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UX EVALUATION

In-car HMI UX Evaluations

#635

In-Car HMI UX Evaluation & Benchmarking

CUPRA Formentor

In SBD Automotive's **HMI UX Evaluation & Benchmarking series**, the latest in-car HMI is evaluated and benchmarked by our UX experts. In this edition, the team is testing the CUPRA Formentor. The SEAT subsidiary's new SUV features several in-cabin technologies which aim to streamline the UX of its infotainment system.

In addition to its 12.0-inch central display touchscreen, the Formentor features a customizable Digital Cockpit – allowing the user to personalize what they see on the car's 10.3-inch instrument cluster. Wireless Apple CarPlay and Android Auto are provided along with integrated Apple Music and Tidal apps. Voice recognition is catered for by VW's native solution alongside an installable Alexa app.

Unfortunately, the implementation suffers from a significant number of issues affecting overall system stability as well as specific areas such as HVAC, navigation, connectivity and voice recognition. Overall, the solution falls well below expectations and is expected to cause significant frustration to new owners.

COVERAGE	FREQUENCY	PUBLICATION FORMAT	PAGES
GLOBAL, NA, CHINA, EUROPE	ANNUALLY, QUARTERLY, 8 CARS PER YEAR	PDF, POWERPOINT, EXCEL, ONLINE	160+

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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

- PRODUCT PLANNERS
- USER EXPERIENCE
- MARKETING
- C-SUITE
- ENGINEERS

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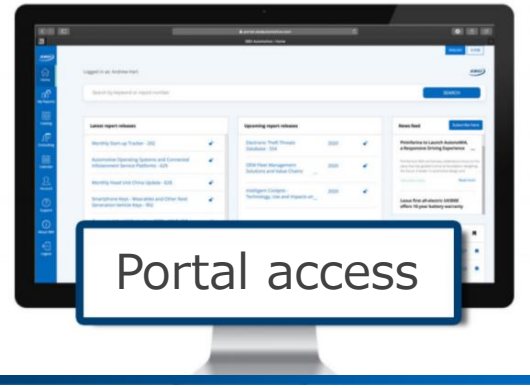

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July 2021

635-21(21b)

In-Car HMI UX Evaluation & Benchmarking CUPRA Formentor

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Introduction

Aim of this report

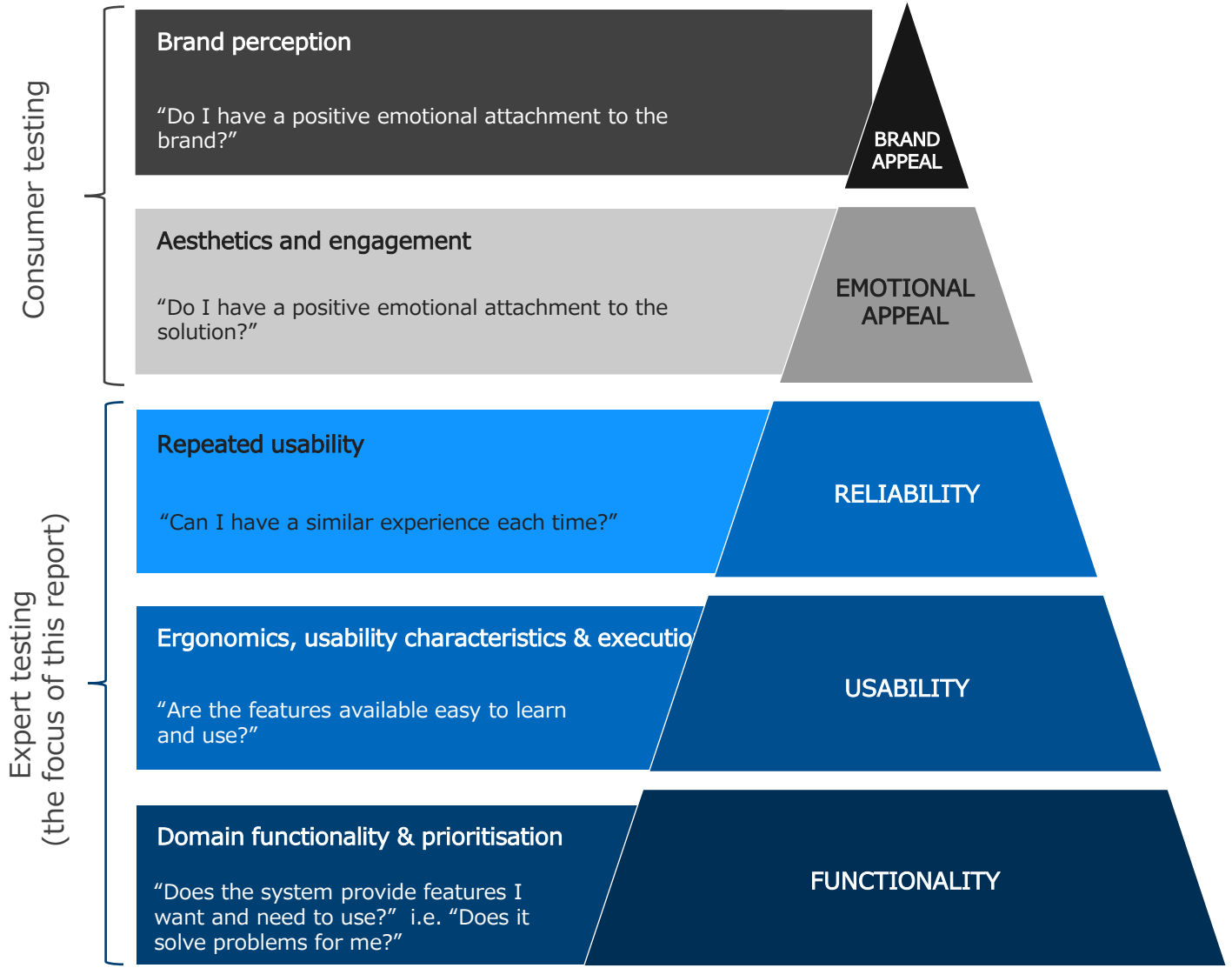
Welcome to the 2021 HMI benchmarking report series. This report has been created to provide a fair, unbiased and objective view of the latest in-vehicle HMI solutions in the European and US markets. Evaluations are carried out by SBD usability experts with a deep understanding of CASE domains such as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

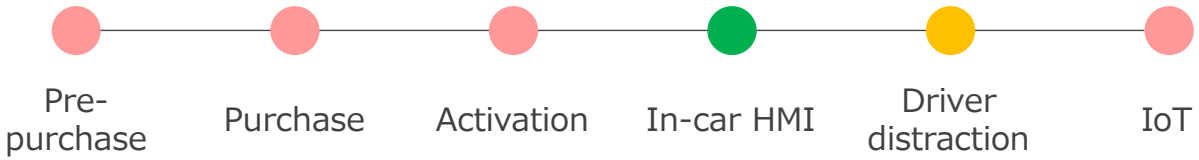
All viewpoints and analysis within the report are aimed defining areas of concern through a data driven approach. This report aims to benchmark and score solutions whilst also being able to provide actionable recommendations to design and development teams.



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 may 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 has chosen eight cars to evaluate in 2021, based on two selection categories. New/interesting UX focuses on systems with to 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 includes vehicles in segments that are sold in high numbers and are entering a new generation of UI for that vehicle. While we make best efforts to adhere to the chosen cars and schedule, the last year has seen release dates slipping significantly, so it may be necessary to make substitutions.

Confirmed cars for 2021

Mercedes-Benz S-Class

- Advanced HUD with augmented reality
- Biometrics
- Multiple wow-features

CUPRA Formentor

- Volume brand offering
- CarPlay and Android Auto analysis
- Departure from VW group UI
- First CUPRA HMI test

Tesla Model S

- Updated Tesla UI
- New steering wheel approach
- High performance graphics
- US market test

Hyundai Ioniq 5

- AR head up display
- Highway Driving Assist 2 ADAS

Lexus LS

- Advanced ADAS feature set
- Japan market test

Rivian R1

- Possible new disruptor
- Appears to have an innovative approach to HMI
- US market test

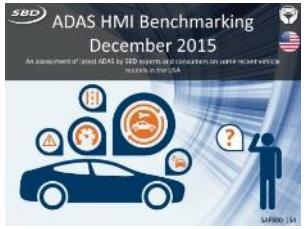
Potential cars for 2021 depending on vehicle availability

BMW iX/i4

Lucid Air

SBD experience through years of testing in-car solutions

Over the last eight years SBD has evaluated 86 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 to 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

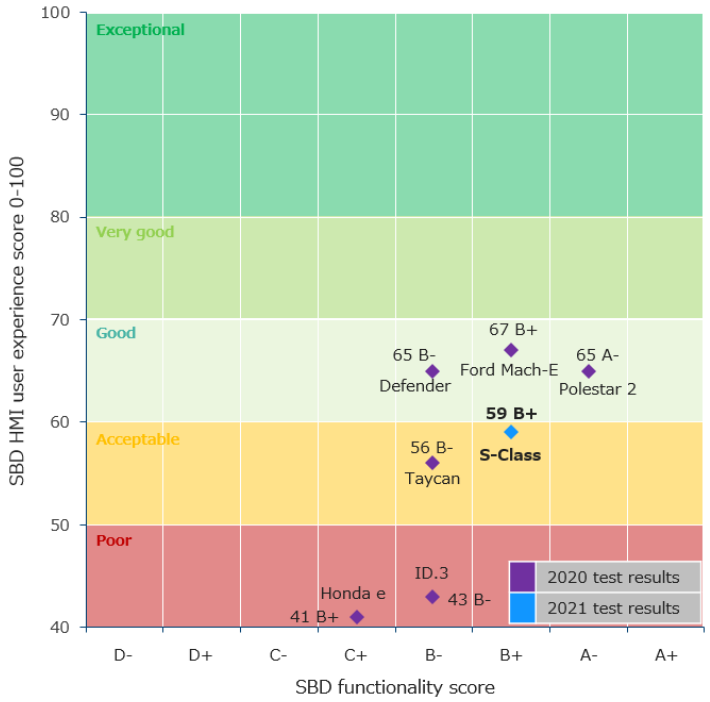
This document does not provide a detailed description of the methodology and this page serves to provide an overview of the approach.

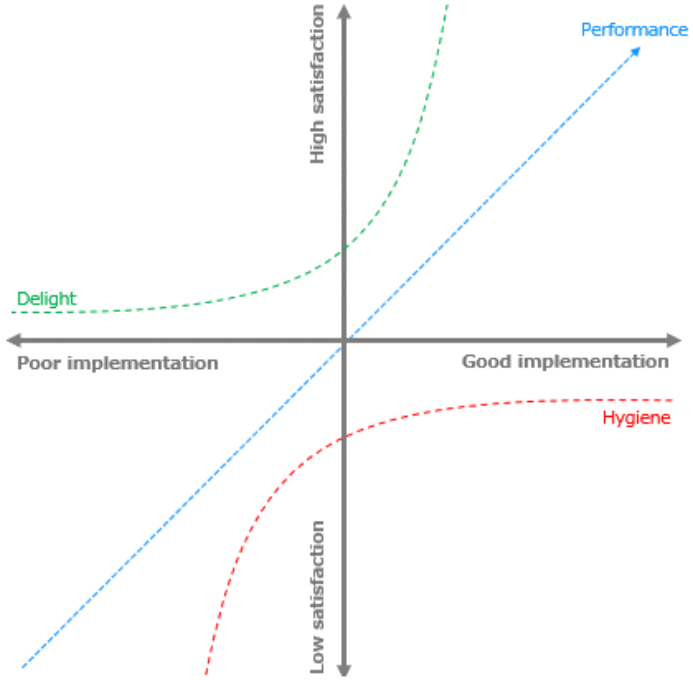
For a detailed discussion and presentation of SBD's methodology please contact us.

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)	✓	✓	✓	✓	✓	✓	✓	

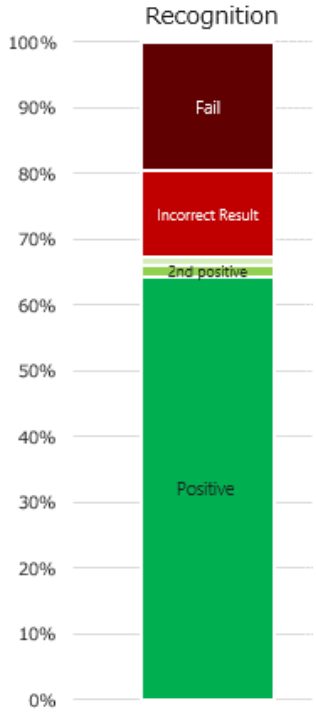
Report structure and how to interpret certain data sets

Throughout the testing and evaluation process SBD uses multiple methodologies to align to the situation and test area. Outputs from these evaluations can be broadly grouped into the following three types of report outputs - SBD's goal with these options is to ensure understanding of the results are as clear and fair as possible.





UX heuristic	Score
Cockpit clutter	Good
GUI clutter	OK
Display quality/size	Good
Map aesthetics	Very good
Map layout	OK
Navigation routing	OK
Instrument cluster	Good
General system HMI	OK



UX & functionality score

Final usability scored based on a 100-point scale with solutions scoring less than 40 defined as "not fit for purpose" with major user complaints expected and score above 80 defined as "exceptional".

Functionality score based on eight core feature set areas: delight features, performance features, hygiene features, navigation feature, ADAS, IoT integration, music, entertainment and info features.

Modified Kano feature analysis

Features plotted against three lines based on their implementation and satisfaction levels:

- Delight features: "wow" features likely to provide high satisfaction even with poor implementation
- Performance features: as the level of implementation increases so does the customer satisfaction
- Hygiene features: poor implementation provides low satisfaction, but good implementation may not provide positive satisfaction as it can be considered as expected functionality

Subjective & objective scores

Scoring across multiple areas through subjective scoring with pre-defined ranges, definitions, and comparison to past results.

Objective scoring generally based on a pass/fail criteria or time-based considerations. SBD attempts to minimize subjectivity as much as possible with results aimed at being fair and reasonable with a minimal level of bias.

Example slides from the 168 page report

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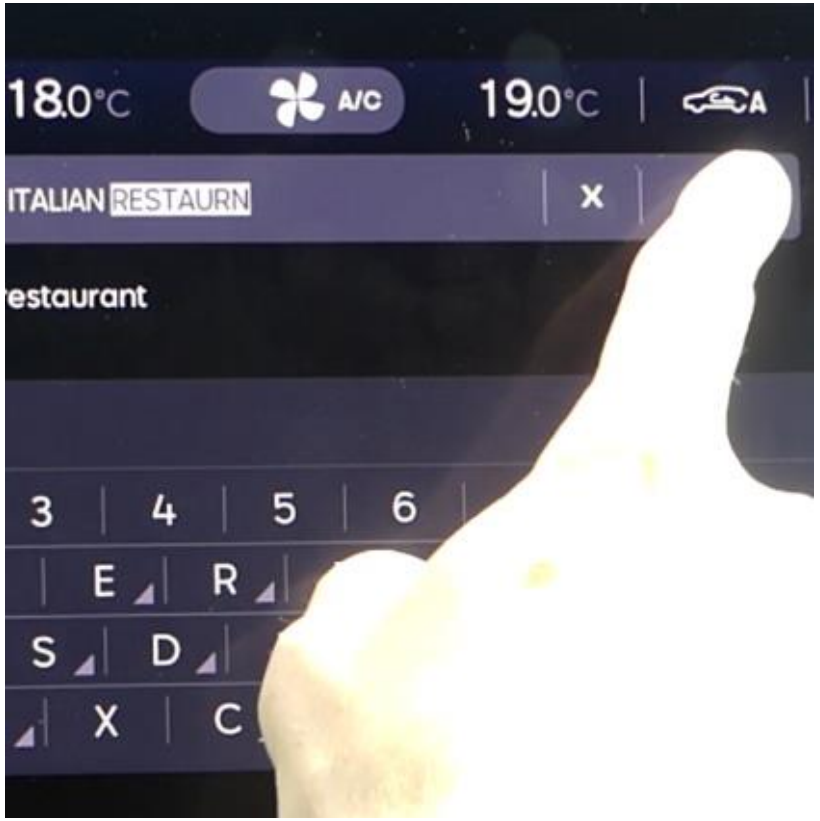
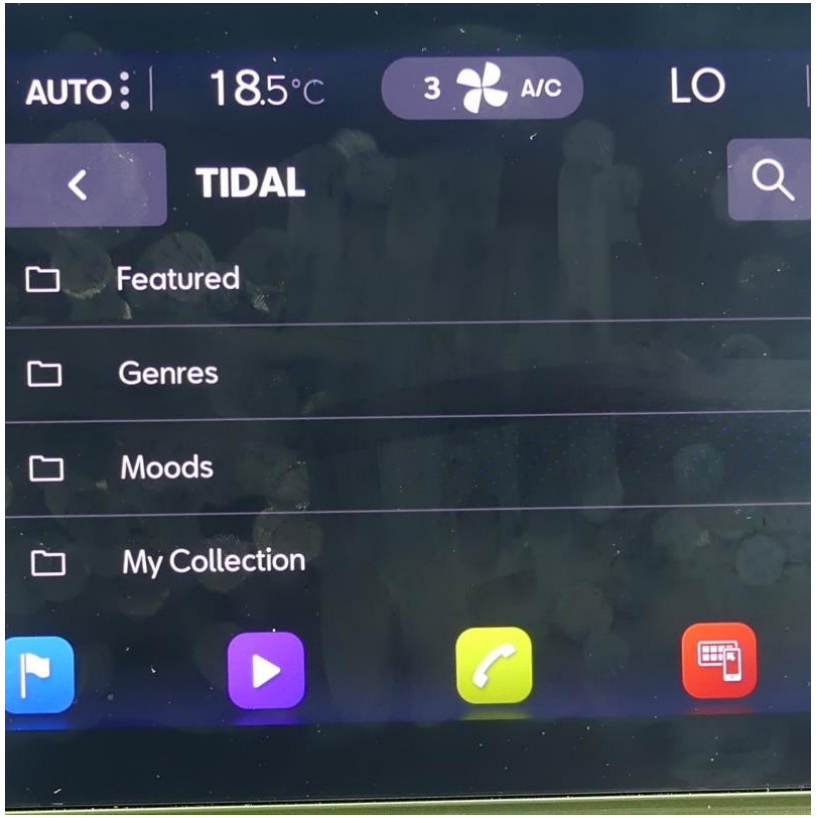
Fundamental concerns, not expected for a vehicle on-sale



Problematic touchscreen input

Effective touchscreen input is one of the most basic hygiene features, so it was disappointing in the CUPRA to find that the system had a major issue affecting all touchscreen interactions. The screen failed to respond to many inputs which was particularly noticeable when using the keyboard as it was not possible to type more than a few letters without one being missed.



Music apps below expectations

Tidal and Apple Music are offered as installable apps, however the installation process was extremely difficult, in part due to a lack of clarity over the requirement for a user data subscription/connection. When installed, it was found that the apps are list-based and offer a primitive interface compared to their smartphone app equivalents. Search is also simplified, resulting in poor relevance of results much of the time.

Alexa setup is problematic

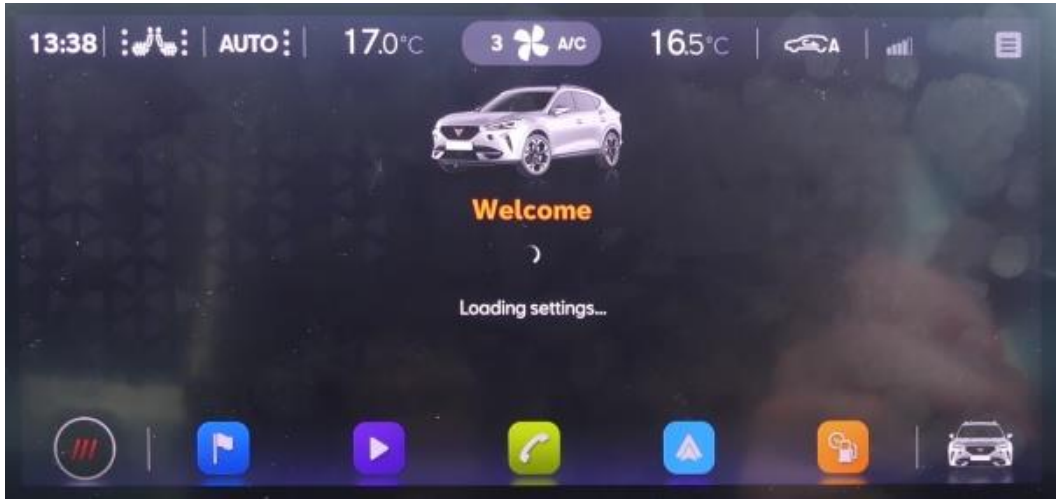
The process to set up Alexa is highly complex, requiring between 40 and 50 steps. It is expected that most users would give up before reaching the end of the setup. Although having Alexa is likely to add tangible benefits to the system, it is not available instantly as it still requires extra steps to start the app, meaning the go-to solution is likely to remain the native Cerence system for much of the time.

System stuck on loading screen until rebooted

1. General system

Following a critical navigation issue that required a system reboot while driving, the system booted most of the way, then became stuck on a loading screen with the message ‘Loading settings’ displayed. Only HVAC was available, no other features worked. It was left in this state for 30 minutes but did not fully boot. Eventually the car was stopped and left to carry out a cold boot after which the system functioned correctly again.

Frequency	Low	Medium	High
Severity	Minor	Major	Critical



Key highlight

Easy to find & identify controls

Lower centre console controls

Reaching the controls

All main controls are positioned well, are highly visible and well within reach. The large centre console space has multiple areas and an armrest that can be utilised by the operator to provide arm support while the controls are in use.

Perceived Quality: Tactile

Level 1	Tactile
SBD viewpoint	**Stiffness & looseness:** Buttons only show a minimal amount of side-to-side play and generally feel secure, giving an impression of quality. The central display is very rigid with little/no observed movement when pressed hard. **Force feedback:** All buttons have a consistent quality feel when pressed and feel appropriate to both the vehicle and their purpose. Only perhaps the steering wheel thumbwheel controls feel a little more clicky and less damped than other buttons, but they do not detract too much from the overall feel of the HMI. **Material quality:** Material quality is consistent across the HMI surfaces and generally feels suitable for this vehicle. Again, the steering wheel thumbwheels are two individual components that feel somewhat cheaper than the other HMI surfaces, but are acceptable. **Material harmony:** HMI material choice is consistent or better in quality to other touch surfaces in the vehicle. The lower centre console area is one zone in particular where the surrounding trim has a low-quality feel, being very hard plastic formed in a basic pebble grain finish. This is actually inferior to the finish of the HMI in this zone, which is consistent with the HMI of other zones like the steering wheel and lighting panel. **Geometric & Positioning:** The shape and positioning of the HMI in the Formentor was found to be very good, particularly the thumbwheels on the steering wheel for control of the instrument cluster menus.

Level 2 scoring				
Stiffness & looseness	Force feedback	Material quality	Material harmony	Geometric & positioning
Excellent	Excellent	Good	Good	Excellent

ADAS failure modes

During normal driving, a number of scenarios exist in which ADAS may not be available or able to support the driver correctly. One of these scenarios is a broken/faulty or obscured sensor. For the purposes of this test, a piece of tape was applied over the forward facing camera used to support vision based ADAS in an attempt to simulate dirt or other contaminants obscuring the camera's view and limiting its ability to fully support all functions.

The reaction from the HMI was adequate for some systems but fell short of the expected reaction for others. When the vehicle was turned ON, there was no immediate message showing which features were unavailable. However, once the vehicle had begun moving for a short distance, a large message and Collision Avoidance icon was shown in the cluster to show this feature was limited. In addition, a constant warning icon was shown in amber on the edge of the cluster. Shortly afterwards a similar message was shown for Adaptive Cruise Control (ACC). However it was noted that Piloted Driving (PD) was struggling to support the driver, even though no message had been provided.

ADAS Failure Mode	
Sensor Blocked	System affected
Camera	Adaptive Cruise Control
	Lane Keeping Assist
	Piloted Driving
Radar	Blind Spot Monitoring
	Automatic Headlamp Dipping
Lidar	Automatic Parking Assist
	Rear Cross Traffic Alert
Ultrasonic	Traffic Sign Recognition
	Collision Avoidance

ADAS Failure Mode	
System reaction	
System continues to try to support regardless	
System supports with limited functionality and warning message	✓
System fails to support and no message	
System fails to support and clear warning message	

Display solutions provide a positive impact on experience

Category	General system
Description	High-resolution displays, instrument cluster has good level of configurability
SBD viewpoint	The Formentor as tested in VZ2 specification has a 12-inch central display and a 10.25-inch instrument cluster, both are high resolution, the central display being 1920 x 860px (175ppi) and the instrument cluster 1280 x 480px (133ppi). • Both displays provide ample screen-estate. In the case of the instrument cluster, where white text on a dark/black background is used, the resulting image appears very high definition. • Although the instrument cluster is physically smaller than other vehicles that utilise 12-inch displays, it never gives the impression of being too small. • The instrument cluster has a large amount of configurability. Six different themes are available as well as customisable content panes on the left and right sides of the display (dependent on theme). • The only time when the central display layout is not suitable and information is seriously obscured is when using the keyboard to input a search. Results are mostly hidden and the keyboard has to be minimised. • The central display is angled towards the driver, so despite its large size, reach to the far side from the driver's seat is not compromised. This does have a slight negative effect on passenger interaction with the screen, however.

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

Some of the display modes feature two customisable zones

1920x860 display resolution provides interface clarity and an impression of quality

Traffic data was accurate and sometimes exceeded expectations

Category	Navigation
Description	Traffic data was accurate throughout testing
SBD viewpoint	Throughout the duration of testing, traffic data was found to be accurate. • Arrival times were acceptably consistent with other providers and sufficiently accurate. • At one point a road was encountered that was closed on a very short-term basis. This was shown accurately on the map and exceeded expectations. It is expected that the level of accuracy provided by traffic information would meet or exceed user expectations.

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

A short-term road closure was shown accurately on the map

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