fleet without compromising operational efficiency. The contribution lies in achieving cost savings of up to 50% over time, minimal carbon footprint, safer and happier co-workers, improved employer branding and profitability. In this project Vialumina contribute with its expertise and put in time in in-kind to be able to work with colleagues and collaborate on new ways to use aggregated data and hopefully commercialize the methods and at the same time help with road safety.

- **Vianova**

Vianova is a leading mobility data solutions provider, empowering cities and transport authorities with innovative digital tools to guide the development of shared mobility services towards safety, sustainability, and efficiency goals. Established in 2019 in Paris, the company has expanded its presence across Europe, partnering with over 60 cities, including more than 10 cities in Sweden such as Gothenburg, Stockholm, Malmö, Gävle, and Jönköping, as well as Helsinki and Ruter (Oslo). Since 2021, Vianova have been leveraging our expertise in big transport data to help identify road safety risk using connected vehicle data. These projects have focused on utilizing data from cars and trucks. In this project we will combine our expertise in micro-mobility and road safety data to help get a better understanding of the risk hotspots with micromobility vehicles.

The project responsibility was shared among the partners:

- SAFER was responsible for managing the project and overseeing the project's validity from an academic perspective.
- GoCimo provided the electric mopeds that will be used to collect data.
- Vialumina provided the telematics sensors on the vehicles and was responsible for data collection, aggregation and storage.
- Vianova was responsible for the processing of data collected from both the electric mopeds and e-scooters and developed the algorithms for data processing. Vianova was responsible for the analysis of the data in respect to the research questions.

# Methodology and activities

The overall approach is that the project took measures to ensure that data collection is from non-biased real daily operational situations with riders performing their routes. Project activities, information, hardware and software did not implicit daily operations for riders.
The data collected by actors in the project, was validated and assessed from quality, and will be made available for future research projects.
The project followed the FESTA V-method[3] described in Figure 1. This method starts from research questions defining the requirements on the data collection in the preparation phase. It continues with the actual data acquisition and handling of the data, and finally the analysis phase. Since a real-world experiment need adaptation, there is need for an iterative process to continuously integrate between the actors. The legal and ethical aspects are considered.

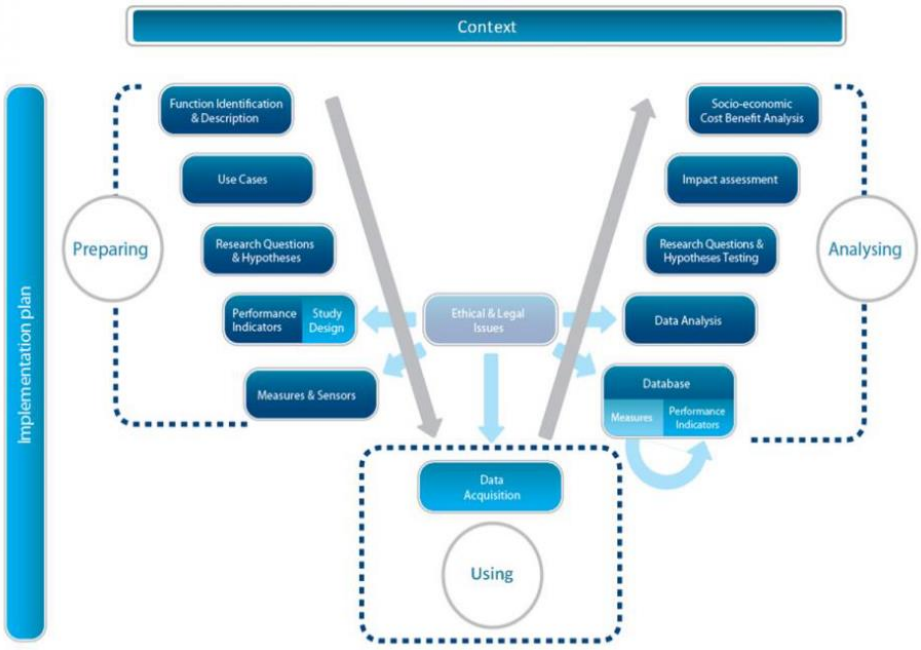



Figure 1: FESTA Methodology (2021)

## Research questions and experimental methods

The research questions guide the investigation of road safety in the context of micromobility. Depending on data availability and scope of the operation, the research questions have been updated during the project. The preliminary research questions were:

- **RQ1:** Are electrical mopeds performing better than gasoline mopeds, with respect to incidents (and accidents)?

[3] FESTA Methodology, 2021, Available at: https://www.connectedautomateddriving.eu/methodology/festa/, Accessed 2025-12-17

    - No gasoline mopeds were used in the study. If similar data is collected for gasoline mopeds, the data from Viasafety could act as baseline for comparison.
- **RQ2:** Is it possible to measure “Traffic safety” with the means of accelerometer and GPS data?
    - This research question remained throughout the project.
- **RQ3:** Is data of enough quality to analyse traffic safety?
    - This research question remained throughout the project.
- **RQ4:** Can the data be used to identify locations where there is a higher risk for incidents or accidents?
    - Identify risk areas and analyse what the increased risks may be due to and, if possible, analyse and identify the need for measures.
    - This research question remained throughout the project.
- **RQ5**: Do winter conditions affect the traffic safety measures?
    - This research question was added since the vehicles were operated 6 months with winter tires.

## Equipment and data availability

The ViaSafety project leveraged on the CoMiMo project’s fleet for real-world mobility data. The vehicles, provided by GoCimo, are electric mopeds with a maximum speed of 25 km/h and a 1,000 W engine, equipped with battery swap capabilities. These mopeds are used for grocery and food deliveries to households and offices in central Göteborg, forming a dynamic urban mobility dataset for traffic safety analysis. Vialumina provided data collection tools for logging, ingestion, and ensuring secure storage and processing. All processes adhere to GDPR regulations, with a strong emphasis on privacy-by-design principles to protect user data.

The data collection framework tailored to the ViaSafety project’s objectives, such as identifying high-risk traffic patterns. GoCimo’s electric mopeds were equipped with embedded data loggers as self-contained units powered by independent batteries to ensure uninterrupted operation. These loggers utilize 2G/3G/4G communication modules for real-time data transmission to Vialumina’s backend.

### Data logger specifications

Each data logger is equipped with multiple sensors to capture relevant mobility and safety metrics:

- **GPS Module**: Records location data at a minimum 10 m resolution to track routes and positional aggregates (e.g., zone-based trip density) while preventing precise geolocation that could identify individuals.
- **Accelerometer**: Measures acceleration, deceleration, and lateral movements to detect events like hard braking or sharp turns, which are critical for identifying candidate safety incidents.
- **Temperature Sensor**: Monitors environmental conditions to contextualize vehicle performance and battery health.

Data is logged in real time at a high collection rate (up to 1 Hz for GPS and accelerometer data) to ensure comprehensive capture of vehicle dynamics. The process include:

- **On-Device Preprocessing**: Raw sensor data is filtered on-device to remove redundant or non-essential readings (e.g., static vehicle states) and apply initial pseudonymization, such as hashing device IDs to prevent direct linkage to riders.
- **Secure Transmission**: Data is transmitted via encrypted 2G/3G/4G channels using TLS 1.3 protocols to Vialumina's cloud infrastructure. Checksums verify data integrity during transit.
- **Cloud Storage**: Data is stored in Vialumina's Digital Fleet Operating System, hosted on secure servers (e.g., Google GCP with AES-256 encryption at rest). Access is restricted through role-based controls and multi-factor authentication, with audit logs tracking all interactions to ensure GDPR-compliant accountability (Article 32).

## Data processing

Vialumina's cloud-based Digital Fleet Operating System provides a secure and robust platform for data aggregation and preprocessing, with documented processes and DPIAs ensuring GDPR compliance.

Once ingested, data undergoes rigorous processing to support Via Safety's analytics goals while adhering to GDPR's data minimization and anonymization principles:

- **Incident Validation**: Instead of using camera-based picture analysis, candidate incidents (e.g., sudden stops or erratic manoeuvres) are validated through cross-referencing accelerometer and GPS data. For example, a hard braking event is confirmed by a sharp deceleration spike correlated with a specific route segment.
- **Data Minimization**: Only necessary fields are retained, such as aggregated speed profiles, route segment frequencies, and incident metrics (e.g., frequency of hard braking events).

# Operations

## Test site location

The test area covers the city of Göteborg with last mile deliveries on micro-mobility vehicles, here electric mopeds. Production peaks during dinnertime weekdays and peaks in the weekends, which offers data from various times as well as workdays and weekends presented in Figure 2.

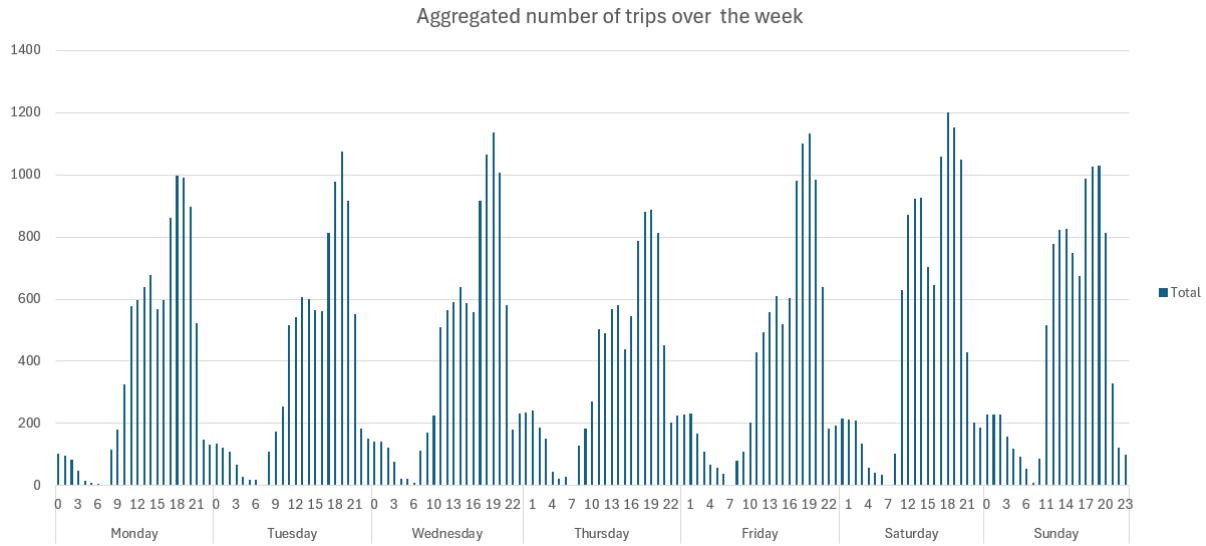



Figure 2: Aggregated trips per hour over the week

## Operational setup

The operational setup with electric mopeds instrumented with data loggers was in the food delivery company's production in Göteborg in cooperation with the Drive Sweden/Vinnova p-nr 2022-03074 project CoMiMo – Connected Micro Mobility 2022-11-01 - 2025-09-30. As the CoMiMo project had 20 electric mopeds in operation in Göteborg and expanded the fleet to 40 mopeds, it was efficient for this project to use the same fleet and loggers to collect data for the purposes of ViaSafety.

Through the deployment of five battery swap stations, where one station had two charging stations and a repair shop, described in Figure 3, and 40 electric mopeds in Göteborg, the setup has proven how the vehicle and battery swapping technology and innovative business models can work together to overcome key obstacles in last mile logistics and therefore make the shift from petrol to electric driveline happen withing light vehicles in B2B fleets.

The system enables automated user verification, remote monitoring, and efficient energy management. These features enhance transport efficiency, reduce climate impact, and improve working conditions for drivers. As of September 2025, 60 mopeds are in traffic in Gothenburg.

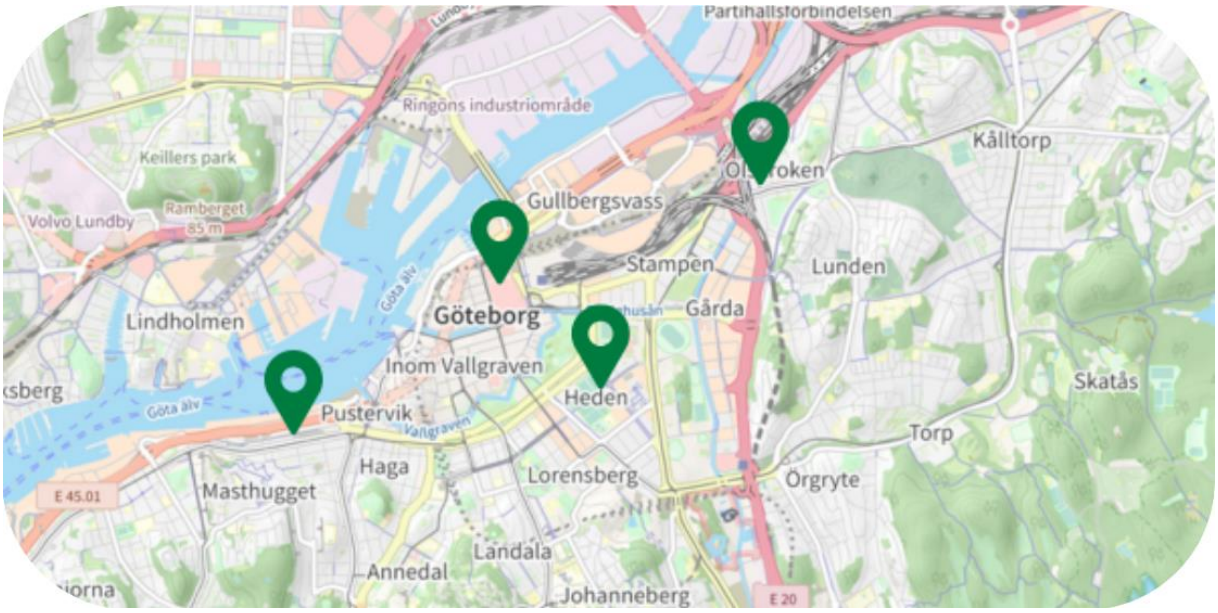


Figure 3: Charging locations

The swap stations, presented in Figure3, are strategically located in central Göteborg in cooperation with location parters Nordstan and Göteborg Parkering. The actual swap where a discharged battery is switched to a fully loaded one takes about 10 seconds, and therefore the swap offers high productivity and efficient management of the mopeds as no hub charging is required. It is also an industrialized safe charging process with over-the-air real time surveillance.

In the work with analyses of aggregated movement data, other sources are also used, which together can explain underlying explanations for identified black spots. The companies will work together to combine information about the usage behaviour of micro-mobility vehicles (e-scooters, bicycles, and mopeds) as well as explore potential supplemental data sources such as the movements of cars and commercial vehicles, pedestrians, and non-shared or fleet managed micro-mobility vehicles. The combination of the data sources, in addition to the city's existing methodology for risk identification, could be used to identify the need for measures and what the measures could be.

## Road safety and air quality impact – studded tires

In preparation for the seasonal change to winter tires on GoCimo's mopeds, we have examined the need for tire studs and their effects on both traffic safety and particulate emissions in Stockholm and Gothenburg. The findings are summarized below.
The project consulted *SAFER*, *the Swedish Transport Administration (Trafikverket)*, and the *Traffic Safety Research Unit at Folksam* to determine which type of tires provide the highest level of traffic safety throughout an entire winter season in the cities of Stockholm and Göteborg.

The prevailing conditions in the central areas of these cities typically include only a limited number of days with compacted snow and ice, combined with efficient snow removal and winter maintenance. For cars, non-studded winter tires are generally preferred under such conditions—regardless of whether the vehicle is equipped with antilock brakes. The reasons are twofold: first, non-studded tires provide sufficient

safety in these environments; and second, studded tires contribute to the generation of road wear particles (PM10), which pose a risk to public health.
For mopeds, however, the conclusion is different. Studded tires are recommended, as it takes very little for the front wheel of a two-wheeled vehicle to lose traction—small patches of ice are sufficient. Non-studded tires perform poorly on polished snow and ice; even short stretches of such surfaces require studs to maintain adequate grip. Studded tires also perform well on asphalt, as the roughness of the surface provides traction without significant slipping. In fact, traction with studs on asphalt is considerably better than that of non-studded tires on ice. Regarding particulate emissions and air quality, the impact from mopeds is negligible due to their low weight and limited road wear.

Based on this assessment, there are strong reasons to use studded tires during the winter season. Winter tires were installed progressively in Göteborg from mid-October until the first week of November 2024. The replacement with summer tires took place between the third week of April and the second week of May 2025.

## Data processing method

The project specified a step-by-step, auditable processing flow from secure collection, ingestion and handling: encrypted transfers from vehicles to back office; schema validation; cleaning and map-matching; event detection; aggregation; multi-factor risk scoring; quality assurance; and publication as static analysis layers for downstream research and operational use.
As outlined in Figure 4, the vehicles' logger transmits data over mobile network to back office at Vialumina. The data is then shared to Vianova and SAFER/Chalmers by secure file transfer. During the analysis phase, there is close collaboration between Vianova and SAFER/Chalmers. The datasets from the project will be maintained in the SAFER Naturalistic Driving Data platform for further analysis during and after the project ends. CLOSER assess the data to get an understanding of how this approach of collecting data can be utilized in further research. The data will be described in the SAFER Data Catalogue, an asset describing relevant traffic safety datasets for the SAFER partners built on the FAIR principles.

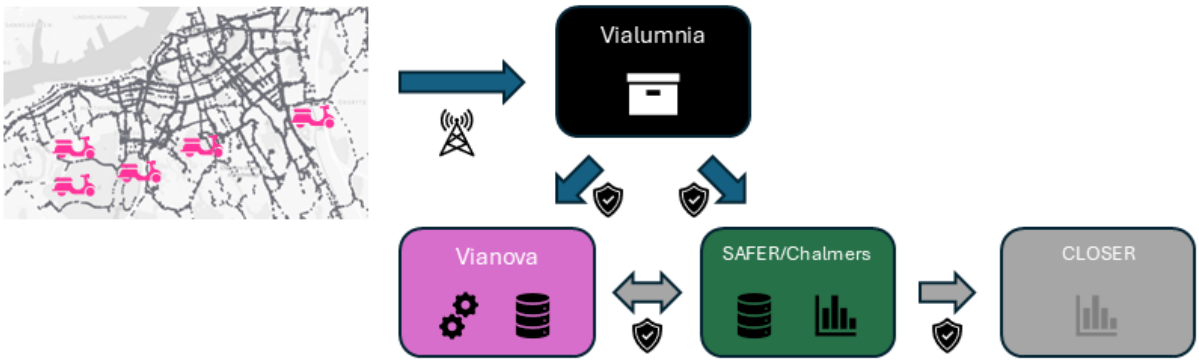



Figure 4: ViaSafety data flow

## Legal requirements and GDPR compliance

Collecting data from riders in their working conditions must be handled with care. Despite the value of connecting a rider to driver patterns and prone to risk, it was early decided to exclude that component due to the need to develop a specialized interface for an end-user.

No vehicle is tied to a specific rider during the operation. The logger records the vehicle number, but not the identification of the driver. This means that it is not possible to identify a natural person in the dataset.

**Camera Exclusion Rationale**: The decision to forgo cameras was reinforced by DPIAs, which highlighted the disproportionate privacy risks of visual data compared to the project's needs. Sensor-based analytics provide equivalent insights (e.g., incident detection via accelerometer patterns) without requiring complex safeguards like real-time image anonymization, which may still fail to prevent re-identification in urban settings.

**Vialumina** acquired pseudonymized traces, no driver information or any personal data existed in sensors or Vialumina System. Personal data elements (e.g., rider names, phone numbers, or exact pickup timestamps) were excluded at source, the delivery company never shared any personal information or aggregators. Vialumnias GDPR-compliant privacy policy, retaining only anonymized legal basis: Contract performance (Art. 6(1)(b) GDPR) and legitimate interest in traffic safety research (Art. 6(1)(f)), indicated DPIAs confirming low risk.

- **Internal Processing and Protection**: Sensors on vehicles logged data locally with on-device encryption before transmission to Vialumina's secure servers. Processing used isolated environments with multi-factor authentication and intrusion detection. Outputs to Vianova were pseudonymized hashes only, with no raw logs shared.
- **Handover to Vianova and SAFER**: Transfers occurred via secure SFTP with checksum verification, limited to necessary fields (e.g., speed/position aggregates). Vialumina's Privacy Plan included breach simulations and annual audits, ensuring end-to-end chain compliance. Any data exchange was logged for accountability. No incidents occurred.

**Vianova** ensured GDPR conformity across acquisition and processing: identifiers were anonymized; only necessary fields were retained; processing occurred in isolated, access-controlled environments; and outputs contained no personally identifiable information. A documented Privacy & Data Protection plan underpinned these measures.

Data acquisition and minimization: raw data from sources such as vehicle telematics (e.g., GPS coordinates, timestamps, speed, acceleration, and device IDs) was acquired with explicit purpose limitation. Only data essential for traffic safety analysis—such as aggregated trip patterns, speed profiles, and route behaviours—

was retained. Unnecessary or high-risk fields were systematically removed or aggregated to prevent re-identification.

Removed fields: direct PII including unique device/user IDs (e.g., IMEI or VIN numbers) and any metadata linking to individuals (e.g., user profiles or session logs). Kept fields: anonymized aggregates like average speed per route segment, total trip counts per zone, directional flow volumes, and behavioural metrics (e.g., hard braking frequency without timestamps). These were limited to what was strictly necessary for ViaSafety's objectives, such as identifying high-risk intersections. Processing environment: all processing occurred in isolated, access-controlled cloud environments (e.g., Google or Azure with role-based access controls and encryption at rest/transit using AES-256). Data pipelines incorporated privacy-by-design principles.
Outputs and retention: final outputs, such as dashboards and reports, contained solely anonymized aggregates with no PII. Retention was limited to 18 months post-analysis, after which data was deleted or fully anonymized for archival purposes. Audit logs tracked all access and modifications to demonstrate accountability.

The ViaSafety data was also made available at the SAFER Naturalistic Driving Data platform. No personal data was part of the dataset, but the data files are still handled with the same data protection framework as of more sensitive data. This framework is built on 15 years of experience handling personal data from research projects, mainly from cars and trucks driving on public roads as parts of joint European research projects. The environment is highly secure, with limited connections to the Internet (having its own sub network), locked room, personal access, and government of the data assets. The environment has been established for more than 15 years with no breaches.

This integrated approach across Vialumina, Vianova and SAFER ensured seamless, privacy-preserving data flows, enabling traffic safety insights while upholding GDPR standards. For full documentation refer to Vianova's GDPR Statement and Vialumina's internal DPIA reports.

## Data sharing agreements

Data sharing within ViaSafety was governed by Data Processing Agreements (DPAs) between partners, outlining roles, security obligations, and breach of notification protocols (within 72 hours per Article 33). Sharing adhered to GDPR's data minimization and security principles, with Vialumina facilitating pseudonymized transfers only when necessary for collaborative analysis (e.g., cross-validation of traffic patterns).

# Results

The ViaSafety project generated a picture of how delivery mopeds interact with the road network in Göteborg, based on high-resolution GPS and accelerometer telematics. Using aggregated, anonymized event indicators, the analysis identifies where harsh events occur more frequently and provides a structured basis for prioritising locations for further research, investigation, and potential safety measures.

## Quality assurance

Vianova established a secure data ingestion workflow and performed quality assurance prior to analysis. This included completeness checks, timestamp sanity checks, and outlier filtering to remove implausible values (e.g., unrealistic speeds). GPS trajectories were cleaned (de-noising) and map-matched to the road network within the area of interest (AOI) to enable consistent segment-level metrics.
As part of the data quality assurance, trips shorter than 50 metres were removed from the dataset. Also, trips having higher speeds than possible (above 50 km/h) were removed. It was learnt that this could happen when the mopeds were moved with vans for service at workshops located in areas outside of the city kernel.

## Final dataset

The final dataset consists of data collected during 15 months from 2024-07-01 to 2025-09-30. The dataset consists of 67 445 trips covering 173 896 kilometres. The mopeds were in use 14 411 hours, while active riding 11 437 hours. 69% of the data was collected in 2024. Despite having longer data collection during 2025, there were less data recorded. This might be explained to some extent on the need for service on some mopeds, that newer mopeds were introduced over time, and might have been selected more often. The evolution of the data collection is stated in Figure 5 below. The dataset contains data from 19 unique data loggers (i.e. vehicles). It should be mentioned that no vehicle logged data every month of the data collection period. Seven of the vehicles recorded more than 10 000 kilometres of driving data (the highest value for a single logger is 17 294 kilometres). This indicate could indicate that the vehicles are operating in a tough environment and driven intensively, thus requiring service and maintenance.

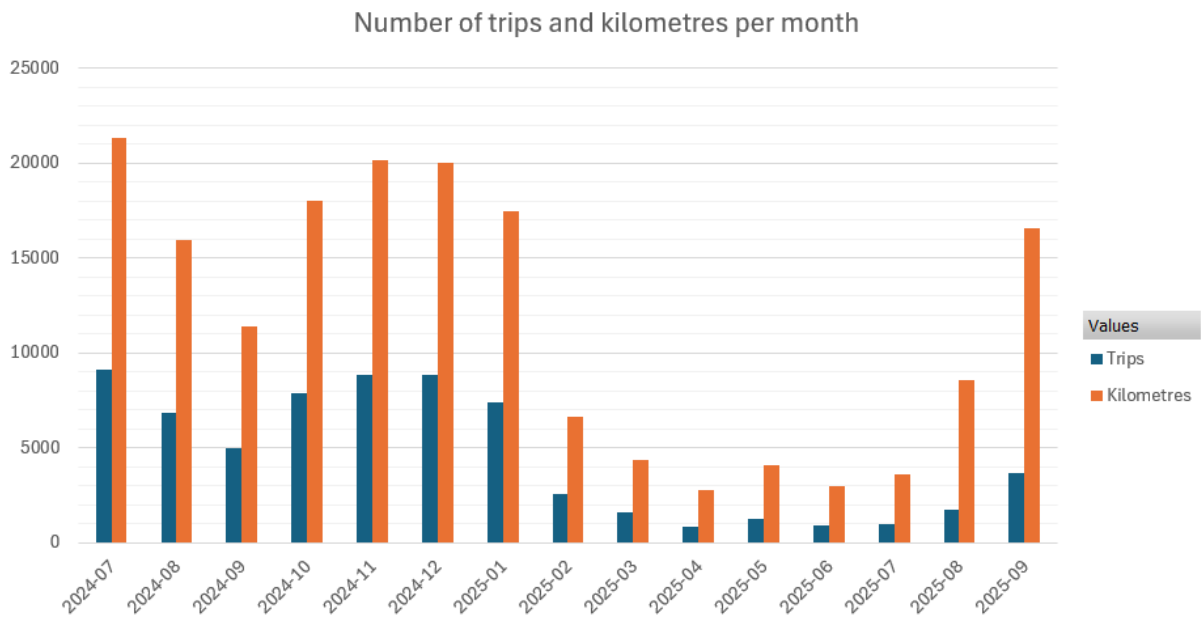


Figure 5: Number of trips and recorded kilometres per month.

Studded tires were mounted from late October and changed back to summer tires in April. In the analysis of winter conditions and stud tires, it is simplified and assumed that the vehicles had winter tires from November 1st to April 30th.

## Refined road safety algorithms

As part of the project's road safety analysis pipeline, refined road safety algorithms were applied. The work was implemented in three steps: (1) data processing and quality assurance, (2) aggregation to comparable spatial units, and (3) scoring and ranking of the road network to identify higher-risk locations.

Validated trajectories and detected events were aggregated to the road segment level (and, where relevant, grid-based summaries) to support network-wide comparability. The road network was derived from Open Street Map, with a normalization to minimize the difference in length between segments. Intersection "segments" were also built to collect the road segments joining together in Outputs *were generated as exposure-normalised rates (e.g., events per distance travelled) and as relative measures (segment ranks and percentiles across the full analysis area).*

Vianova applied and adapted its existing analysis methods, developed to identify risk hotspots using Floating Car Data (FCD) to the delivery moped dataset to quantify safety-relevant riding behaviour and prioritise locations for follow-up. The analysis focused on three derived indicators:

- **Harsh acceleration (2.31 m/s$^2$):** When you press the gas pedal too quickly, causing the vehicle to "jerk" forward. This is registered as an event if the acceleration is too abrupt, e.g., going from a standstill to high speed in a short time.

- **Harsh braking (2.52 m/s$^2$):** Sudden braking where you press the brake pedal hard, often too late or unnecessarily. This can occur in stop-and-go traffic or unexpected stops.
- **Harsh cornering (2.94 rad/s):** Taking turns too quickly, causing the vehicle to lean or slide. This is particularly noticeable in sharp curves or at higher speeds.

All three event types can be indicative of evasive driver manoeuvres, in other words actions taken by moped drivers to avoid a potentially hazardous situation themselves. Alternatively, the behaviour, particularly for smaller form factors such as mopeds, could be seen as causing unpredictability on the road for other users. When analysed together, therefore, these activities are likely to be seen as indicators of potential design or behavioural "conflict points", worthy of further investigation.

These indicators were normalised to support fair comparison between road segments and combined into a composite risk score. Each segment received a score and percentile ranking (0–100), enabling identification of higher-risk corridors and spatial clusters ("blackspots") for targeted review. The score is based on the number of recorded events per road segment with each event having the same weight in the calculation. More events in each category lead to a higher risk score.

## Analysis

Following validation, traffic-safety performance indicators (KPIs) were calculated from the data. The analysis computed indicators such as heavy braking, harsh cornering, and high acceleration. KPIs were aggregated at both segment level and area level to enable comparison across the test area while controlling for exposure.

Based on the KPI layers, high-risk locations ("blackspots") were identified by ranking road segments using a composite risk approach and detecting spatial clusters of segments with elevated event rates. These outputs are intended to support targeted follow-up, such as on-street review and prioritisation of candidate safety interventions.

- A ranked list of road segments (by risk) and hotspot maps.
- KPI summaries per indicator (rates, ranks, percentiles) at segment and area level.
- Documentation of data quality, coverage, and limitations to support research reuse (e.g., via SAFER).

### Network-wide KPI overview

For the full analysis period, the network-wide hourly speed rates and number of trips are presented in Figure 6. In Figure 7, the hourly occurrences of harsh cornering and harsh braking events are presented, again, with the hourly number of trips.

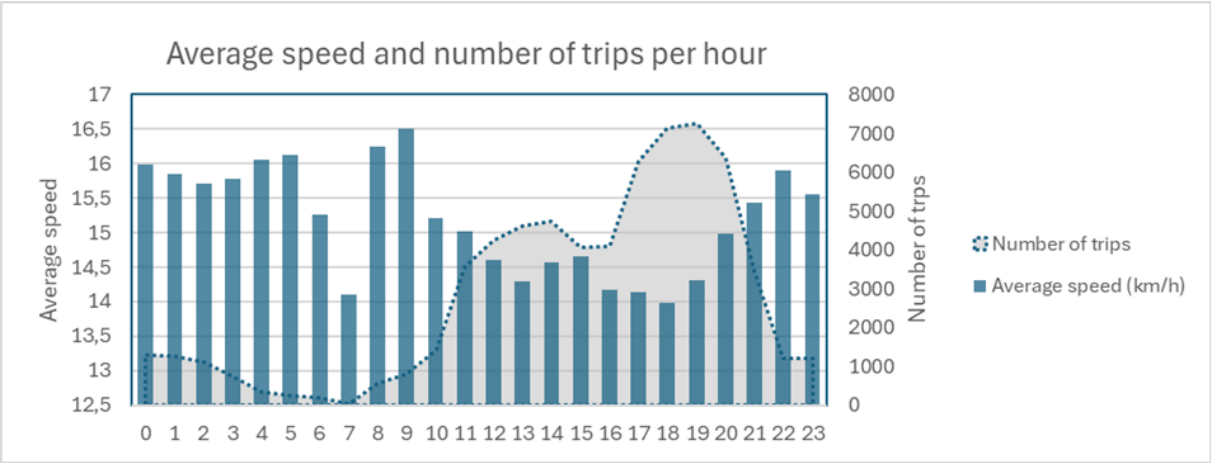



Figure 6. Average speed and number of trips per hour

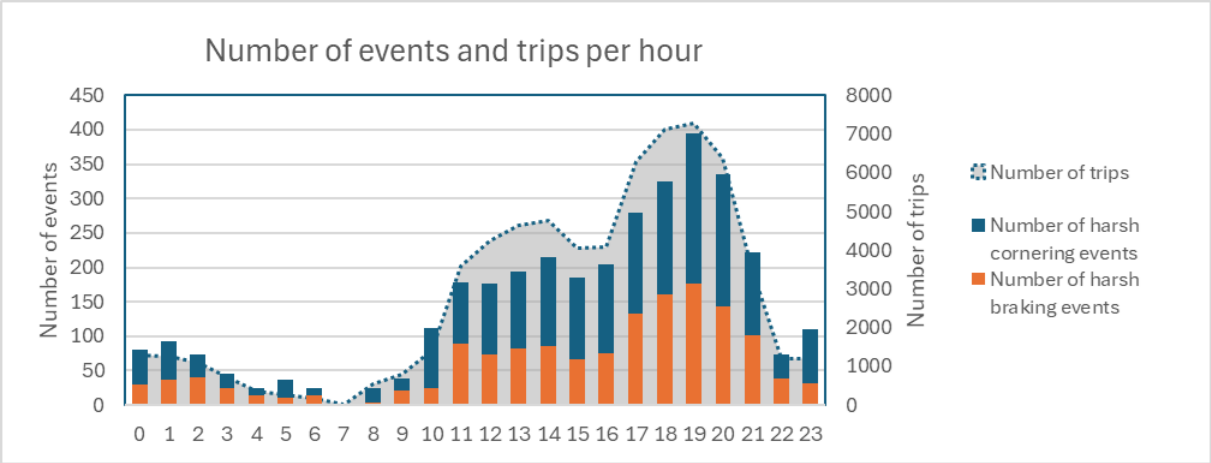



Figure 7. Number of events and number of trips per hour

The speed profile varies during the day, depending on the traffic volume. The events correlate with the number of trips, where the trips during daytime (11-18) have a bit fewer event per trip compared to the trips during the night. Obviously, the number of trips during nighttime are significantly lower.

## Top locations by event type

To support targeted review, the analysis produced ranked road lists for each indicator.

### Harsh acceleration – Top 5 roads

- Redbergsvägen
- Engelbreksgatan
- Ånäsvägen
- Gibraltargatan
- Ullevigatan

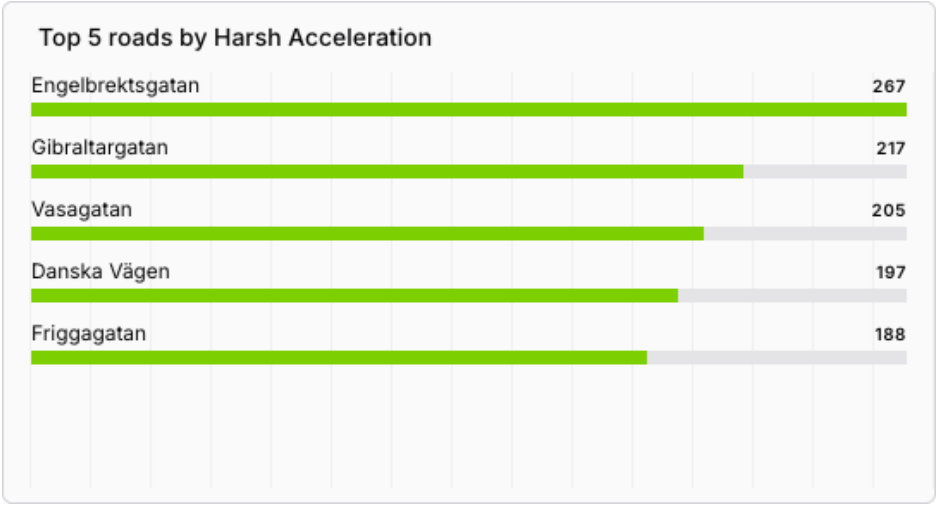



Figure 8. Top 5 roads by harsh acceleration

**Harsh braking – Top 5 roads**

- Friggagatan
- Redbergsvägen
- Ullevigatan
- Södra vägen
- Vasagatan

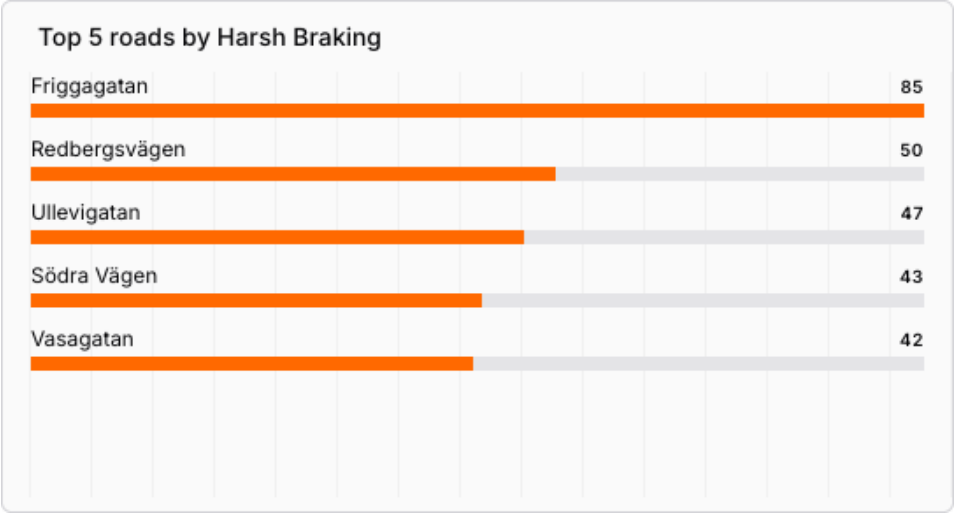



Figure 9. Top 5 roads by harsh braking

**Harsh cornering – Top 5 roads**

- Sankt Pauligatan
- Fjällgatan
- Jungmansgatan-Fjällgatan
- Viktor Rydbergsgatan
- Redbergsvägen

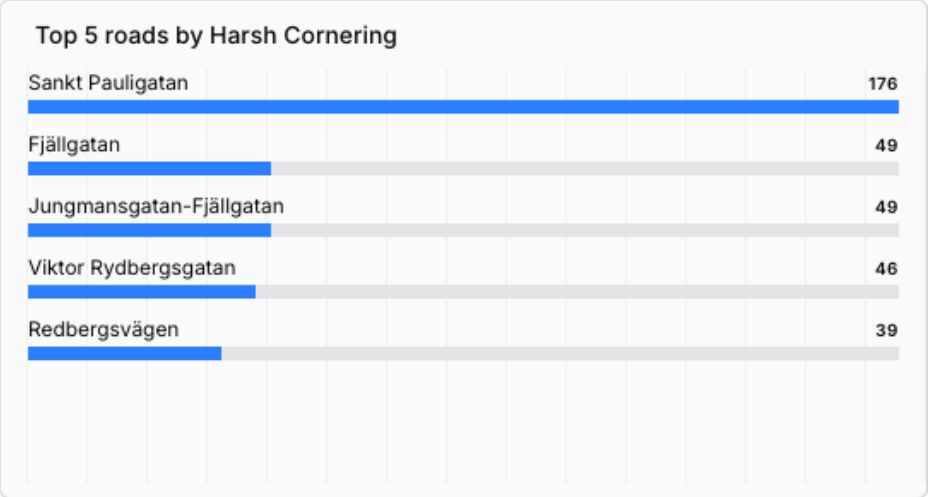



Figure 10. Top 5 roads by harsh cornering

**Highest-ranked segments by composite risk score (blackspots)**

Combining the three event types into a composite risk score produces a prioritised list of locations where harsh events are concentrated relative to distance travelled. In the analysed period, the top-ranked road segments were:

- Ullevigatan
- Redbergsvägen
- Sofiagatan
- Ekelundsgatan
- Redbergsvägen

Figure 11 displays how the events can be plotted on a map. The map layer did not have the bicycle paths included, why the mapping linked to Ullevigatan. In this case, there is a bicycle tunnel under the road (please see the in-depth for more details on this specific location).

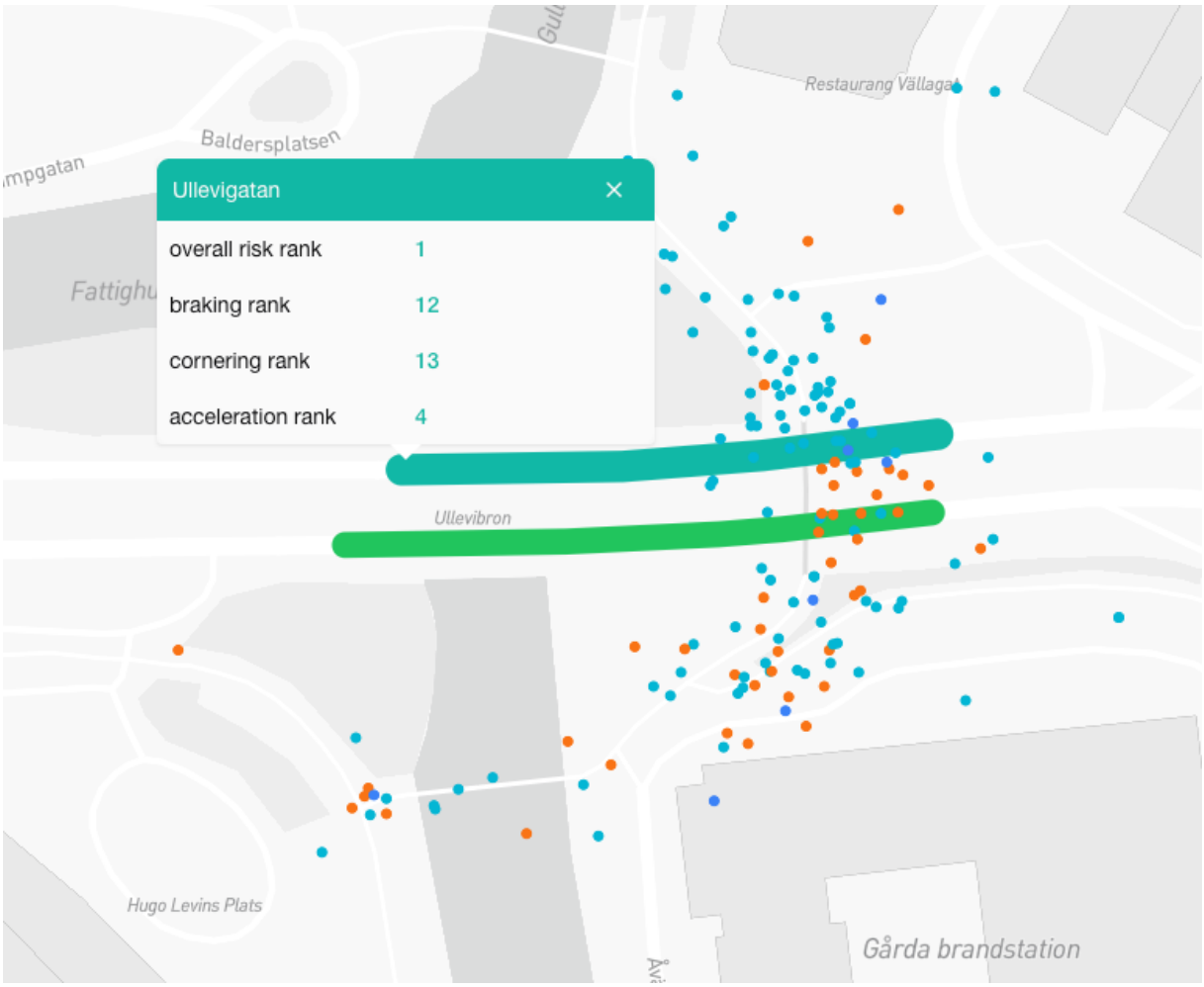


Figure 11. Ullevigatan, top road by overall risk rank as well as harsh braking.

**Hotspot in-depth analysis**
The automated analysis detecting hotspots served as input to an in-depth analysis. For this analysis, the measure of harsh braking was used. Some additional clustering was needed, and exposure was added by the number of passes on a specific location or road segment. To complement the analysis, bicycle accident reported in STRADA 2021-2025 was added, to add another layer in the risk profile. This was done for 10 locations based on the risk score of harsh braking's (9 locations), in correlation with accident hotspots in STRADA (1).

In Figure 12 and 13, the locations are outlined.

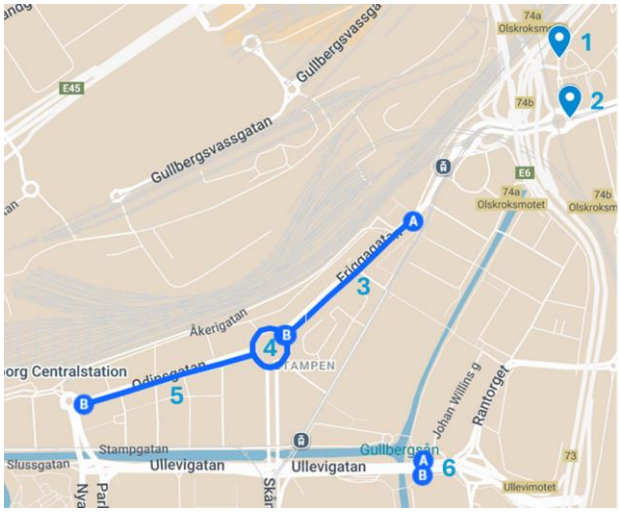



Figure 12. Hotspot 1-6

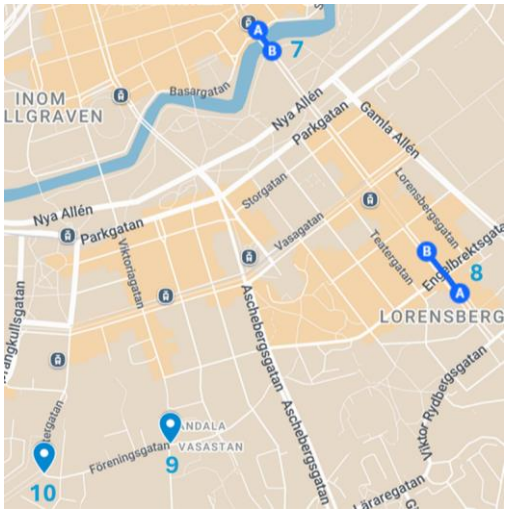



Figure 13. Hotspot 7-10

As mentioned above, the bicycle tunnel under Ullevigatan (no 6) has the highest brake ranking. But aggregating harsh braking and including the exposure, other locations indicate a higher risk profile described in Table 1.

Table 1. Analysed hotspots

| ID | Segment | Aggregated passes | Aggregated harsh brakings | Harsh brakings / passes | Passes / harsh brakings | Harsh braking rank |
|---|---|---|---|---|---|---|
| 1 | Olskroken bicycle passing | 4200 | 16 | 3,81 | 263 | 27 |
| 2 | Olskroken round-about | 8200 | 47 | 5,73 | 174 | 4 |
| 3 | Friggagatan | 8050 | **66** | 8,20 | 122 | 27 |
| 4 | Odinsplatsen | 4400 | 33 | 7,50 | 133 | 63 |
| 5 | Odinsgatan | 6650 | 52 | 7,82 | 128 | 16 |
| 6 | Ullevi bicycle tunnel | 6700 | 47 | 7,01 | 143 | **1** |
| 7 | Kungsportsavenyn lower | 6100 | 7 | **1,15** | **871** | 95 |
| 8 | Kungsportsavenyn upper | 5833 | 56 | 9,60 | 104 | 6 |
| 9 | Föreningsgatan / Södra Victoriagatan | 2850 | 32 | **11,23** | **89** | 7 |
| 10 | Västergatan / Föreningsgatan | 2800 | 29 | 10,36 | 97 | 2 |

The outliers are indicated in bold where red indicates higher risk profile, green lower risk profile. Aggregating the geographical elements, Friggagatan (66 harsh brakings), Odinsgatan (47), Kungsportsavenyn upper (56), and Olskroken round-about, all have higher numbers of harsh braking. Taking the risk measure of how many passes (i.e., exposure) there are in-between harsh braking, the intersection of Föreningsgatan / Södra Victoriagatan has the lowest number of passes (one harsh braking per 89 passes). This broadens the scope of what could be relevant and included in the risk score.

This has been a manual process, and there are alternatives in the map engine to address this in future analysis. The score of harsh braking divided by passes is calculated: harsh braking / passes * 1000. A higher score indicates higher risk.

As mentioned, bicycle accidents reported in STRADA 2021-2025 have been investigated for these specific hotspots. When evaluating this data, one road segment stood out in STRADA but having very low risk in ViaSafety data: Kungsportsavenyn lower. The number of accidents is included in Table 2 below.

Table 2. Hotspot in relation to registered accidents

| ID | Segment | Aggregated passes | Accidents 2021-2025 | Accidents / passes |
|---|---|---|---|---|
| 1 | Olskroken bicycle passing | 4200 | 2 | **0,48** |
| 2 | Olskroken round-about | 8200 | **16** | **1,95** |
| 3 | Friggagatan | 8050 | 7 | 0,87 |
| 4 | Odinsplatsen | 4400 | 7 | 1,59 |
| 5 | Odinsgatan | 6650 | 6 | 0,90 |
| 6 | Ullevi bicycle tunnel | 6700 | 3 | **0,45** |
| 7 | Kungsportsavenyn lower | 6100 | 12 | **1,97** |
| 8 | Kungsportsavenyn upper | 5833 | 9 | 1,54 |
| 9 | Föreningsgatan / Södra Victoriagatan | 2850 | **0** | **0** |
| 10 | Västergatan / Föreningsgatan | 2800 | 1 | **0,36** |

The round-about by Olskroken has many accidents reported (16), as well as the lower part of Kungsportsavenyn with 12 accidents. The intersection Föreningsgatan / Södra Victoriagatan stands out in the opposite direction, having many harsh braking in ViaSafety, but no accidents reported at all. Using the aggregated passes of ViaSafety in relation to STRADA data might be misleading, and larger mobility patterns would give an even better understanding and more precise risk score. This score (accidents / passes * 1000) should be interpreted as the higher value, the higher risk.

**Detailed description of targeted hotspots**

The ViaSafety data could be used to highlight unsafe road infrastructure for the city planners. The data might be difficult to interpret, but the city planners could use this as a tool to investigate hotspots.

The bike and pedestrian tunnel nearby Ullevi, is such case, with location in Figure 14 and photos in Figure 15 and 16. There is a slope in a curve with bad sight, leading to harsh braking by the ViaSafety riders and accidents reported in STRADA.

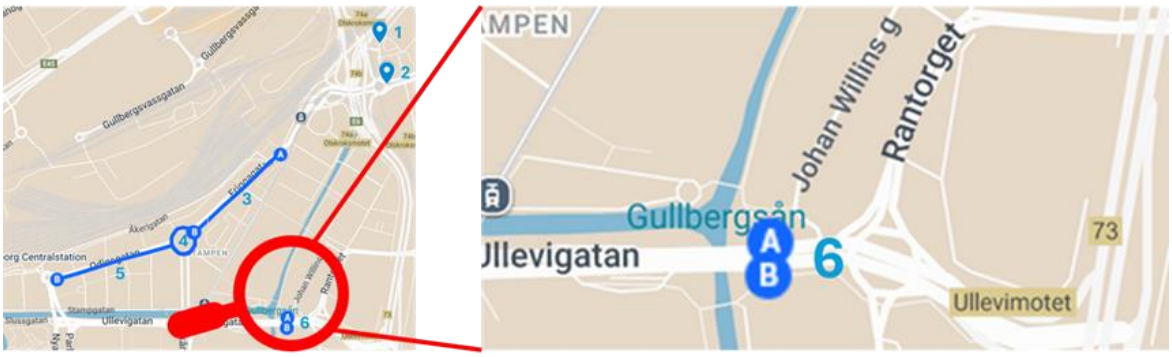



Figure 14. Location of Ullevigatan.

Figure 15. South entrance for the tunnel.

Figure 16. North entrance for the tunnel.

The city planners could investigate if it is possible to straighten the road to increase visibility.

Friggagatan has been upgraded quite recently with bicycle lanes, still causing many harsh brakings (66). There are many inhabitants in the area, as well as offices and schools in the nearby vicinity. There are many restaurants in the area making this a quite lively street and increasing the exposure for the drivers. The location is presented in Figure 17, and a photo in Figure 18.

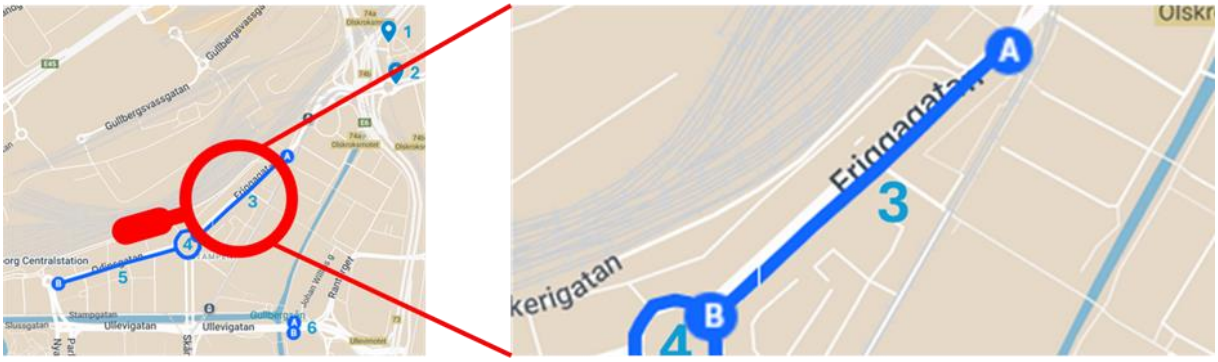



Figure 17. Location of Friggagatan.

Figure 18. Friggagatan.

This is an example of separating different traffic modals, but there are still many bicycle accidents (STRADA) and quite a few harsh braking (ViaSafety). Speed

enforcements for bicycles and mopeds could be on the table to reduce friction between pedestrians and cyclists.

The round-about at Olskroken is also newly upgraded, and maybe some of the reported bicycle accidents (16) happened during the construction. There are many bicyclists crossing the road having both cars and trams. The location is described in Figure 19 and a photo in Figure 20.

Figure 19. Location of Olskroken.

Figure 20. Olskroken round-about.

Many of the hotspots detected in the overall dataset have trams crossing. This adds an additional layer to the traffic complexity, increasing the risk of accidents.

The final example is the T-crossing by Föreningatan / Södra Victoriagatan (Figure 21). It is not a T-crossing for cyclists, and this might be a reason for harsh braking. The road coming from the left on the Figure 22, have a slope downwards Föreningsgatan, which might be one reason for the harsh braking. Noticeable, the risk score is high in the ViaSafety dataset, but no accidents have been reported in STRADA. Does this indicate that there could be a higher risk of an accident in the future?

Figure 21. Location of Föreningsgatan / Södra Victoriagatan

Figure 22. Föreningsgatan / Södra Victoriagatan

**Driving in winter conditions**

We grouped the data indicating usage of stud tires from November 2024 to April 2025, described in Table 3. The main conclusion is that the average speed is lower in winter conditions, the frequency of harsh braking and harsh cornering is lower in winter conditions. This is expected, and it would have been interesting to measure the maximum longitudinal acceleration (deceleration) and brake locking (equivalent to ABS for cars) to compare harsh braking. In addition, the maximum lateral acceleration in harsh cornering events could detect if the moped fell or not (accident). As mentioned before, there were no accidents reported in this study (which has been the case in other cities).

Table 3. Studded tires

| Stud tires | Trips | Dist (km) | Harsh accelerations | Harsh brakings | Harsh cornering | Avg speed (km/h) | Dist / harsh braking | Dist / harsh cornering |
|---|---|---|---|---|---|---|---|---|
| No | 36981 | 101354 | 10990 | 2185 | 1137 | 15,59 | 46 | 89 |
| Yes | 29232 | 69381 | 2585 | 1263 | 339 | 13,58 | 55 | 205 |

## Results in relation to the research questions

**RQ1: Are electrical mopeds performing better than gasoline mopeds, with respect to incidents (and accidents)?**
NO- This was not measured, since the final analysis did not include gasoline mopeds. If equivalent telematics data is collected for gasoline mopeds in the future, the VIASAFETY dataset can serve as a baseline for comparison.

**RQ2: Is it possible to measure "traffic safety" with accelerometer and GPS data?**
YES—this project demonstrates that accelerometer and GPS data can be used to derive scalable, segment-level indicators (harsh speeding, braking, and cornering) and to generate ranked hotspot lists. However, more data (additional vehicles / modals, and more detailed data, e.g., maximum lateral and longitudinal acceleration in the case of events) is needed to improve robustness and to support more detailed interpretation (e.g., stability over time and across operating conditions).

**RQ3: Is the data of enough quality to analyse traffic safety?**
YES—the data quality was sufficient to produce consistent aggregated KPIs and hotspot rankings. Still, since there is no ground truth available (using e.g., video cameras), the result can be seen as indicative of higher risks in the traffic environment. Interpreting why specific blackspots appear would benefit from complementary datasets (e.g., infrastructure context, traffic volumes, accident data, or additional road user data) and/or targeted local validation.

**RQ4: Do winter conditions affect the traffic safety measures?**
NO- In the analysed data, speeds appear slower during winter periods, but the dataset and analysis did not support a firm or quantified conclusion about winter impacts on safety indicators. A more conclusive assessment would require additional data and a dedicated comparison design (clear winter/non-winter windows and controls for exposure).

# Conclusions, lessons learned and next steps

ViaSafety demonstrates that telematics from micromobility delivery fleets can be transformed into scalable, privacy-preserving safety indicators and segment-level hotspot rankings. The project shows clear potential for using “near-miss proxy” signals (harsh acceleration, braking, and cornering) to identify candidate risk locations in an operationally up-to-date way, complementing traditional crash statistics that are often sparse and delayed.

## Key conclusions

- The method is usable in practice: delivery moped telematics supported stable event detection, aggregation, and ranking of road segments in central Göteborg, though as with any connected vehicle source, coverage must be robust and representative of general patterns.

- The outputs can prioritise candidate blackspots for follow-up, enabling a proactive approach to identifying risk locations rather than relying only on historical crashes and concentrating limited resources in a statistically meaningful way.

- The approach is scalable: the same pipeline can be extended to larger fleets, additional attributes, longer time periods, and (in future work) additional micromobility modes. Also, adding more cities or regions to the data could give interesting opportunities for comparing infrastructure solutions and rider culture.

- Winter analysis indicates lower speeds in winter periods, but a more robust study design and increased data volume are needed to conclude effects on event rates.

## Lessons learned

- Context is essential for interpretation. Telematics can show where harsh events occur more often, but explaining underlying causes requires complementary context (road design, maintenance, traffic volumes, work zones, etc.) and/or targeted site review. This fact is consistent with approaches to use other forms of connected vehicle insights to derive safety suggestions.

- An understanding of both the legal and actual operational domain of mopeds is critical to deriving relevant insights.  The mopeds used in this analysis are

legal to operate not only in roadways, but in bike lanes and multi-use areas, therefore their operational behaviour must be evaluated in that context.

- Operational artefacts must be handled. Vehicle transport outside normal operation (e.g., vans to service locations) can create implausible signals; explicit QA rules (e.g., removing >50 km/h trips and very short trips) improve reliability.

- Representativeness must be stated clearly. Delivery mopeds reflect a specific operational profile (routes, peak times, rider tasks). Results should be framed as valid for this population and used carefully when generalising to broader micromobility users.

## Deliverables

The primary deliverables are this final report together with the processed datasets and analysis outputs (event layers and aggregated segment-level results) prepared for further research and evaluation by project partners. This dataset, raw as well as aggregated, will be maintained within the SAFER NDD Platform for further analysis.

As key result the project has proven that method is usable – possibility to use this type of data to identify blackspots of increased risks, usage of close to “real time” data can indicate increased risk in specific locations earlier than accident databases are being updated.

However, other datasets (I.e. STRADA National Traffic Accident Database, Vulnerable Road Users, Floating Car Data) could be ingested in the platform to broaden the scope and indicate even better risk scores. It would then be possible to connect real-time data from vehicles to identify real time impact of road work, potholes, slippery condition to identify sudden changes in risk profiles.

## Plan for utilization of results

This project combines the opportunity with private companies whose business area is to analyse and use large amounts of data for the control of vehicle fleets. With road safety research's need to be able to evaluate the quality of this type of data and the scalability to evaluate scalable measures of road safety. All in all, this project has good opportunities to become relevant for broad collaborations in road safety research and in the work that the companies do with cities and authorities in different parts of Europe.

The project aims to make data accessible and available (according to boundaries to be defined within the project) to CLOSER [2]via the national logistics data lab with the goal of increasing the potential (competence, legal, business technical, economical) for collaborations on sharing and using data within the branch. CLOSER takes responsibility to follow legal and ethical regulations according to handling the data and in accordance with GDPR and depending on each case/project. The national logistics data lab will benefit the development of a sustainable transport system in the future.

There is a close and ongoing collaboration between Vianova and the city of Gothenburg with good areas to continuously feed data and knowledge to the city about the traffic safety situation and the need for measures. Within the project, there may be an opportunity to analyse the effect of measures, and additionally to incorporate the results of the study into the network planning and implementation of various road safety interventions such as traffic calming, dedicated micro-mobility infrastructure, or speed reduction strategies.  There is a close and ongoing collaboration between Vialumina/GoCiklo and the delivery company with good surfaces to continuously feed data and knowledge to the company about the traffic safety situation and the need for measures. Discussions with AI Aware[3] has been initiated, and there are obvious research questions to be further explored with the Drive Sweden project “Uppkopplade fordon för innovativ trafiksäkerhet”, for future extended and combined efforts within this area.

This project focuses on leveraging the expertise and cost-effectiveness made possible by independent companies most used to analyse this type of data, and this is also reflected in the structuring and construction of the project. The companies are in many cases independent, and a lot of focus is placed on analysing the data to get a focus on data quality and conclusions.

The main direction of SAFER and the road safety research is on the quality review of data and conclusions to evaluate and validate how they can be used for further research and scalability. We believe in this project that this is the right way to work with a cost-effective approach with the issue of scalable measures of road safety.

## Suggested next steps

- Expand data volume and coverage: extend collection across more vehicles and time and increase continuity of logging across months to strengthen statistical stability.

- Add complementary datasets: integrate (where feasible) crash/incident data, infrastructure attributes, traffic volumes, work-zone information, and/or other connected-vehicle signals to support interpretation and measure design.

- Validate hotspots with stakeholders: run joint reviews with the city/operator to confirm whether ranked locations correspond to known issues (e.g., intersections, surface conditions, signalling, curb geometry) and to define plausible countermeasures.

- Move toward continuous monitoring: automate preprocessing and KPI generation to provide frequent updates that can highlight changes due to road works, seasonal conditions, or network changes.

- Enable intervention evaluation: once a set of candidate measures is identified, re-run the same pipeline on comparable pre/post windows to assess directional change in event rates (with attention to exposure and seasonal controls).
- Explore techniques to provide notification and communication to drivers about the potential for risk in hotspot locations, to evaluate the change in behaviour at these locations.  Techniques including haptic or auditory feedback could be explored as low-cost alternatives to road-design improvements.
- There is potential to collect larger amounts of data in a next step as GoCimo is now in operations in five and within weeks seven cities: Gothenburg, Stockholm, Malmö, Copenhagen and Amsterdam, and soon Uppsala and Örebro with a total fleet of 300 vehicles. From late 2025 all vehicles are equipped with IoT for data collection. In addition, new vehicles concepts such as mopeds with trailers and cargo light electric vehicles such as *Evig* will be on the roads during 2026.

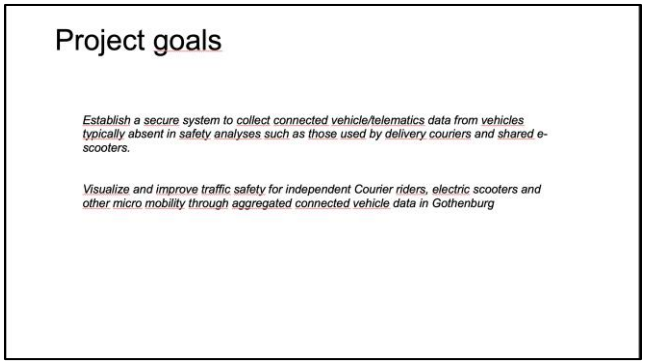
# Disseminations

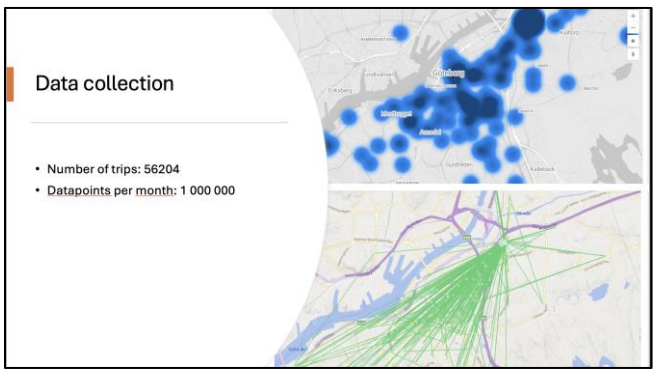
1. **Drive Sweden 2023**

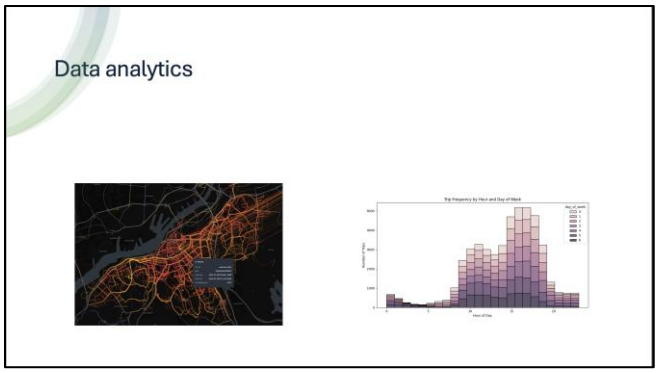
The ViaSafer project was presented at the Drive Sweden Conference 2023, providing an overview of the project background, purpose, and planned activities.

2. **Drive Sweden 2024**

At the Drive Sweden Conference 2024, the ViaSafer project was presented, including a brief status update on project progress.

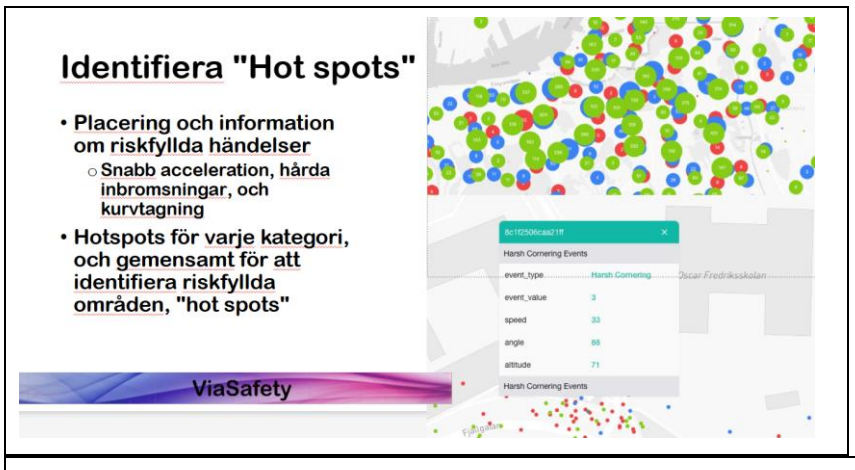






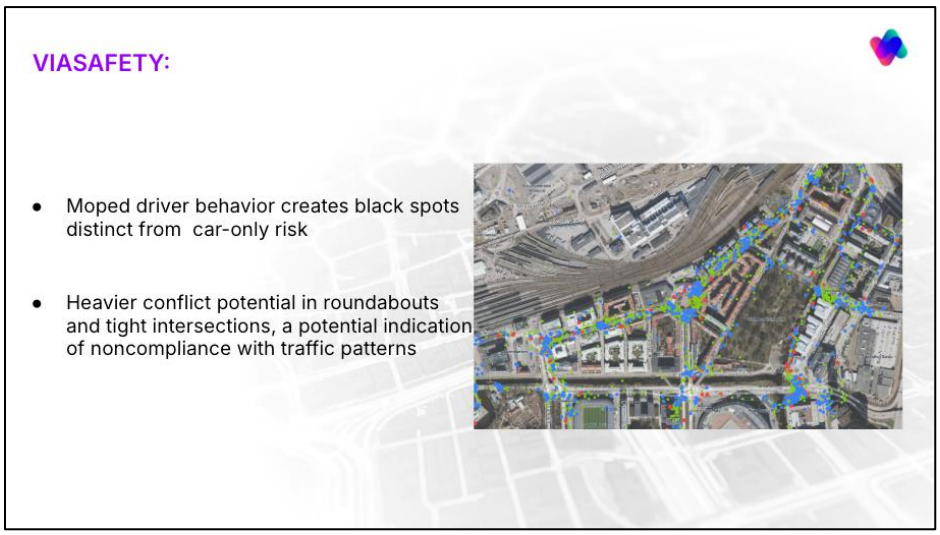

### 3. Almedalen, Visby, June 2025

The project was presented at “Hållbarhetsarenan” - the Sustainability Arena - at the political week of Almedalen, June 2025. This is the largest sustainability arena there and the seminar was also broadcasted live on the YouTube channel. The seminar was part of the Mobility theme day at the arena.



### 4. Road Safety GB Conference (Vianova)

Vianova presented at the Road Safety GB conference (https://roadsafetygb.org.uk/) on November 5th, 2025, on a panel about how to better understand the needs and challenges of managing micro-mobility safety. Vianova highlighted early learnings including hotspot detection, risk vs exposure analysis and the opportunities from connected moped data.




### 5. Safer research day June 2025

The project and preliminary results was presented at the SAFER Research Day June 2025.

### 6. Drive Sweden final event in 2026

Final project results will be presented at Drive Sweden Forum September 2026.

*This is the back of the report and should be on it's own page.*

**Drive Sweden** är ett av regeringens sjutton strategiska innovationsprogram (SIP). Drive Sweden består av partners från akademi, industri och samhälle och tillsammans tar vi oss an utmaningarna kopplade till nästa generations mobilitetssystem för människor och varor. SIP-programmen finansieras av Vinnova, Formas och Energimyndigheten. Lindholmen Science Park AB är värd för Drive Sweden.