Volvo Group Trucks Technology
Collaborative Research for Safe Automated Driving
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With the customer in focus

- Improving fuel efficiency
- Optimizing handling and maneuverability
- Improving security
- Preventing information overload
- Reducing weight
- Autonomous driving
- Exploring uptime services: Extended Vehicle technologies
For all Volvo Group brands

- Dongfeng Trucks (SA)
- Nova Bus
- SDLG (JV)
- UD
- Eicher (JV)
- Prevost
- Sunwin (JV)
- Volvo
- Mack
- Renault Trucks
- Terex Trucks
- Volvo Penta

JV = Joint Venture
SA = Strategic Alliance
Planning for the future and setting the direction

- Analyzing customer and society needs
- Long term technology development and planning
- Planning for competitive product ranges and vehicle services
- Research collaboration with suppliers, academia, institutes and authorities
Different levels of automation introduced in parallel

- **DRIVER ONLY**
- **ASSISTED**
- **PARTIAL AUTOMATION**
- **CONDITIONAL AUTOMATION**
- **HIGH AUTOMATION**
- **FULL AUTOMATION**

- Automatic Emergency Brake
- Adaptive Cruise Control
- Platooning
- Highway auto pilot
- Autonomous FMX truck for mining
- Autonomous electric hauler
Different solutions for different needs

Automation in confined areas

Automated maneuvering

Urban automation

On-road automation
Traffic Safety
- In the hands of the human factor

Volvo’s Accident Research Team has been learning from real life accidents since 1969

10%  30%  90%

- Vehicle-related
- Road environment
- Driver-related
Active Safety products

Driver Alert Support

HOW IT WORKS: DRIVER ALERT SUPPORT – DAS
A support system that alerts the driver if he/she is inattentive or drowsy. The system uses a camera sensor that tracks the position of the truck in its lane and also monitors steering wheel movements. If any symptoms of tiredness are detected, the system activates an audiovisual alert.

Lane Keeping Support

HOW IT WORKS: ADAPTIVE CRUISE CONTROL – ACC
The Adaptive Cruise Control automatically adapts the vehicle's speed to the actual flow of traffic and lets the driver know when the distance to the vehicle in front presents a risk. The system has a radar fitted to the front of the truck, which interacts with the vehicle's brakes. If the distance becomes unsafe, the wheel brakes are activated.

Lane Changing Support

HOW IT WORKS: LANE CHANGING SUPPORT – LCS
Changing lanes can be a challenge for drivers due to the trucks blind spots on the passenger side. Lane Changing Support, Volvo Trucks’ radar system, is designed to help the driver.

Adaptive Cruise Control

HOW IT WORKS: LANE KEEPING SUPPORT – LKS
Lane Keeping Support is an active safety system that significantly reduces risk factors in traffic like distraction or tiredness. The system is designed for long haul operations and monitors the truck's position on the road when it is going over 60 km/h. If the driver unintentionally crosses a road marking, the system alerts him by a buzzer.
On Road: ADAS towards Autopilot

Customer Value
- Safety, Productivity, Convenience

Technology
- Environment perception - sensor and sensor fusion
- Vehicle control and decision

Challenges
- Safety
- Environment perception
- Acceptance
- Regulation
- Infrastructure
- Human factors
- Transition of control

Collision Warning with Emergency Brake
Collaborative ACC towards Automated Platooning

Customer & society Values
- Safety, fuel savings & traffic flow

Definition
- Communication between trucks for cooperative driveline control and safety

Technology
- V2X communication
- High integrity safety

Challenges
- Vehicle to Vehicle introduction cross brand
- Safety sets the limits on time-gap
- User and society acceptance (time-gap and platoon length dependant)
- Regulation and certification
Automation from Controlled Environments towards Public Roads

- Driverless Predefined mission
- Driverless Predefined Routes
- Remote Supervision
- Remote Control
- Driver support
- Machine Control
- Active safety & Driver assistance
- Scenario based automation of driving “tasks”, e.g. queue assist
- Low speed control and maneuvers
- Autonomous vehicles and sites
- Automated safe & green driving & vehicles
- Highly automated driving, & “Platooning” like concepts
- Partly automated driving & vehicles, e.g. C-ACC

Public roads

Controlled environments (e.g. workyard, harbour, construction sites)
Confined Area & Terminals

Customer Value
- Productivity
- Safety
- Energy Efficiency

Definition
- Automated hauling systems
- Low speed scenarios

Technology
- Fully autonomous vehicles
- Site management & control

Challenges
- Localisation
- Site production system integration
Autonomous Refuse Truck in the Urban Environment

Customer Value
- Productivity and Safety
- Improved working condition
- Lower environmental impact

Definition
- Automated refuse handling

Technology
- Automated vehicles
- Reversing operation
- Site management & control

Challenges
- Localisation
- Manuvering
- Recycling system integration

Volvo Group, together with Swedish waste and recycling specialists Renova, is testing a pioneering autonomous refuse truck that has the potential to be used across the urban environment. The project explores how automation can contribute to enhanced traffic safety, improved working conditions and lower environmental impact.
Industry and society need to work together

- Standards, rules and regulations
- Cyber security
- The role of the driver
- Social acceptance
Automated Vehicle Development Paths for Freight Transport

Extract from the final version 7.0
29 May 2017
ERTRAC Roadmap on Automated Driving

New 2017 version: full update!

- Common definitions agreed by the industry
- Up-to-date development paths for 3 applications
- Updated information on EU and national initiatives
- New structure for 11 key challenges
- Recommendations for H2020 WP2018-2020
Why Automated Driving?

Automated Driving is seen as one of the key technologies and major technological advancements influencing and shaping our future mobility and quality of life. The main drivers for higher levels of Automated Driving are:

- **Safety**: Reduce accidents caused by human errors.
- **Efficiency and environmental objectives**: Increase transport system efficiency and reduce time in congested traffic. Smoother traffic will help to decrease the energy consumption and emissions of the vehicles.
- **Comfort**: Enable user’s freedom for other activities when automated systems are active.
- **Social inclusion**: Ensure mobility for all, including elderly and impaired users.
- **Accessibility**: Facilitate access to city centres.
**Road Definitions**

- **Public road** with mixed traffic in single or multiple lane operation on regional, and highway operation, various automation level vehicles. Local, regional, national and European and cross borderer regulation needs to be taken into consideration when targeting automation level.

- **Dedicated road/lane** where vehicles with defined automation level are allowed but the area is not confined, such as parking areas and dedicated lanes. Higher level of automation could be considered.

- **Confined areas** with restricted access control, such as terminal areas and ports. Full automation for autonomous vehicles could be considered.
Automated Freight Vehicle Development Paths

| Automation Level | Established | 2018 | 2020 | 2022 | 2024 | 2026 | 2028 | 2030 | ...
|------------------|-------------|------|------|------|------|------|------|------|------|
| Level 5: Full Automation | | | | | | | | | Fully Automated Freight Vehicles
| Level 4: High Automation | | | | | | | | Highly Automated Vehicles on Open Roads
| | | | | | | | Highly Automated Vehicles on Dedicated Roads
| | | | | | | Highly Automated Vehicles in Confined Areas
| Level 3: Conditional Automation | | | | | | | Highway Pilot Platooning
| | | | | | | | Highway Chauffeur
| | | | | | | Traffic Jam Chauffeur
| Level 2: Partial Automation | | | | | | Automated Truck Platooning
| | | | | | Traffic Jam Assist
| Level 1: Driver Assistance | | Adaptive Cruise Control Stop & Go
| | | Lane Keeping Assist
| | | Lane Change Assist
| Level 0: No Driving Automation, support beyond human capability to act | Lane Departure Warning
| | Blind-spot Warning
| | Forward Collision Warning
| | ABS, ESC
| | Emergency Brake

Truck: Freight vehicle > 3.5 tonnes categorie N2 or N3
Key Challenges on the Path to Higher Levels of Automated Driving