SBD

April 2025   635-25(25a)
In-Car HMI UX Evaluation & Benchmarking
Volvo EX90

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UX
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#635

In-Car HMI UX Evaluation & Benchmarking

Volvo EX90

Welcome to the 2025 HMI benchmarking report series, where SBD's user experience experts carry out thorough UX evaluations of the features and technologies offered in the latest vehicle releases.

The first edition of the 2025 series sees the UX team test the all-new Volvo EX90. While noting the benefits of Volvo's updated Google Built-In infotainment system, and the implementation of its various ADAS, our experts noticed a number of stability issues that hindered the EV's overall user experience.

| COVERAGE				FREQUENCY			PUBLICATION FORMAT				PAGES
GLOBAL	NA	CHINA	EUROPE	ANNUALLY	QUARTERLY	9 CARS PER YEAR	PDF	POWERPOINT	EXCEL	ONLINE	120+

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Scoring

> **Features and functionality:** evaluating whether the solutions provide features that customers expect, need and solve problems (or provide a wow factor).

> **Usability:** evaluating whether the features available are easy to learn and use. This considers areas such as ergonomics, legibility, usability characteristics and how the system implements the various features.

> **Reliability/stability:** evaluating the repeated usability and whether the users can have a similar (positive) experience each time.

> **Perceived quality:** evaluating the potential perception in quality of the HMI components and how this contributes to the overall customer experience.

This research is useful for

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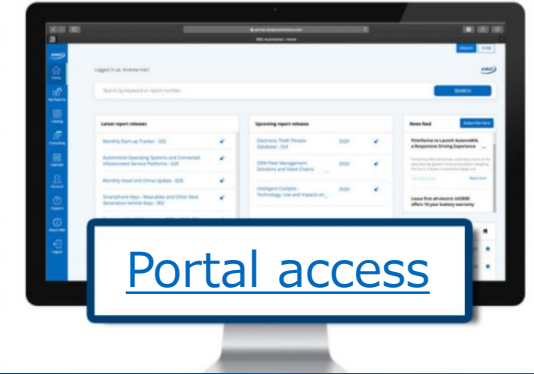
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Customer Feedback
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Total number of pages - 126

Introduction

Report Introduction

Welcome to the 2025 HMI benchmarking report series. This report has been created to provide a fair, unbiased and objective view of the latest in-vehicle HMI solutions in the US, European, and Chinese markets. Evaluations are carried out by SBD usability experts with a deep understanding of CASE domains such as the Connected Car and ADAS & autonomy domains.

SBD supports clients throughout the development of new HMI and products from a relatively simple companion app to a more complex multi-domain infotainment solution. The methodologies used in these reports take into account many years of experience with consumer testing and custom client projects to provide a fair and, as much as possible, objective methodology.

All viewpoints and analysis within the report are aimed defining areas of concern through a data driven approach. This report aims to benchmark and score solutions whilst also being able to provide actionable recommendations to design and development teams.

Please note that due to the ever-evolving automotive technology market, SBD updates its methodology each year, but does not update scores from the previous years. Therefore, please assume a drop in scores from the previous year for both user experience (UX) and functionality.

Intuitive	Supportive	Flexibility

Consistency	Brevity	Depth	Presentation

Layer	Section	Conclusion
STRATEGY & IMPACT	Executive Summary	This report provides an in-depth look at the user experience (UX) the vehicle provides across many domains and provides an overall UX score and features and functionality score in order to benchmark vehicles against each other.
LEARNING & ACTION	System Usability	An in-depth look at factors impacting overall usability including Execution, System Performance, Legibility, Ergonomics, and System Stability.
	Features & Functionality	Breaks down the vehicle's features and functionality offering into three categories, Hygiene, Performance or Delight features.
	Perceived Quality	An evaluation of 17 different attributes that impact perceived quality of a vehicle, in which each are given a score which is calculated into the overall usability score.
CORE INSIGHTS	Analysis by domain	An in-depth analysis of each domain including the major and minor positive and concern points for Voice recognition, General system, Navigation, ADAS, Other domains.
CONTEXT	Birds Eye View	Please read the 635 25j Summary Report (available December) for consideration of the wider CX context
	Future Outlook	
	Next Steps	

Report series & test vehicle

This report series offers insights, analysis, and perspectives based on a well-defined testing methodology. SBD Automotive has been conducting UX and HMI testing for automakers since 2012, initially focusing on connected vehicle solutions across global markets. Over time, our methodology and approach have evolved in response to industry advancements and client feedback.

The 2025 series marks our fourth major update, featuring the following enhancements:

- Inclusion of safety considerations and risk assessments
- Integration of AI testing
- Streamlined HMI heuristic evaluations
- Updated voice, static, and dynamic use cases
- Improved legibility to align with ISO guidelines
- Introduction of emotion evaluation to perceived quality evaluations
- Restructured ADAS testing to reflect current industry trends
- Simplified report structure

The Volvo EX90 has been evaluated in this report with testing conducted in Germany in March 2025. This vehicle was chosen as it is Volvo's latest solution with an updated 14.5-inch touch screen infotainment display, IoT integration, plug and charge technology, Pilot Assist (ADAS suite) which includes lidar.

Software version tested: AW 1.2.6

Methodology overview

Testing is conducted by two SBD usability experts over a five-day period. Evaluations are aiming to be fair and unbiased covering the vehicle's infotainment and ADAS HMI solutions. The key components of the methodology are outlined below.

First impressions	Preliminary assessments of key aspects such as build quality, reach, wow factor, and ergonomics
Use cases	Testing of static and dynamic use cases, including acceptability ratings and detailed analysis
Voice recognition	Voice recognition evaluations, focusing on command structure, recognition accuracy, flexibility, localization
Heuristics	General UX guideline assessments, considering factors like error prevention, consistency, and user control
Execution	Analysis of visual elements (GUI, display, map, etc.), responsiveness, and system reliability
Ergonomics	Evaluation of ergonomic factors such as reach, gaze and visibility, strain, and fatigue
Performance	Quantitative testing of practical use cases, including route calculation and rear-view camera delay
ADAS	Assessment of driving assistance features considering Levels 0/1/2/2+/3 (e.g. PD, BSM, RCTA, SAPA/FAPA)
HUD	Evaluation of feature set, HUD quality, and performance under various conditions
Legibility	Assessment of display quality, including contrast, character count, and viewing angle
UX laws	Verification against common UX principles and alignment with in-vehicle usage

SBD's usability & HMI consulting support

Since 2012, SBD has been conducting HMI evaluations for both publicly available research reports and bespoke client studies. Our team of domain experts and seasoned industry professionals ensures that all research findings are data-driven and objective. While this report focuses on expert evaluation methods, our bespoke studies encompass a wide range of topics and HMI use cases. SBD has carried out testing across the globe covering a wide variety of topics and domains; from both in-vehicle and external evaluations.

Expert evaluations

Voice of the customer

Performance testing

Evaluations carried out by SBD experts with global UX testing experience. Example projects:

HMI best practice guidance: summary results of past system failures, creation of common HMI guidelines and rules, and an overview of technology trends

Prototype bench unit evaluation: Onsite assessments conducted through targeted expert testing to identify key issues, provide recommendations, and rank them by importance based on their impact on overall UX.

Evaluations carried out by end consumers with either 'hands-on' or remote testing. Example projects:

Full HMI UX evaluations: A hybrid approach combining expert and consumer perspectives, utilizing both blind and targeted testing methods, exploratory testing, use case analysis, and assessments of emotional engagement.

ADAS Real World Consumer Testing: Designed to understand consumer expectations of partially automated systems, with a focus on real-world usage and perceptions.

Evaluations carried out with dedicated test equipment to evaluate system performance. Example projects:

ADAS performance testing: Testing on proving grounds with prototype solution to evaluate vs upcoming regulations.

EV range performance & CX: Multiple market evaluations of EV range estimates and how the information is presented to the end user (both accuracy and depth of information)

Stability issue evidence (1/14)

1. Steering wheel controls operated intermittently

All steering wheel controls operated intermittently, with the right side controls being particularly problematic, only operating for an estimated 66% of the time. Functions for these buttons include Google Assistant activation, volume control, track selection and steering wheel and mirror adjustments. Controls sometimes started working after repeated attempts at use.

Frequency	High
Severity	Critical

2. Rebooting system switched off all displays

Rebooting the system while stationary entirely switched off all displays including HUD and instrument cluster for approximately 23 seconds. This was also tested while driving and the behaviour repeated. It is expected that if a critical infotainment crash occurred, all screens would similarly switch off. Having no speed or tell-tales displayed for an extended period poses a critical safety issue, and may mean that the system does not comply with ISO 26262 or meet ASIL D.

Frequency	Low
Severity	Critical

ADAS display, controls and overall system works very well

Performance — Very effective ADAS

Performance — Complexity of ADAS display

Performance — Simplified ADAS controls

L2 ADAS AD (Assisted Driving) works very effectively. The visual implementation in the instrument cluster is also well implemented.

An advanced level of information is shown in the ADAS display, detecting and showing surrounding cars, trucks, motorbikes, bicycles and pedestrians. This enhances the user's trust and confidence in the system.

ADAS is activated and deactivated by pushing down the right stalk. A button on the steering wheel controls switches between ACC and AD mode.

Perceived Quality: Auditory

Level 1	Auditory
SBD viewpoint	**Squeak & rattle (passive):** No passive squeaking or rattling was noted during testing. **Solidity:** The rotary volume control and air direction controls rattle when using them, and the sound doesn't always match the HMI component, which gives off a lower quality. **Active sound:** Sounds from the system are consistent with brand and feel high quality, nothing stands out as being badly implemented.

Air direction controls rattle during use

No passive squeaks or rattles noted throughout testing

Level 2 scoring		
Squeak & rattle	Solidity	Active sound
Excellent +	Good -	Good +

# Home screen suffers from several issues (1/2)

Major negative	Home screen presentation suffers from some clutter and logic issues

While the new home screen design provides significant advantages, it also suffers from several issues in its implementation.

- The presentation of controls in the lower dark section of the screen is heavily cluttered. In expanded view, it contains 29 main elements in addition to text descriptions for the middle row (see following slide). Although some color distinction is apparent between the sections, it's not fully sufficient to reduce the clutter.

- The transition between expanded and compact view is poorly animated and appears unfinished.

- Shortcuts for the last three used apps is a clever idea, however it is imperfectly implemented, and even then, does not provide the flexibility of permanent core shortcuts persistent throughout the system. Issues are as follows:
  - If a media app e.g. Spotify is the last used, it shows in last three as well as the media panel, leading to repetition and the replacement of a useful shortcut (see this slide)
  - Some shortcuts such as video apps don't appear in the last three.
  - In compact view and on some other non-media screens, the last three are replaced by a compressed media bar (see right), meaning most apps, even recent ones have to be opened via the "All apps" menu.

- The HVAC seat and temperature controls each have two icons which adds to the clutter and potentially increases cognitive load (see further information in HVAC section).

- The hazard warning light switch is easy to misoperate as it is a soft button and placed relatively close to the car menu. This is a minor safety concern.

Reducing the clutter in the lower panels, improving transitions, improving last three logic by making it more intelligent and improving the hazard warning light operation would significantly improve usability of the home screen.
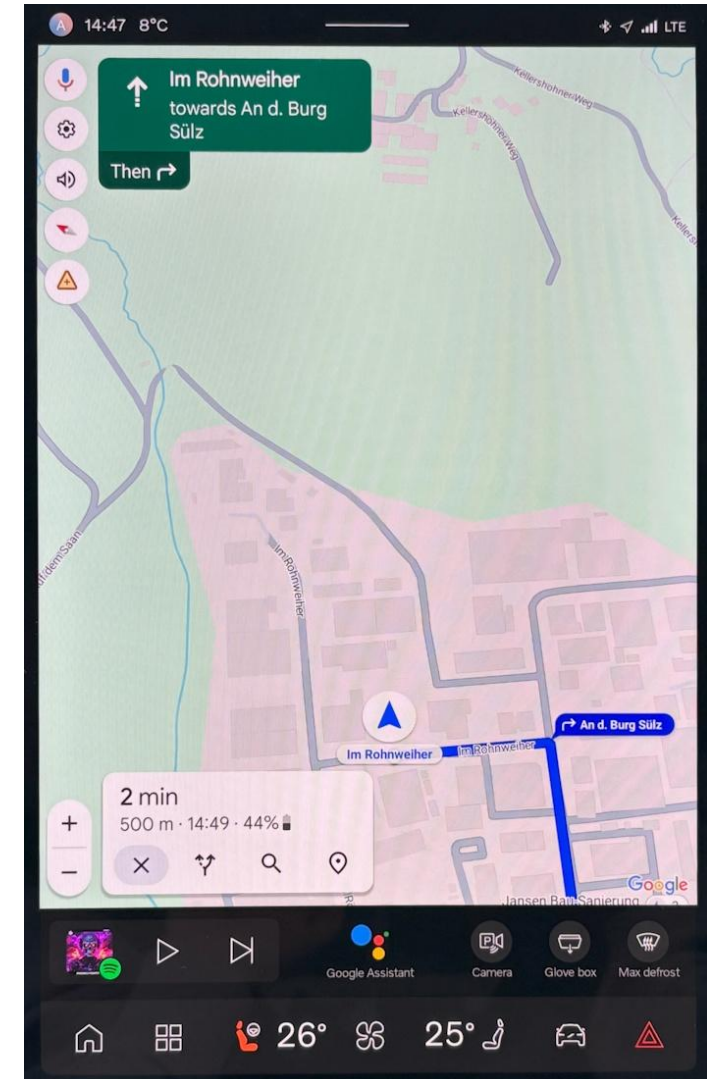
Easy to use system and elimination of legacy features

Minor positive	Intuitive system operation

Following an initial learning period to activate and use Volvo's ADAS system – where the activation via the right stalk required some familiarization – the system's effectiveness and ease of use became evident. Users can seamlessly switch between two ADAS modes: ACC and L2 Assisted Driving (AD) via a single button and the system remembers the chosen setting across ignition cycles.

Furthermore, Volvo's ADAS system prioritizes usability by reducing controls to a minimum. Consequently, cruise control is removed along with any ability to adjust headway. While it is strongly recommended to retain some degree of adjustment within settings, this design simplifies the user experience overall, instead relying on the system to provide optimal conditions.

Unlike the Nissan Ariya, Volvo simplifies the experience by eliminating the separate Cruise Control and headway selection features

Once AD is activated the lane markings become green and automatic lane change is available

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Contact SBD Automotive

Do you have any questions?

If you have any questions or feedback about this research report or SBD Automotive's consulting services, you can email us at info@sbdautomotive.com or discuss with your local account manager below.

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