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UX EVALUATION

In-car HMI UX Evaluations

#635

In-Car HMI UX Evaluation & Benchmarking

NIO ES8

In this edition, the UX Team is testing the NIO ES8. Targeting the premium segment, this Norwegian-market spec NIO tested by the UX Team features new infotainment and advanced ADAS software as well as other updates such as a larger central display (10.4 increased to 11.3-inches) and instrument cluster (IC) (8.8 to 9.4-inches), slightly redesigned interior, steering wheel changes and an added fragrance system.

However, with the European software version, it loses some functionality including a significant amount of voice recognition ability, weather information and a map display in the IC. Both versions lack messaging functionality and only have one streaming media app.

COVERAGE

GLOBAL | NA | CHINA | EUROPE

FREQUENCY

ANNUALLY | QUARTERLY | 8 CARS PER YEAR

PUBLICATION FORMAT

PDF | POWERPOINT | EXCEL | ONLINE

PAGES

150+

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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.

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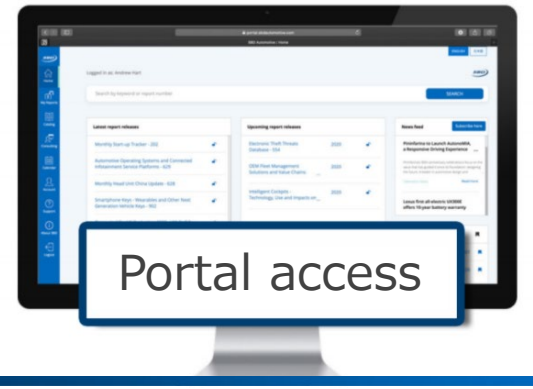

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In-Car HMI UX Evaluation & Benchmarking Series
NIO ES8

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January 2022

CON635-21(21h)

In-Car HMI UX Evaluation & Benchmarking
NIO ES8

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Introduction

Aim of this report

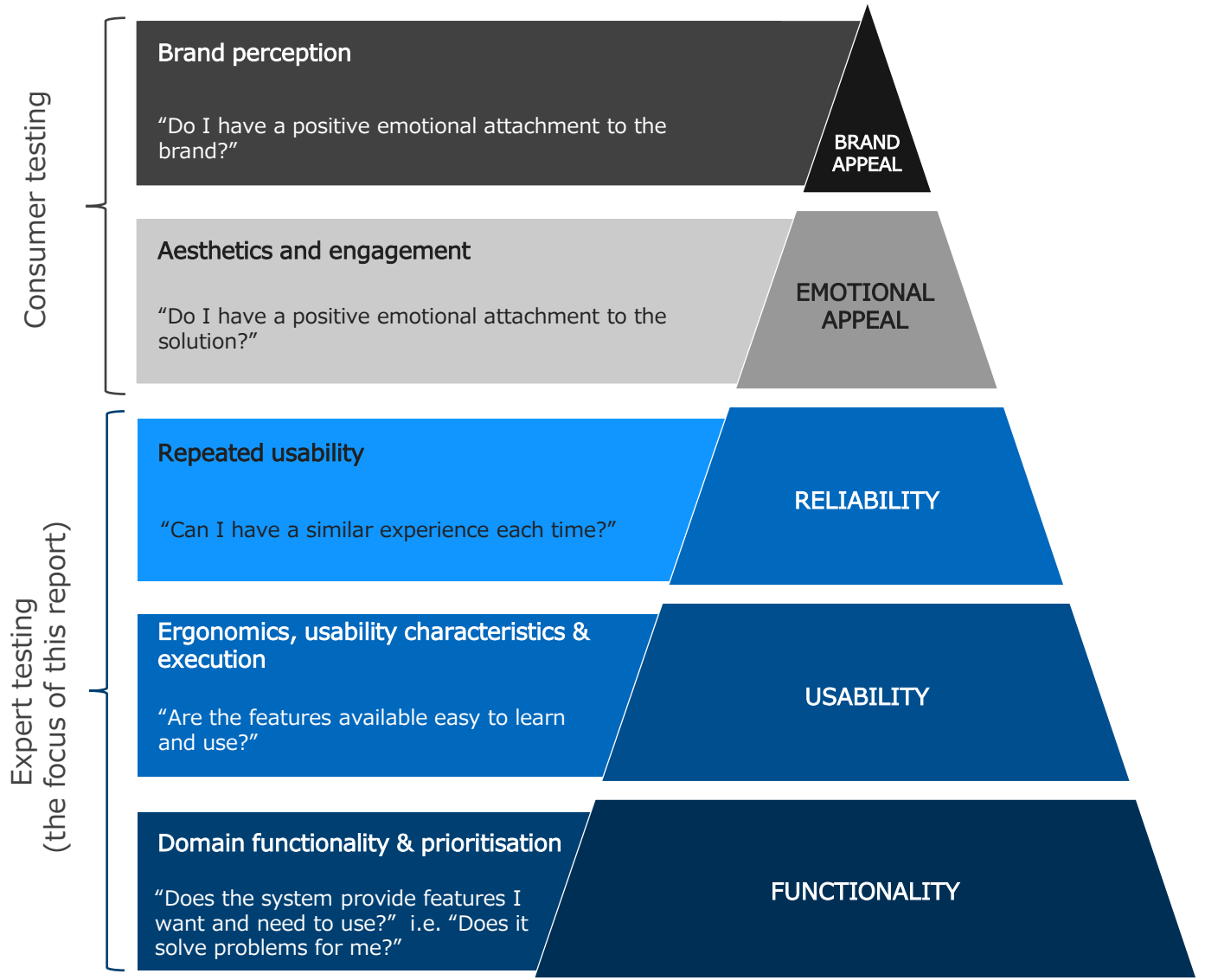
Welcome to the 2021 HMI benchmarking report series. This report has been created to provide a fair, unbiased and objective view of the latest in-vehicle HMI solutions in the European, US and Japanese markets. Evaluations are carried out by SBD usability experts with a deep understanding of CASE domains such as the Connected Car and ADAS & autonomy domains.

One of the core goals of these studies is to provide a true indication of what the final customer experience of each solution could be. To do this evaluations are focused on providing scoring and analysis in the following areas:

- **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

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.

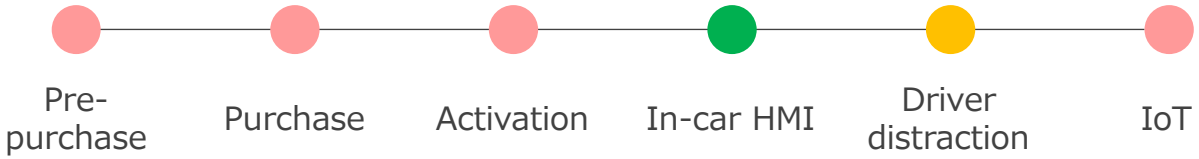
All viewpoints and analysis within the report are aimed at defining areas of concern through a data driven approach. This report aims to benchmark and score solutions whilst also being able to provide actionable recommendations to design and development teams.



SBD's view on the hierarchy of needs for CX benchmarking

Scope of report: focus on in-car HMI evaluations

The scope of evaluations in this report are constrained to the in-car HMI experience, in both static and dynamic conditions. One notable element is driver distraction which SBD covers at only a high level in this study as carrying out a full driver distraction evaluation requires biometrics test equipment to ensure the collected data is unbiased and objective.



A full evaluation of the end-to-end customer experience is not within scope of this report, but it is something which SBD has many years experience in from both a consumer and expert perspective. Other areas such as the companion app, online portal and in-home smart devices are not in scope as they are defined as “out of car” experiences.

Within the vehicle, any HMI element the user interacts with is evaluated including steering wheel controls, touch screen displays, voice control, HUDs and digital keys. The features and services on offer have been broadly grouped into the following domains (or test areas):

- ADAS domain
- Infotainment domain
- Navigation domain
- Voice recognition domain
- Connected services domain
- Convenience domain

Vehicle list

SBD chose eight cars to evaluate in 2021, based on two selection categories. New/interesting UX focused on systems with never-seen-before features or functionality, or the implementation of a solution that has previously been a challenge or pain-point for end-users. New mass-market UX included vehicles in segments that are sold in high numbers and are entering a new generation of UI for that vehicle.

Cars tested in 2021 report series

Mercedes-Benz
S-Class

CUPRA
Formentor

Tesla
Model S

Hyundai
IONIQ 5

Lexus
LS

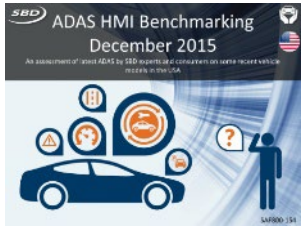
Cadillac
Escalade

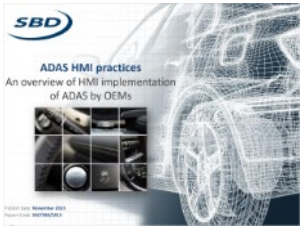
BMW
iX

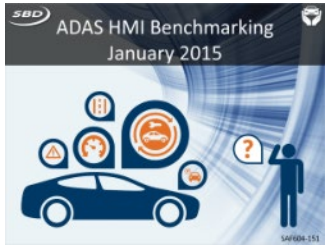
NIO
ES8

SBD experience through years of testing in-car solutions

Over the last nine years SBD has evaluated almost 100 solutions from a Connected Car or ADAS perspective for our public report series (many more for private client evaluations). This current report series is an evolution of both test methodologies to provide a holistic view of in-car HMI. Furthermore, custom evaluations methodologies used across the globe for SBD clients have been included where applicable to enhance the overall approach.







One page methodology overview

One of SBD's core goals of this report is to be as objective, fair and as transparent as possible. To achieve this, various methodologies are used throughout the testing to evaluate different areas of the solution in various conditions.

These methodologies are a mix of different types of tests:

- **Objective tests:** where the value provided is not influenced by a tester's viewpoint e.g. response time
- **Subjective tests:** the test score is based on the expert testers' viewpoints e.g. task ease of use
- **Task-based:** evaluations carried out based on a predefined task list e.g. navigate to a pizza restaurant near location X
- **Freeform:** random free testing by the tester with no clear pre-defined task list. This allows the testers flexibility to dig deeper into various parts of a solution when needed
- **Scoring range:** ranges and definitions of how to score a test element e.g. poor depth and accuracy score = the results provided are not in line with what is reasonably expected by the user
- **Static:** tests are carried out when the vehicle is not moving
- **Dynamic:** tests are carried out when the vehicle is moving in various road conditions and locations e.g. motorways/highways, cities, villages, country roads etc.
- **Misuse/failures:** carried out to evaluate the stability of the solution in unusual conditions e.g. repeatedly pressing the voice command button

This document does not provide a detailed description of the methodology and this page serves to provide an overview of the approach.

For a detailed discussion and presentation of SBD's methodology please contact us.

Test area	Type of tests							
	Objective	Subjective	Task based	Freeform	Scoring range	Static	Dynamic	Misuse/ failures
First impressions		✓		✓		✓	✓	
Static tasks	✓	✓	✓		✓	✓		
Dynamic tasks	✓	✓	✓		✓		✓	
Random free	✓	✓		✓		✓	✓	✓
Navigation specific tests	✓	✓	✓		✓		✓	✓
Voice recognition	✓	✓	✓	✓	✓	✓	✓	✓
Performance & response	✓		✓			✓	✓	✓
System Usability Scale (SUS)		✓			✓			
Final SBD UX score	✓	✓			✓			
ADAS	✓	✓	✓		✓	✓	✓	✓
UX heuristics	✓		✓			✓	✓	
Execution		✓			✓			
Ergonomics	✓	✓	✓			✓	✓	
Legibility & readability	✓		✓			✓	✓	
Perceived Quality (PQ)	✓	✓	✓	✓	✓	✓	✓	

Example slides from the full 150+ page report

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Some hygiene features lacking, navi is good but still needs improving

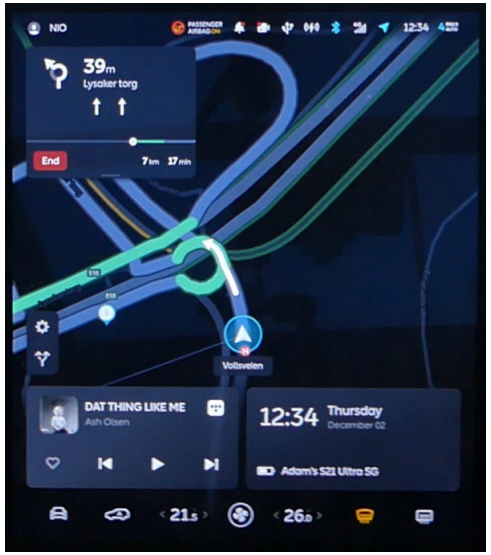
- Several hygiene features fall short of the expected implementation level within the ES8, in addition to several issues within media relating to execution and consistency.
- Within the infotainment screen, the system lacks core buttons with home and all apps restricted to hard buttons only.
- Smartphone mirroring is notably missing, restricting user interaction with preferred apps (notable in the absence of music streaming apps such as Spotify/Apple Music).
- EV charging routing is also a notable absence and seen as being of significant value.
- Connected services such as weather and information are also not provided.

Infotainment lacks core soft buttons and ‘day’ theme

The infotainment system colour theme is permanently dark, appearing like a ‘night’ theme. The option to change this to a lighter, more vibrant theme during daylight hours would be a positive.

Additionally, the lack of core menu buttons on the screen causes a constant mental/physical switch between screen and hard buttons located below. This can be inconvenient and slightly lengthens the time taken to complete some tasks.

- The navigation interface in the NIO ES8 forms the homepage for the infotainment system. Overall the system functions effectively and is simple to operate. Verbal alerts also enhance the user experience by giving information about upcoming points along the route that help the driver to prepare or adjust their driving accordingly. POI information is effectively implemented and is easy to use.
- However, the system is not without issues. Route guidance is sometimes very unclear depending on traffic information colour. If traffic colouring is not present, it can be very hard to tell which road should be taken in some circumstances. The inclusion of waypoints on a route is also limited to four types of POI and is poorly implemented.



Route colouring can sometimes be very confusing

When traffic is not shown on the navigation map, the route colouring is very similar to the normal road colouring for some roads. This can result in a very confusing interface, especially when navigating through complex junctions and road layouts.

HVAC frequently blew cold air although temperature was set to HI.

2. HVAC

HVAC frequently blew cold air although temperature was set to HI. No clear logic could be understood, but it appears that in Auto mode, the system behaved as expected, but in manual mode and also after switching off front demisting, this issue occurred.

Frequency	Low	Medium	High
Severity	Minor	Major	Critical

Key lowlights

Central display lacks core links

Central display issues

Lack of core links on-screen requires mental and physical shift

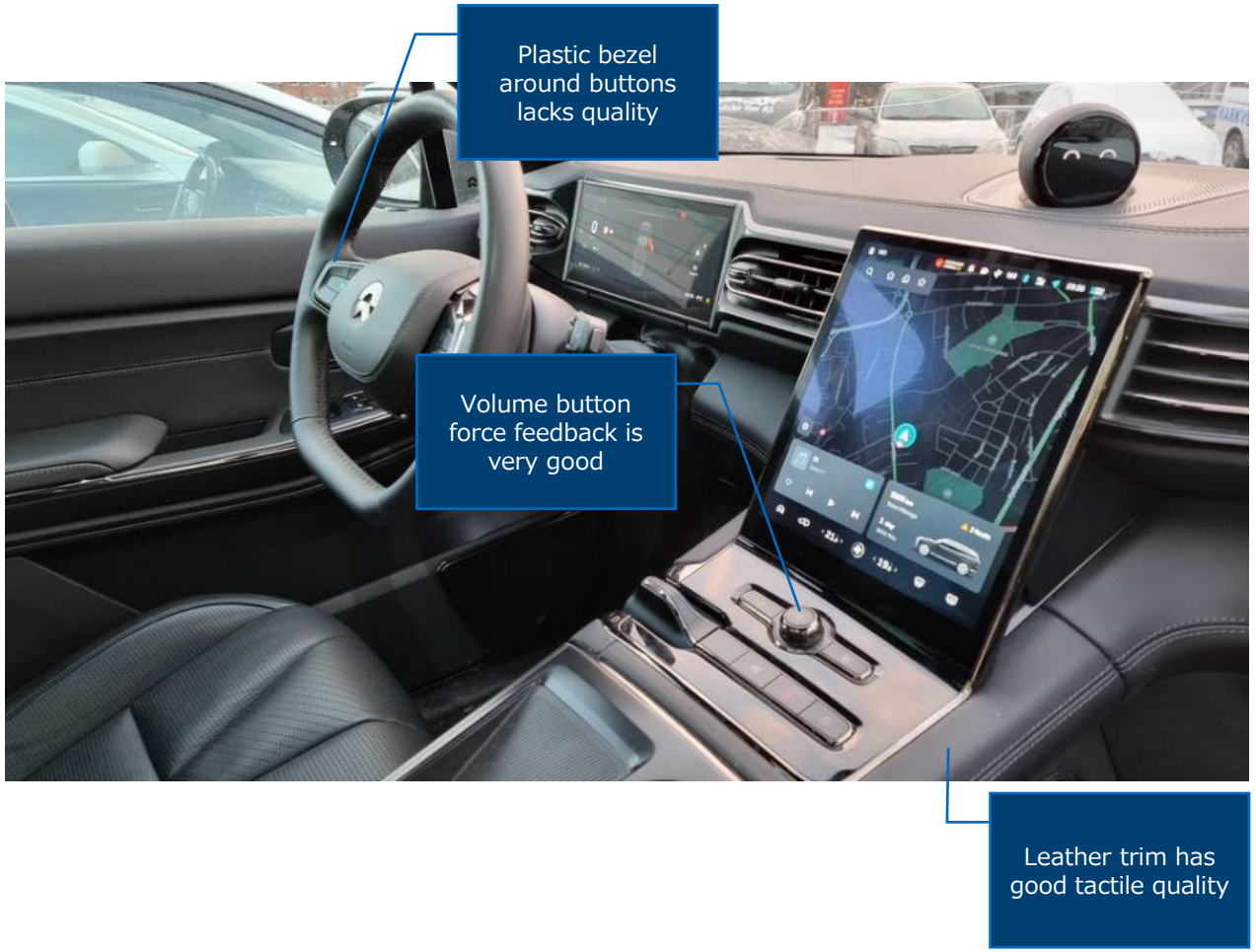
Several minor concerns were identified with the central display. Firstly usage requires the user to lean forward so their shoulder leaves the seat slightly. No specific hand support is provided, although this was not found to be an issue during testing and the user can stabilise their hand using the side of the screen if necessary. Very occasional misoperation was experienced during usage.

The lack of core links on-screen, specifically for home and all apps, calls for the user to make a mental and physical shift from touch input to hard buttons in order to return to the home page or view the all apps page. The buttons are located just below the screen and the home button is on the left as expected, however, the necessary shift has the effect of slightly slowing down task completion and feels unnecessary during usage. Integrating these two shortcuts as soft buttons within the central display would result in a more seamless experience for the user.

Perceived Quality: Tactile

Level 1	Tactile
SBD viewpoint	**Stiffness & looseness:** The stiffness and looseness of interior materials and elements meets the expected standard. **Force feedback:** The volume rotary has an optimal level of resistance when used. The buttons located around the centre console are of a good quality, however the steering wheel buttons lack sufficient resistance when pressed. The wheel control for vent on/off feels premium. **Material quality:** Material quality in some places is lacking. This is particularly evident around the centre console and phone charger where smooth untextured plastics have been used. The leather that has been used to trim the cabin and seats is of a good quality. **Material harmony:** Material harmony is of a good quality overall, however it is let down by the use of smooth, non premium feeling plastics around some areas. **Geometric & Positioning:** Throughout the cabin this has been achieved in most areas. However, the bezel around the buttons on the centre console and steering wheel give a cheap sensation of interference when the buttons are pressed due to the sharp corners beside the buttons.

Level 2 scoring				
Stiffness & looseness	Force feedback	Material quality	Material harmony	Geometric & positioning
7	7	6	6	6



SAE Level 0 ADAS: System usage

System usage: LKA/LDW

Minor deviation

Serious deviation

Good level of LKA warning given

System usage: BSM

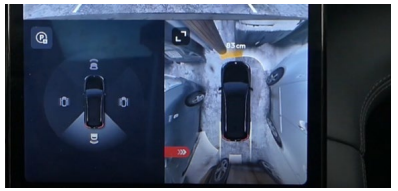
Cluster warning

Mirror warning

Good BSM warning in instrument cluster and mirror

System usage: RCTA

Mirror warning



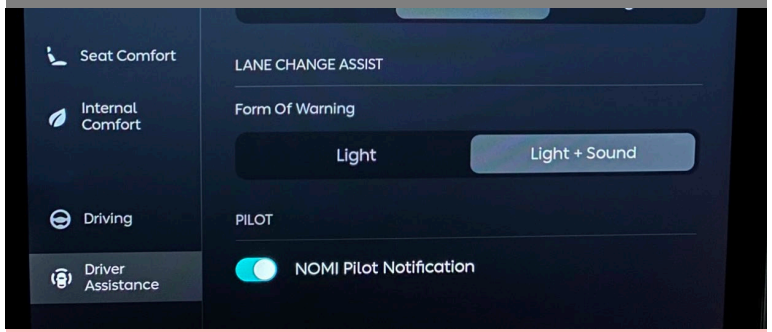
Infotainment warning

Good visual warning in mirrors and in the infotainment

System usage: LKA/LDW

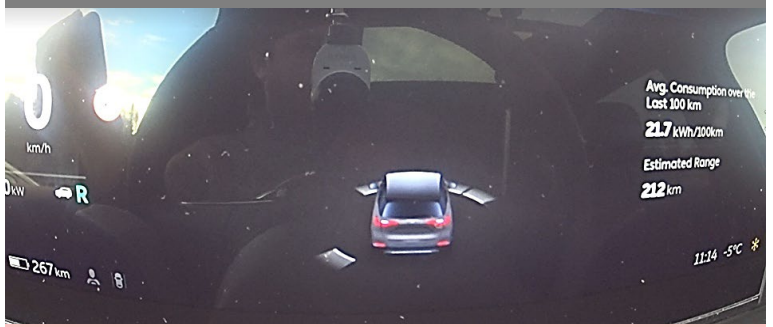
No reaction when settings are changed in instrument cluster

System usage: BSM



No reaction when settings are changed in instrument cluster

System usage: RCTA



No system status indication in instrument cluster

Rationale for providing hard home and all apps buttons is unclear

Category	Media
Description	Hard buttons for ‘Home’ and ‘All apps’ interrupt UI flow
SBD viewpoint	Three physical controls are provided in front of the base of the central display: a Home button, a volume rotary/push switch and an ‘All apps’ button. While the volume control is a logical addition expected to please users, the Home and ‘All apps’ buttons are less successful. • No ‘Home’ and ‘All apps’ buttons are provided on-screen, therefore every time the user wishes to use these shortcuts (a frequent occurrence), they must reach away from the screen, disrupting the user journey. This interrupt also creates decision paralysis, especially when using the system initially, as the buttons are expected to be found on-screen. • Taking the system in the BMW iX as an example, duplicate input methods are provided (rotary controller/buttons and touchscreen) which provides two logical input methods. In the NIO, two shortcuts alone are separated from the screen (without duplication) which makes little sense from a user perspective. Additionally in the BMW, the physical inputs form part of a larger control area, offering the user a choice of system control whereas in the ES8, this is not the case: the only additional control is volume. A software fix would be to provide duplicate on-screen buttons for ‘Home’ and ‘All apps’, but in the longer-term it is recommended these two hard buttons are removed and replaced with the on-screen ones.

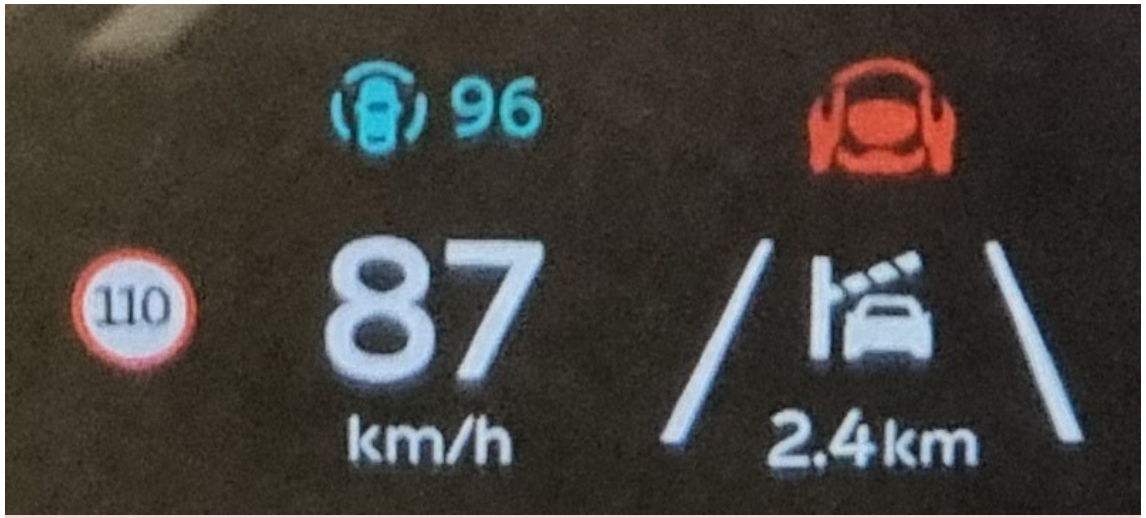
UX impact	Major negative	Minor negative	No impact	Minor positive	Major positive

Hard ‘home’ and ‘All apps’ buttons would be better placed on screen

HUD shows limited content and can be too dim

Category	Infotainment
Description	HUD provides a relatively basic level of information
SBD viewpoint	The HUD in the ES8 is a positive addition, however, it shows a lower level of detail than many competitor systems. • Information displayed comprises current speed limit (red when exceeded), current speed, basic navigation information and ADAS status/prompts. • Incoming phone calls are shown on the instrument cluster and central display along with an animation on NOMI's screen. No information is shown in the HUD. • In terms of navigation, the HUD shows very basic information meaning the driver must often refer to the central display. • HUD visibility at night can be very poor. Increasing the brightness setting to full improves visibility slightly, but not to the level of good competitor systems. • One positive point of interest is that adjusting the driver's seat gives the driver the option to change HUD height on the central display. Overall, the HUD leaves room for improvement, both in terms of content and display intensity.

UX impact	Major negative	Minor negative	No impact	Minor positive	Major positive



HUD offering is relatively basic

Night-time visibility can be poor, especially on pale backgrounds

NOMI provides a positive lift to the infotainment and car as a whole

Category	Infotainment
Description	NOMI implementation is a very strong positive
SBD viewpoint	NOMI was first evaluated in SBD's 2018 ES8 UX report in the China market and scored very positively. Three years later it scores no less positively and remains one of very few implementations of a physical avatar in a car and one of the most notable points of the ES8. • Hardware comprises a motorised sphere on top of the dashboard which can rotate in two axes, left/right and up/down. Rotation of the image on the screen provides the illusion of third-axis rotation. • NOMI turns to face the driver or passenger when they enter/leave the car, also when woken by steering wheel button or wake word. The voice output is consistent with the character although older than the Chinese version (early 20s rather than young teens). • The screen uses only black and white, is high resolution and with a high refresh rate to provide a high-fidelity image. • Numerous animations are shown in different circumstances, for example playing music, waiting, engaging piloted driving, navigating or greeting passengers. Several have been added since SBD's previous evaluation. Due to the simplicity of the animations, they are pleasing and entertaining while causing minimal distraction. The addition of NOMI to the system provides significant benefit by humanising the interface and may encourage users to interact with the infotainment system by voice. It also reduces friction when commands are unsuccessful due to the perception of interacting with a sentient being rather than a faceless computer.

UX impact	Major negative	Minor negative	No impact	Minor positive	Major positive

NOMI is extremely well implemented and provides significant 'wow-factor'

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Request price

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