Customer Satisfaction Barometer for Driver Assistance Systems: Exploring the Trade-Off between Function, Trust, and Acceptance

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Abstract.
An international survey (n = 13,374), conducted on behalf of the FIA in mid-to-late 2025 [2], reveals substantial differences in customer perception, satisfaction, trust, and usage behavior between Adaptive Cruise Control (ACC) and Lane Keeping Assist (LKA). ACC achieves consistently higher satisfaction and trust across all investigated countries, whereas LKA weaknesses significantly reduce user acceptance and increase switch-off behavior — demonstrating that technological availability alone does not guarantee practical acceptance. Denmark represents a notable exception: Danish drivers report significantly higher satisfaction, trust, and usage rates for both systems, driven by stronger technological openness, greater familiarity, and proactive communication about ADAS safety benefits. A mutual understanding gap emerges as the central systemic weakness of current LKA: drivers do not sufficiently understand system behavior, while systems cannot adapt to driver intent, state, or road context. Satisfaction shows no improvement with vehicle age, suggesting successive system generations have not kept pace with rising user expectations. Closing this gap requires context-aware and driver-adaptive systems that explain their behavior in the moment of intervention and build driver competence through self-explaining interaction rather than manuals that go unread. A share analysis of verified German accident statistics [11] finds no measurable reduction in rural road run-off fatalities attributable to LKA since mandatory fitment under GSR (EU) 2019/2144 and Euro NCAP assessment protocols — contrasting sharply with the demonstrated impact of ESC. The dataset from the study has the potential to support further differentiated analyses at brand, model, and model-year level; corresponding findings will be published in subsequent papers. The findings aim to provide the automotive industry with actionable evidence to inform the development of next-generation ADAS and DCAS from a human-centered perspective.

Keywords: Customer Satisfaction; Driver Assistance Systems, Adaptive Cruise Control (ACC); Lane Keeping Assist (LKA); Technology Acceptance Model (TAM), Road Safety, Technology Trust; User Experience (UX); HMI

1. Introduction

Advanced Driver Assistance Systems (ADAS) have become a central element of modern vehicle safety strategy. Regulatory frameworks such as the EU General Safety Regulation (GSR 2019/2144) and UN-ECE Regulation 79 have mandated the fitment of Lane Keeping Assist (LKA) across all new vehicle types, reflecting the expectation that wider technological availability will translate into measurable road safety gains. The emerging DCAS (Dynamic Control Assistance Systems) framework defines a stepwise path toward higher automation, with LKA representing a foundational building block. However, technological availability does not automatically translate into effective use. A system that is switched off or mistrusted cannot deliver its theoretical safety potential. This paradox is particularly evident for LKA: despite mandatory fitment, German accident statistics [11] reveal no measurable reduction in rural road run-off fatalities since LKA requirements were introduced under UN-ECE R79 and Euro NCAP protocols — contrasting sharply with the well-documented impact of ESC, which operates transparently and without requiring active driver engagement.

At the core of LKA's acceptance failure lies a mutual understanding gap: drivers do not sufficiently understand how and why LKA intervenes, while LKA systems cannot distinguish inadvertent lane drift from deliberate maneuvers, nor adapt to varying driver states — such as distraction, or hands-off situations — or to differing road and traffic conditions. The result is a high rate of perceived nuisance interventions, eroding trust and driving switch-off behavior. The consequences extend beyond current safety performance: if drivers associate LKA with unreliable or intrusive behavior, the trust necessary for broader DCAS Phase 2 and Phase 3 acceptance is undermined before those technologies reach the market.

Against this background, the FIA commissioned a large-scale international user survey in mid-to-late 2025 to assess real-world customer satisfaction, trust, and usage behavior for ACC and LKA across multiple markets (n = 13,374) [2]. This paper presents the key findings, derives implications for system design and user communication, and identifies priority areas for future research on context-aware, driver-adaptive ADAS. Further differentiated analyses at brand, model, and model-year level will be addressed in subsequent publications.

2. Research Model

2.1. Theoretical Concept

The theoretical foundation of this study is linked to the Technology Acceptance Model (TAM) developed by Davis [6], which conceptualizes perceived usefulness and perceived ease of use as key determinants of technology adoption. According to TAM, innovations are more likely to achieve widespread market acceptance if users

perceive them as valuable, understandable, and easy to integrate into existing routines. In this regard, customer acceptance becomes a fundamental prerequisite for the successful commercialization and societal diffusion of ADAS technologies and future autonomous driving systems. Even technologically advanced innovations may fail if they do not achieve sufficient user acceptance. The TAM model is directly linked to customer satisfaction theory – according to the fulfilment of factors leading to acceptance and application of new technologies.

Customer satisfaction analysis is grounded in the confirmation/disconfirmation paradigm introduced by Anderson [7], which conceptualizes customer satisfaction as the outcome of a subjective comparison between prior expectations and perceived product performance. Accordingly, the identification and systematic assessment of customer expectations represent essential prerequisites for effective satisfaction management. This aspect becomes particularly relevant in the context of innovative technologies, where customer expectations are often heterogeneous, dynamic, or only partially understood during early market diffusion stages.

Within the context of ADAS technologies, customer satisfaction represents a key explanatory variable for trust formation, technology acceptance, and long-term usage behavior [1,3]. The present study therefore extends the traditional confirmation/disconfirmation framework by incorporating behavioral and acceptance-related dimensions. Since satisfaction evaluations are influenced by both cognitive and affective mechanisms, the resulting perception of technological performance remains inherently subjective and user specific [4,5].

Against this background, the quantitative study investigates customer expectations, satisfaction levels, trust perceptions, and usage patterns related to ACC and LKA systems across multiple European markets. The analysis aims to contribute to a more comprehensive understanding of how user-centered evaluations influence the acceptance, utilization, and long-term diffusion of ADAS technologies within the broader transformation toward automated mobility.

2.2. Research Methodology

The empirical dataset consists of 13,374 respondents. The largest national subsamples originate from Germany (6,362 respondents), Austria (4,813 respondents), and Denmark (1,164 respondents), jointly representing 92.3% of the overall sample. Smaller subsamples include participants from Switzerland (484), Luxembourg (119), Italy (114), as well as additional international markets (318).

Despite these comparatively small case numbers, the relatively limited variance observed across countries allows these subsamples to provide valuable insights for comparative cross-national analyses.

Table 1. Sample structure and country distribution.

Total	Austria	Den-mark	Ger-many	Italy	Luxem-bourg	Switzer-land	Other
13,374	4,813	1,164	6,362	114	119	484	318

Across all country groups, the median vehicle registration year is 2021, indicating a comparatively modern vehicle fleet within the sample. Notably, vehicle age does not appear to exert a significant influence on overall driver satisfaction, a finding that will be discussed in greater detail in later sections of the paper. Reported driving styles can predominantly be characterized as moderately sporty, without a pronounced tendency toward either highly defensive or highly aggressive driving behavior. Furthermore, respondents reported a balanced distribution of driving activities across urban, rural, and highway environments. A considerable proportion of participants additionally reported annual driving distances exceeding 15,000 kilometers.

Overall, the sample primarily represents frequent drivers with comparatively high technological affinity and ADAS familiarity, which contributes positively to the robustness of the findings. However, this likely produces a more favorable picture than a fully representative sample would yield — drivers with lower familiarity can be expected to report even lower satisfaction and trust. The large sample nonetheless enables differentiated analysis across user groups, as presented in the following sections.

3. Results of the study

3.1. Customer Engagement with ADAS systems

Customer engagement with advanced driver assistance systems (ADAS) prior to vehicle purchase can generally be characterized as moderate to low across all analyzed markets. The cross-market mean value is 3.15. This indicates that ADAS currently plays only a limited role within the vehicle purchasing process for a large proportion of customers. Correspondingly, ADAS functionalities are not yet perceived as decisive factors for either brand or vehicle selection, as fewer than 40% of respondents stated that such systems significantly influence their purchasing decisions. The findings remain relatively consistent across countries, although moderate variations can be observed.

Germany and Switzerland exhibit slightly higher levels of customer involvement and interest in ADAS-related topics, whereas Austria, and Italy remain below the overall average. Nevertheless, even in the comparatively stronger-performing markets, only approximately one third of respondents report a high degree of engagement with ADAS technologies prior to purchase. The comparatively small variance between countries therefore suggests a broadly homogeneous pattern of limited customer involvement across European markets.

From the perspective of innovation diffusion and technology acceptance research, this comparatively weak customer engagement represents a critical finding. Limited active interest in ADAS technologies indicates a rather low level of intrinsic motivation to explore, understand, and integrate these systems into everyday driving behavior. Such conditions may constitute an unfavorable starting point for the broader diffusion and acceptance of increasingly complex vehicle automation technologies.

In contrast, customer groups characterized by stronger technological curiosity and innovation affinity (such as typical Tesla users in the study sample) often demonstrate substantially higher engagement with digital vehicle technologies and therefore may also be more receptive toward experimentation, learning processes, and long-term technology adoption. This suggests that technology enthusiasm and user involvement represent important moderating factors for customer acceptance and satisfaction in the context of ADAS and future autonomous driving systems.

3.2. Familiarization with ADAS Technology

The subsequent analysis therefore focuses on the ways users familiarize themselves with ADAS technologies after vehicle purchase. The findings reveal that self-directed familiarization without formal instruction constitutes the dominant approach across all analyzed markets. Particularly high shares can be observed in Germany (59.3%) and especially Denmark (67.2%). At the same time, the comparatively high proportion of respondents reporting “no conscious familiarization” in Austria (30.6%) appears noteworthy and may partly explain lower levels of technology acceptance and system understanding.

Dealer-supported introduction to ADAS systems reaches its highest levels in Switzerland (49.4%), Austria (47.8%), and Denmark (40.5%), whereas substantially lower shares are observed in Germany (31.3%), Italy (31.9%), and Luxembourg (27.4%) (see Table 2). Overall, self-familiarization dominates across all countries, accounting for 57.9% of responses.

Denmark demonstrates comparatively strong engagement with ADAS technologies, as reflected by the lowest proportion of respondents reporting no conscious familiarization. This stronger involvement may contribute positively to customer satisfaction, trust formation, and overall acceptance of the systems.

Table 2. Familiarization with ADAS Systems – EU Average versus Denmark (top performer).

Familiarization with ADAS by…	…the delivering car dealer (e.g. instruction by the salesperson)	…the car manufacturer's information channels (e.g. videos)	…free information channels (e.g. video, online forums, etc.)	I familiarized myself with the system without instructions	No conscious familiarization
EU Average	38.1%	44.8%	31.5%	57.9%	**25.9%**
Denmark -top performer-	40.5%	37.6%	20.3%	67.2%	**7.5%** (significantly lower)

Despite evident shortcomings in structured user introduction and familiarization processes, the majority of respondents nevertheless report feeling relatively comfortable using ADAS functionalities. This apparent contradiction may indicate a tendency among users to overestimate their own understanding of system capabilities and limitations, potentially resulting in insufficient system comprehension despite perceived confidence in usage.

3.3. ADAS Customer Expectations and Fulfillment

User expectations represent a central determinant of customer satisfaction with advanced driver assistance systems (ADAS). Satisfaction is influenced less by the absolute technological performance of a system than by the extent to which the system fulfills prior expectations. Unmet expectations therefore result in disproportionately negative evaluations, whereas moderate expectations that are fulfilled may generate comparatively positive satisfaction perceptions. Across both investigated systems (Adaptive Cruise Control (ACC) and Lane Keeping Assist (LKA)) user expectations follow a remarkably consistent structure: safety constitutes the dominant expectation dimension, followed by comfort and stress reduction, while driving pleasure is of comparatively low relevance.

The empirical findings reveal substantial differences between ACC and LKA regarding expectation fulfillment. ACC achieves consistently high evaluations across all investigated dimensions and largely fulfills customer expectations, particularly in the areas of safety, reliability, and comfort. In contrast, LKA exhibits significantly lower expectation fulfillment, especially regarding stress reduction and comfort enhancement. Consequently, ACC is broadly perceived as a reliable and beneficial technology, whereas LKA remains associated with comparatively weak user confidence and limited perceived value. The results clearly indicate that successful ADAS diffusion depends primarily on fulfilling safety- and comfort-related expectations rather than on enhancing driving enjoyment.

3.4. Satisfaction and Trust toward ACC and LKA

The comparative analysis demonstrates a systematic and highly stable satisfaction gap between ACC and LKA across all investigated countries. ACC consistently achieves substantially higher satisfaction scores than LKA, indicating markedly stronger user acceptance. Particularly notable are the results from Denmark, where both systems achieve significantly higher evaluations than in all other countries. Conversely, Austria and Luxembourg record the lowest LKA satisfaction levels.

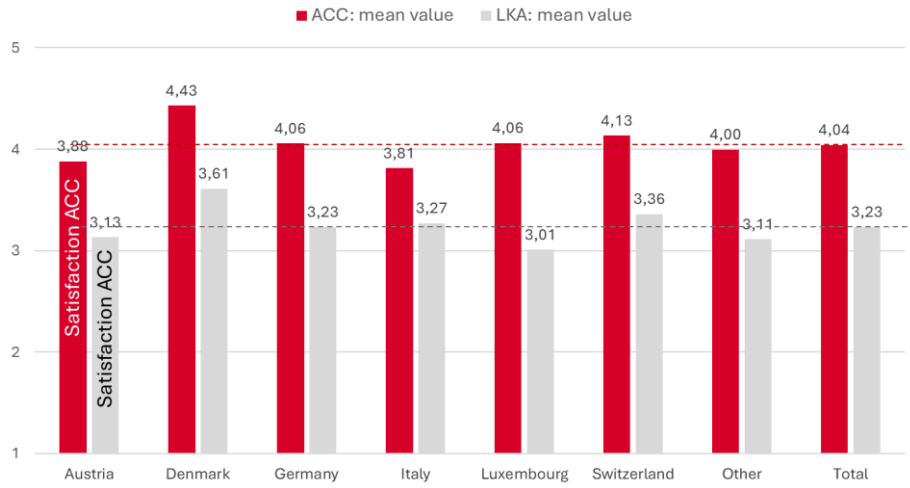

Fig. 1. User satisfaction scores for ACC and LKA across countries.

The conducted customer satisfaction measurement uses the concept of the net promoter score (NPS) [8]. For this research a net satisfaction score (NSS) is applied. The NSS identifies the share of satisfied customers versus the dissatisfied one. For this purpose, scale ranges 1 and 2 are defined as detractors (range of dissatisfaction). Scale ranges 3 and 4 do not indicate complete satisfaction, i.e., no enthusiasm is triggered in the customer [see 9]. Only the scale value 5, "completely satisfied", is considered as promoter, since only this leads to clear positive confirmation. Subtracting the detractors from the promoters results in the net satisfaction score (NSS). The Net Satisfaction Score (NSS) analysis further reinforces these findings. LKA, by contrast to ACC, records negative NSS values in nearly all countries and only reaches a slightly positive result in Denmark. This divergence indicates that ACC has already achieved broad practical acceptance, while LKA continues to face substantial skepticism among users.

Notably, vehicle age shows no statistically relevant correlation with satisfaction. This suggests that technological maturity alone does not explain the observed differences in user evaluations, and that successive system generations have not kept pace with rising customer expectations.

The brand-specific analysis (37 brands in sample) reveals a remarkable pattern regarding customer satisfaction with ADAS technologies (see Fig. 2). Only four European brands are represented within the top-10 performing group, while several established European premium manufacturers perform below the overall average satisfaction level. This finding appears particularly noteworthy given the strong technological and innovation-oriented positioning of many European premium brands.

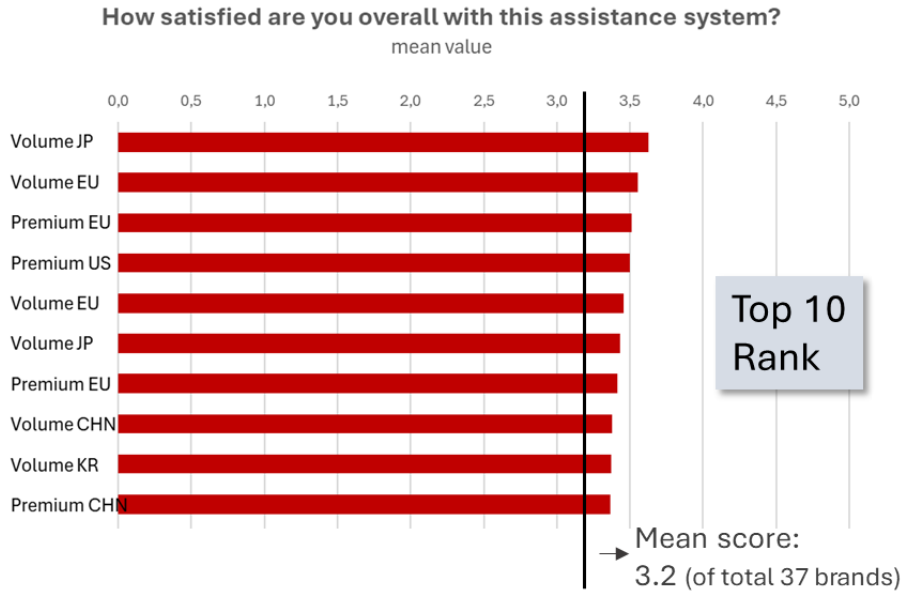

Fig. 2. Brand Performance Ranking for Lane Keeping Assist (LKA).

One possible explanation may lie in the gap between customer expectations and perceived system performance. Premium-brand customers typically exhibit substantially higher expectations regarding technological sophistication, system reliability, comfort, and seamless user experience. Consequently, even comparatively minor system limitations or inconsistent interventions may lead to disproportionately critical evaluations. Customer satisfaction therefore seems to depend not only on objective system performance but also on the subjective expectation level associated with specific brands and market positioning. Brands associated with strong technological leadership may face particularly demanding customer expectations, increasing the risk of expectation–performance gaps and more critical user evaluations.

Trust levels reveal an even more critical pattern, particularly for LKA. Across all markets, trust scores for LKA remain substantially below satisfaction scores, resulting in a systematic “trust gap.” While average LKA satisfaction reaches 3.23, trust declines to 2.80. This demonstrates that moderate satisfaction does not automatically translate into confidence in the system’s reliability and safety performance. The consistently

low trust levels outside Denmark indicate structural weaknesses in the perceived dependability of LKA systems.

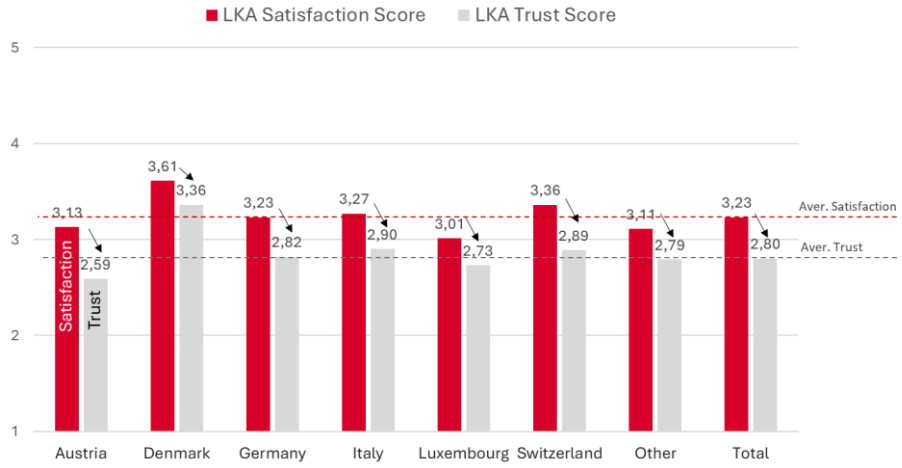

Fig. 3. LKA mean scores for user satisfaction and user trust.

The relationship between satisfaction and trust becomes even more evident when considering gender and familiarity effects. Male respondents consistently report higher satisfaction and trust values for both systems. Gender impact on technology and innovation acceptance is discussed in other empirical studies as well [10]. More importantly, user familiarity exhibits an exceptionally strong correlation with satisfaction. Users who describe themselves as highly familiar with LKA report satisfaction scores nearly twice as high as users with low familiarity. This finding strongly suggests that system understanding and user engagement significantly influence acceptance and trust formation.

Road conditions also substantially affect satisfaction levels. LKA performs comparatively well on highways but receives significantly weaker evaluations on rural roads, where the NSS drops to -24%. This finding is particularly critical because rural roads represent one of the most relevant application contexts for traffic safety improvements through ADAS technologies. Therefore, satisfaction, trust, familiarity, and actual usage behavior are closely interconnected and jointly determine ADAS acceptance.

3.5. Drivers of Satisfaction and Dissatisfaction

The analysis of specific satisfaction drivers confirms the fundamentally different perception patterns for ACC and LKA. ACC receives highly positive evaluations regarding usability, reliability, safety benefits, and operational precision. Denmark, Switzerland, and Germany consistently report the strongest results across these dimensions. Denmark stands out particularly through exceptionally high scores for usability,

reliability, and perceived security. Austria and Italy, by contrast, remain consistently below average across most ACC dimensions.

LKA exhibits a substantially different evaluation structure. Usability remains the only consistently positive dimension, while all other dimensions — particularly reliability, personalization, road adaptability, and safety perception — achieve only moderate or negative evaluations. These results directly correspond to the previously identified trust deficits and weak usage rates. Again, Denmark records the strongest overall evaluations, although even Danish respondents identify similar structural weaknesses regarding system precision and functionality in varying driving conditions.

Table 3. LKA and drivers of satisfaction respectively dissatisfaction*.

Rank	**LKA feature ranked by satisfaction results**	**TOTAL Ranking (EU)** Scales: 5 (max.) to 1 (min.)
1	Operation and usability	3.63
2	Reaction speed	3.38
3	Reliability	3.16
4	Sense of security	3.10
5	System precision	3.10
6	Traceability of system actions	3.01
7	Function in all weather situations	2.98
8	Function in all road situations	2.98
9	Customizability	2.75

*Values above 3.50 indicate satisfaction, value between 2.50 and 3.49 indicates indifference, below 2.50 rather dissatisfaction.

The data therefore suggest that user dissatisfaction with LKA is not caused by isolated usability issues but by broader deficits in perceived system reliability, transparency, and controllability. The strong negative impact of “unpleasant system intervention” further supports this interpretation. In general, reliability, precision, and predictable system behavior represent the core determinants of ADAS acceptance.

3.6. Usage Profiles and Deactivation Behavior

The observed differences in satisfaction and trust directly translate into actual usage behavior. ACC is strongly integrated into everyday driving practices, whereas LKA is frequently deactivated or ignored. Approximately 69% of respondents report frequent ACC usage, while only 12.8% actively do not use the system. In contrast, LKA shows a high degree of disengagement: nearly one third of drivers report not using the system at all (29.7%), and a comparable share actively switch it off (30.7%). Denmark again represents an exceptional case. Danish users report substantially higher usage rates for both systems, corresponding closely with their elevated satisfaction and trust

levels. The findings therefore indicate a highly consistent causal relationship: higher engagement and familiarity lead to higher satisfaction, which in turn strengthens trust and actual usage behavior. The principal reasons for deactivating LKA are unpleasant system intervention (54.4%), perceived unreliability (32.8%), and unpleasant system warnings (27.9%). Similar patterns emerge for ACC, although on significantly lower levels. German respondents report particularly strong dissatisfaction with unpleasant interventions, whereas Danish respondents report substantially lower complaint levels. In summary, trust deficits translate directly into reduced system usage and increased deactivation behavior.

3.7. Consequences for System Improvement

The identified weaknesses allow clear conclusions regarding future system optimization priorities. For LKA, users primarily demand improvements in system precision, reliability, road adaptability, action traceability, and personalization — reflecting a fundamental gap between how the system behaves and what drivers expect. Usability itself is not perceived as the main issue; rather, users criticize insufficient transparency, inconsistent behavior across road situations, and unreliable interventions. These are not surface-level complaints but symptoms of a system that neither adapts to its environment nor to the driver operating it. ACC receives substantially more positive evaluations, yet users still identify optimization potential regarding precision, weather robustness, and transparency of system behavior. Notably, improvement priorities remain remarkably consistent across countries, including Denmark. This indicates that Danish users do not perceive fundamentally different systems but rather evaluate similar systems more positively due to stronger engagement, greater familiarity, and higher technological openness.

Short conclusion: Future ADAS development must primarily focus on precision, transparency, and predictable system behavior rather than on additional comfort functions.

3.8. Attitudes towards Autonomous Mobility

Actual trust in ACC and LKA is linked to the belief in future technologies. Attitudes toward autonomous mobility remain comparatively skeptical across all investigated countries. Only 41.9% of respondents express confidence in autonomous driving technologies. Germany reports the highest approval levels (50.8%), whereas Austria, Italy, and Denmark exhibit substantially lower acceptance. Interestingly, Denmark simultaneously shows the highest ADAS satisfaction levels but relatively skeptical attitudes toward fully autonomous mobility. This suggests that positive experiences with current ADAS technologies do not automatically translate into unconditional acceptance of higher automation levels. The strongest concerns relate to liability issues (63.6%) and safety concerns (54.7%). Autonomous driving is primarily perceived as beneficial for highway usage and shuttle applications, which aligns closely with the previously identified strengths of ADAS technologies in controlled driving

environments such as highways. Acceptance of autonomous mobility remains strongly dependent on perceived safety, controllability, and legal clarity.

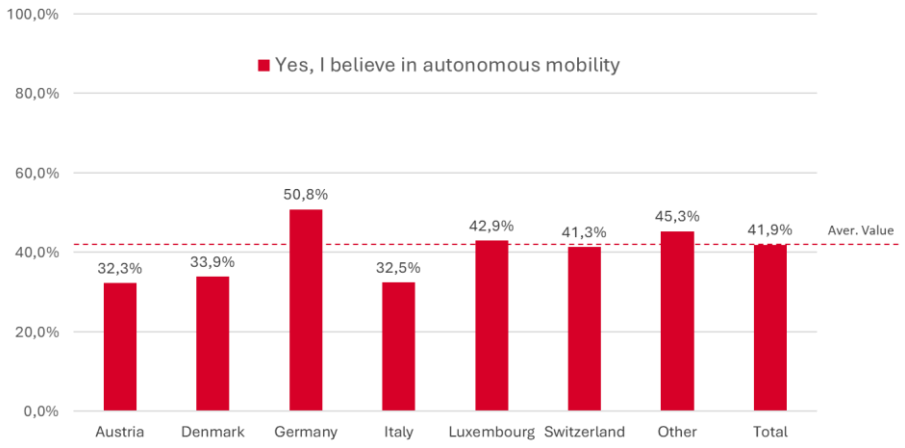

Fig. 4. Belief in autonomous mobility across countries.

4. Road Safety Impact of LKA: Expectations versus Evidence

A central justification for the mandatory introduction of LKA systems under EU regulations was the expected reduction of run-off-road accidents on rural roads. Although rural roads account for only about a quarter of all persons injured in German road traffic (26% in 2024), they are the site of roughly 57% of all road fatalities — and run-off-road events represent the dominant fatal accident pattern in this environment [11]. It is precisely this disproportionate concentration of fatal risk on rural roads that LKA was expected to address.

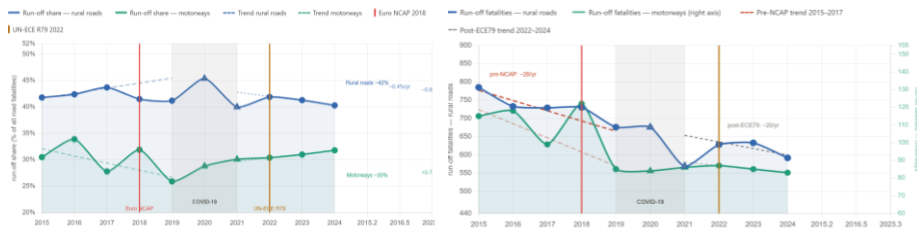

Fig. 5. Run-off accident share of all road fatalities by road type [11] (left=rel, right=abs).

Verified GENESIS data (Destatis, table 46241-0005, 2015–2024) [11] provide the sharpest available empirical test. The share of run-off accidents among all road fatalities (see Fig. 5) remained essentially unchanged throughout the observation period — both

during the phase of Euro-NCAP-driven voluntary uptake (Emergency Lane Keeping was added to the consumer rating assessment in 2018) and after the EU fitment mandate under GSR (EU) 2019/2144 took effect, applying to new vehicle types from July 2022 and to all new registrations from July 2024. The absolute figures tell the same story: no inflection point, no measurable effect [11]. The methodological logic is unambiguous: if LKA were effective, the run-off share would decline while other accident types remain stable. This differential signal is absent on both road types. ESC, by contrast, produced a sustained and measurable reduction during its mandate period (2008–2014) — operating transparently, without dependence on marking quality or user acceptance. This aligns directly with the survey: systems deactivated by a third of users and rated NSS –24% on rural roads cannot deliver their theoretical safety potential. Accident research by Alliance confirms the pattern. As currently designed and mandated, LKA produces a situation in which all stakeholders lose: customers bear the cost of technology that does not meet their expectations; manufacturers invest heavily in systems that fail to deliver their regulatory promise; and society foregoes the anticipated safety benefit while absorbing the macroeconomic cost of unreduced run-off accidents. This is not an inherent limitation of lane-keeping technology — it is the predictable consequence of mandating availability without ensuring reliability, usability, and contextual robustness where the need is greatest.

5. Design Principles for High-Satisfaction LKA: From Survey Findings to System Requirements

The survey results translate this diagnosis directly into engineering requirements. Based on the identified failure modes and user expectations, the authors propose six concrete design priorities for next-generation LKA systems that could close the mutual understanding gap and restore user trust:

(1) Mutual understanding between driver and system. Most LKA dissatisfaction stems from a fundamental asymmetry: drivers do not understand the system, and the system does not understand driver intent. Three adaptive layers are needed: driver-state awareness (e.g. via interior cameras), driver-intent recognition (e.g. suppressing interventions during intentional maneuvers), and route and traffic adaptivity (e.g. later, gentler guidance on narrow roads). Together they shift LKA from a boundary enforcer to a context-aware driving partner.

(2) Intervention feel. Beyond intent recognition, the physical quality of the intervention matters: "unpleasant system intervention" drives 54.4% of deactivations. Steering inputs should be progressive, well-timed, and release smoothly — like a co-driver suggesting a correction, not imposing one.

(3) Graceful degradation on rural roads. The NSS of –24% on rural roads is the most critical safety finding. When marking quality falls below threshold, LKA should transition transparently to a warning-only mode rather than silently drop off.

(4) Transparency of system actions. "Traceability" scores only 3.01. Visual or haptic feedback indicating why the system acts — e.g. displaying detected lane boundaries or flagging reduced confidence — increases perceived controllability. The Danish results confirm the link between transparency and acceptance.

(5) Personalization and automatic adaptivity. "Customizability" ranks last (2.75). A context-aware, driver-adaptive LKA — or at minimum selectable intervention profiles and persistent driver preferences — reduces the perception of the system as an external actor.

(6) User onboarding and self-explanation. Satisfaction nearly doubles between low- and high-familiarity users. Beyond structured onboarding, a self-explaining system offers significant potential: indicating via HMI why it intervened, what it detected, or why it is inactive builds competence and trust during normal driving without additional user effort.

Addressing these dimensions is not merely a UX goal: closing the LKA trust deficit is a strategic prerequisite for DCAS Phase 3 adoption and the broader transition to autonomous mobility.

6. Conclusions

The study identifies a mutual understanding gap as the central systemic weakness: drivers do not sufficiently understand system behavior, while systems cannot adapt to driver intent, state, or road context. Notably, satisfaction shows no improvement with vehicle age. Successive system generations have not kept pace with rising user expectations. Closing this gap requires context-aware and driver-adaptive LKA that distinguishes intentional maneuvers from inadvertent drift, explains its behavior in the moment of intervention, and builds driver competence through self-explaining interaction rather than relying on manuals that go unread. The absence of a measurable reduction in rural road run-off fatalities since mandatory fitment confirms that mandatory availability alone is insufficient. Real safety gains require systems that perform reliably on poorly marked rural roads and earn user trust through consistent, transparent behavior. The dataset has the potential to support further differentiated analyses at brand, model, and model-year level; corresponding findings will be published in subsequent papers.

7. Impact on Future Research on ADAS Technology

A central finding is the strong interrelationship between familiarity, satisfaction, trust, and usage behavior. Users who actively engage with ADAS and understand system functionality report substantially more positive evaluations — Denmark illustrates this most clearly, where higher engagement, proactive communication, and favorable infrastructure produce significantly higher acceptance levels. The results reveal structural

limitations for future automated mobility: LKA trust deficits indicate that broader acceptance of higher automation levels cannot be assumed without systematically addressing current weaknesses in transparency, reliability, and user understanding. Three research directions follow directly. Context-aware and driver-adaptive LKA requires empirical validation of how driver state and intent can be reliably inferred and how intervention thresholds should respond. Self-explaining interaction as a design principle remains largely unexplored and should identify which in-situ modalities most effectively build calibrated trust during normal operation. Finally, cooperative and pleasant lateral intervention requires simulator and real-vehicle experiments to establish perceptual thresholds and design guidelines across driver profiles and road contexts. Overall, the future success of ADAS and autonomous mobility will depend not solely on technological progress, but equally on user trust, system transparency, and practical acceptance in real-world driving environments.

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