Case study:
Argo AI - The Road to Driverless Operations

**Add value.
Inspire trust.**

Argo AI is a global autonomy products and services company. The Argo Autonomy Platform and Solutions support autonomous ridesharing and goods delivery for the benefit of communities around the world. TÜV SÜD assessed Argo AI's test vehicles according to the TÜV SÜD Automated Vehicle Conformity Framework to confirm their functional safety.

The industry challenge of L4 AV

There are two major milestones on the journey towards full automation safety of the driving task. First, the autonomous vehicle (AV) stack must achieve maturity for operating in the operational design domain (ODD), which is verified by testing in virtual environments and closed driving courses. Then, the AV stack capabilities need to mature to the point where sufficient performance for safe driverless operation can be claimed. However, safe validation of both claims often requires a trained employee inside the AV who can monitor and override systems.

Proving safe ADS behavior requires a mix of virtual testing, hardware testing, software testing, track testing, and real-world public road testing. Driving on public roads under real-world conditions can only be advocated if safety has been demonstrated beforehand. Finding and maintaining that safety threshold with respect to public road testing is one of the key challenges of the AV industry.

Argo's business challenge

Argo AI wanted to operate a limited size fleet of automated test vehicles with the operator removed from the driver's seat on public roads. Their opportunity was to build additional trust and confidence in their safety case for driverless operations. For the area of functional safety, Argo AI subsequently commissioned TÜV SÜD to conduct a third-party safety review and endorsement.

OVERVIEW	
Client name	Argo AI
Industry	Autonomous Rideshare & Delivery
Profile	Argo AI builds the software, hardware, maps and cloud-support infrastructure to power autonomous vehicles, employing more than 2,000 people worldwide, headquartered in Pittsburgh, PA, USA.
Business challenge	Safely deploy driverless test vehicle operations in Miami and Austin. Argo AI approached TÜV SÜD to conduct third-party safety reviews/assessments of their autonomous driving technology and testing methods.
Our solution	Argo AI's test vehicles were assessed according to the TÜV SÜD Automated Vehicle Conformity Framework, which is federally recognized in Germany. Because this framework is a holistic safety approach, it has been successfully applied to this use case in the U.S.
Business benefits	TÜV SÜD's Automated Vehicle Conformity Framework helps build trust in automated vehicle technology through independent assessments, testing, and validation.

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TÜV SÜD's solution

TÜV SÜD assessed the vehicles' functional safety using the TÜV SÜD Automated Vehicle Conformity Framework for the use case of human-supervised driverless operation. This is based on the current state-of-the-art standards for functional safety for road vehicles (ISO 26262) and takes both UNECE-ANNEX and the requirements of the working group of technical inspection bodies in Germany into account. It is a federally recognized procedure in Germany that is closely aligned with the U.S. Department of Transportation's Voluntary Guidance for Automated Driving Systems.

The Safety-in-Use of Argo's Autonomy Platform primarily relies on the integrity of autonomy performance in its intended ODD, with the ADS being competent and well tested for its use. Competency is achieved by relevant autonomy testing in virtual and closed course environments, as well as public roads. In addition to the ADS competency for fallback maneuvers (i.e. MRC), the Argo Functional Safety Concept also includes an e-stop activated automated vehicle emergency brake system that can be triggered by a trained employee in the vehicle, in the event of an unforeseen hazardous situation.

The functional safety pillar of the TÜV SÜD's Automated Vehicle Conformity Framework considers four key elements to assess the effectiveness and trustworthiness of the applied safety fallback concept for a dedicated use case and ODD:

- Hazard and risk analysis
- Coverage analysis (based on functional and technical safety concepts, and safety analyses)
- Validation testing
- Safety case

Argo AI demonstrated the integrity of its safety concept during numerous review meetings with TÜV SÜD. Associated arguments were backed by a process audit conducted by TÜV SÜD in 2022, in accordance with SAE International's J3018 standard and AVSC Best Practice for Safe Road Testing. The effectiveness of the e-stop-activated automated vehicle emergency brake system was demonstrated during TÜV SÜD's visit to their test track in Western Pennsylvania. The inputs provided here were evaluated with respect to the identified hazards and not for full compliance with any internal or external standard.

Business benefits

Following the successful completion of TÜV SÜD's independent safety assessment, which took place over a six-month period, Argo AI began driverless operations in May 2022 in two major U.S. cities - Miami and Austin. The fleet of vehicles consists of Ford Escape Hybrid SUVs equipped with the Argo Autonomy Platform. The assessment helped Argo AI build trust in their AV technology. The holistic assessment approach and experience of TÜV SÜD experts from global AV projects such as IAMTS, PEGASUS, VVM, and CETRAN were critical to this project.

The road to full automation

To further support AV technology developers towards full automation, the TÜV SÜD Automated Vehicle Conformity Framework can also be applied to non-human-supervised use cases. While the above four key elements for assessing effectiveness and trustworthiness remain, it is necessary to have additional elements considered including increased safety of the automation platform based on its expanded ODD and operations.

TODD FRONCKOWIAK, DIRECTOR SAFETY POLICY & ASSURANCE, ARGO AI

> " TÜV SÜD shares a common goal with us – to build the public's trust in the safety of autonomous vehicle technology to achieve widespread consumer acceptance. Their holistic assessment approach and experience with highly automated driving projects have taken us one step closer to fully realizing this goal, helping us to build trust in our AV technology. "

Add value. Inspire trust.

TÜV SÜD is a trusted partner of choice for safety, security and sustainability solutions. It specialises in testing, certification, auditing and advisory services. Since 1866, the company has remained committed to its purpose of enabling progress by protecting people, the environment and assets from technology-related risks. Through more than 25,000 employees across over 1,000 locations, it adds value to customers and partners by enabling market access and managing risks. By anticipating technological developments and facilitating change, TÜV SÜD inspires trust in a physical and digital world to create a safer and more sustainable future.