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In-car HMI UX Evaluations

#635

# In-Car HMI UX Evaluation & Benchmarking

## Jeep Grand Wagoneer

In this edition, the UX team is testing the Jeep Grand Wagoneer.

Overall, the Jeep Grand Wagoneer impresses with its comprehensive feature offerings including a highly connected navigation system, entertainment and information features and numerous delight features meaning it scores highly for SBD functionality score. However, the system is pulled down in terms of user experience score due to a high number of critical or major bugs experienced during testing and concerns regarding overall legibility.

### COVERAGE



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# Scoring

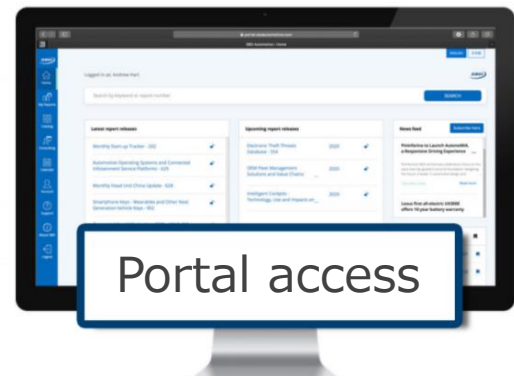
- > **Features and functionality:** evaluating whether the solutions provide features that customers expect, need and solve problems (or provide a wow factor).
- > **Reliability/stability:** evaluating the repeated usability and whether the users can have a similar (positive) experience each time.
- > **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.
- > **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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Jeep Grand Wagoneer

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## 635 - In-Car HMI UX Evaluation & Benchmarking – Jeep Grand Wagoneer

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## Introduction

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# Aim of this report

Welcome to the 2023 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 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.

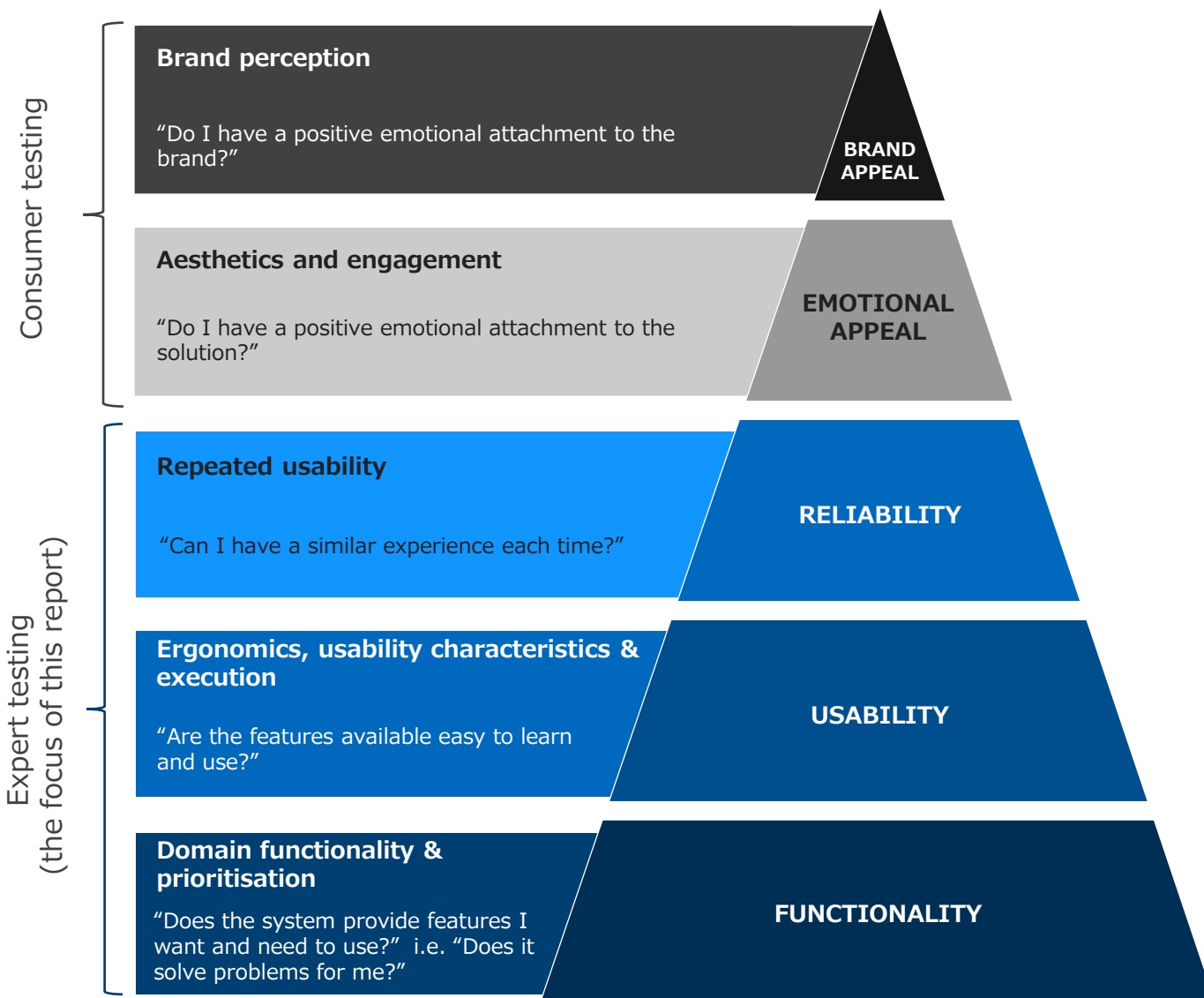
One of the core goals of these studies is to provide a true indication of what the final customer experience of each solution could be. To do this evaluations are focused on providing scoring and analysis in the following areas:

- **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 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 it's methodology each year, but does not update scores from the previous years. Therefore, please assume a slight drop in scores for both user experience (UX) and functionality from the previous year.



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













# 2023 vehicle list

SBD has chosen six cars to evaluate in 2023, 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 two years have seen release dates slipping significantly, so it may be necessary to make substitutions.

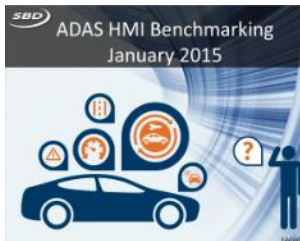
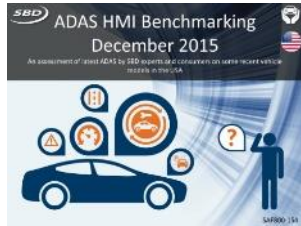
Cars tested	Planned cars for 2023				
					
<b>Jeep Grand Wagoneer</b>	<b>Nissan Ariya</b>	<b>BYD Seal</b>	<b>BMW X1</b>	<b>Fisker Ocean</b>	<b>Ford F-150 Lightning</b>
<ul style="list-style-type: none"> <li>▪ Passenger display</li> <li>▪ Amazon Fire TV</li> <li>▪ Active Drive Assist</li> <li>▪ US market test</li> </ul>	<ul style="list-style-type: none"> <li>▪ ProPilot Assist</li> <li>▪ Unique HMI and interior</li> <li>▪ EV SUV</li> <li>▪ German Market Test</li> </ul>	<ul style="list-style-type: none"> <li>▪ Unique Home Screen HMI</li> <li>▪ EV</li> <li>▪ Chinese market test</li> </ul>	<ul style="list-style-type: none"> <li>▪ Expected iDrive 9 debut</li> <li>▪ German market test</li> </ul>	<ul style="list-style-type: none"> <li>▪ EV SUV</li> <li>▪ Sustainable materials</li> <li>▪ Large central display</li> <li>▪ US market test</li> </ul>	<ul style="list-style-type: none"> <li>▪ Android-based OS</li> <li>▪ EV Truck</li> <li>▪ US market test</li> </ul>





# SBD experience through years of testing in-car solutions

Over the last ten years SBD has evaluated over 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 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)	✓	✓	✓	✓	✓	✓	✓	





# Example slides from the report

The example slide features a photograph of a car's interior dashboard and steering wheel. Below the image is a blue banner with the SBD logo on the left, the text 'March 2023 In-Car HMI UX Evaluation & Benchmarking Jeep Grand Wagoneer' in the center, and the number '635-23(23a)' on the right. At the bottom of the slide is a blue button with the text 'Request price' and a white right-pointing arrow.





# Many delight features, minor performance feature issues

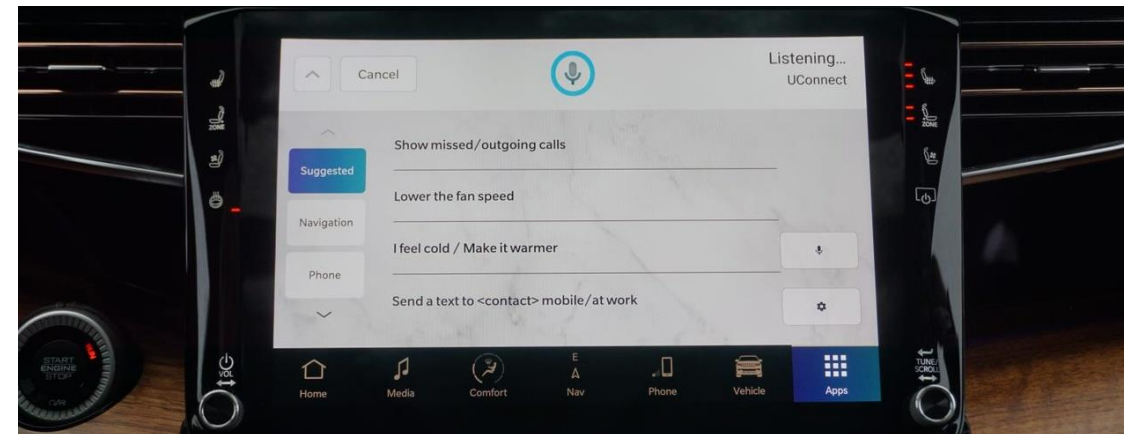
- The system features a large selection of delight features that are expected to wow the majority of users.
- Minor delight features include a McIntosh sound system, rear seat entertainment with Amazon Fire TV, rear touch screen HVAC control, massage seats, drop-down step and Fam Cam (interior passenger camera) from which front passengers can individually select rear seats to monitor.

- Voice recognition can be inconsistent in understanding and interpreting commands correctly.
- Visual inconsistency between cluster and HUD, especially regarding navigation commands.
- Some ADAS such as ACC lacks sufficient user support in stop and go traffic situations.



## Passenger display is a major wow-factor

One of the major delight features is a passenger display which is visible to the passenger but cannot be viewed by the driver to minimize distraction. Passengers can watch Amazon Fire TV, plan and send routes to the navigation system in the central display and connect external devices such as mobile devices, headphones and other devices via HDMI.

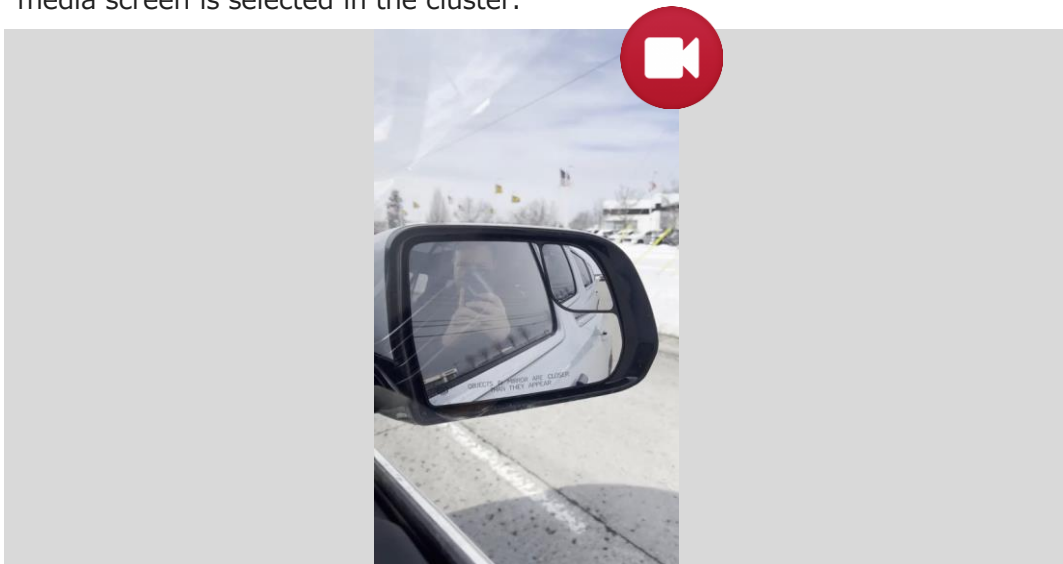


## Voice recognition struggles with some commands

The voice recognition system fails some simple use cases. For example, the system fails to successfully complete some media-based commands such as 'pause', 'shuffle' and 'repeat all tracks'. This is likely to fall short of most users' expectations for a premium vehicle. Most navigation-based performance tasks are also not possible, often being misunderstood by the system or completely rejected.

# Inconsistent audio prioritization for some systems, POIs lack detail

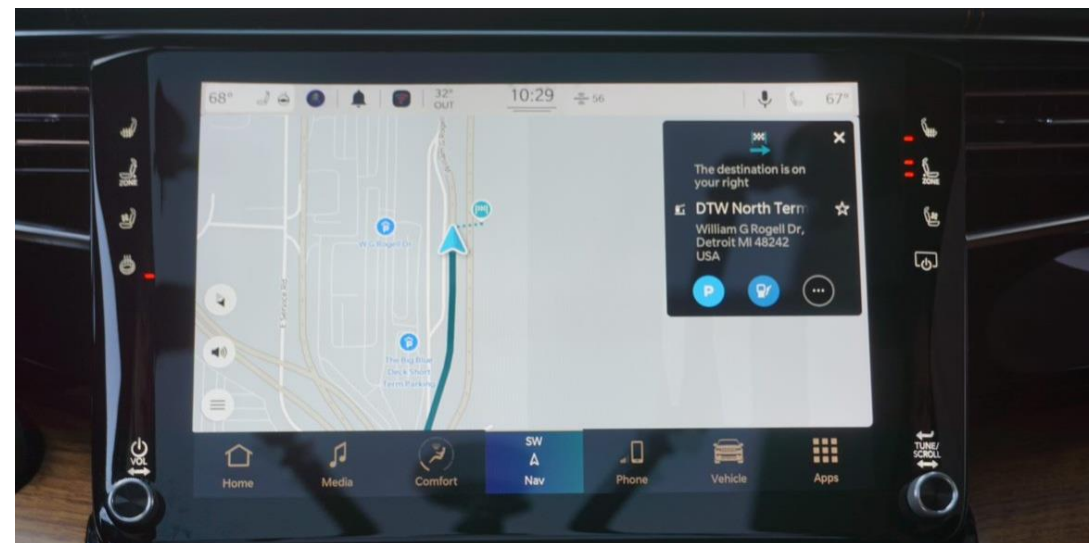
- Audio prioritization for ADAS is very good, however it is insufficient for navigation which struggles to prioritize voice commands over infotainment volume.
- Phone SMS messaging is often unstable, working for a certain period before becoming unavailable.
- Volume control from the steering wheel is not possible. This is something that most users would likely notice is missing. Source selection is only possible when the media screen is selected in the cluster.



## Audio prioritization for some features, but no others

Some systems including ADAS have complete audio prioritization. When an ADAS audio alert is given, all infotainment volume is completely muted to allow for full prioritization. However, for navigation some level of prioritization is given but when infotainment volume is loud, voice commands still struggle to be heard. Ideally, audio prioritization should be consistent across all elements of the system.

- The navigation system is mostly well implemented with accurate ETAs from start to finish and efficient routing.
- Verbal commands are delivered in a timely manner and include important information such as street name and direction.



## POI icons can sometimes be inaccurate and illogical

When navigating to the airport, the system showed a POI icon that clearly depicted an 'aircraft'. However, on arrival the POI icon now used a gate image. This icon meant 'gated access' which was clear inaccurate. When navigating past an airport, a 'Shell fuel' icon is shown nearby on the map, when in reality there is no fuel station nearby accessible to the public.



# Good status communication, some poor graphical implementation

SBD tested six ADAS on the 2022 Jeep Grand Wagoneer. These were Fully Automatic Park Assist (FAPA), Rear Cross Traffic Alert (RCTA), Lane Departure Warning/Lane Keeping Assist (LKA/LKA), Blind Spot Monitoring (BSM), Adaptive Cruise Control (ACC) and Piloted Driving (PD).

Overall, most systems provided good visual feedback in the cluster and excellent audio prioritization. However some systems were let down by basic visual warning in the side mirrors and central display while others lacked the required level of user support. Use of correct and clear iconography was also lacking throughout most systems. Multiple ADAS views are available in the cluster and all maintain basic system status and warning displays.

The system does not automatically scan at low speeds, The user must press the button to begin scanning. Step-by-step instruction is clear, however FAPA graphics fall well below the expected standard.

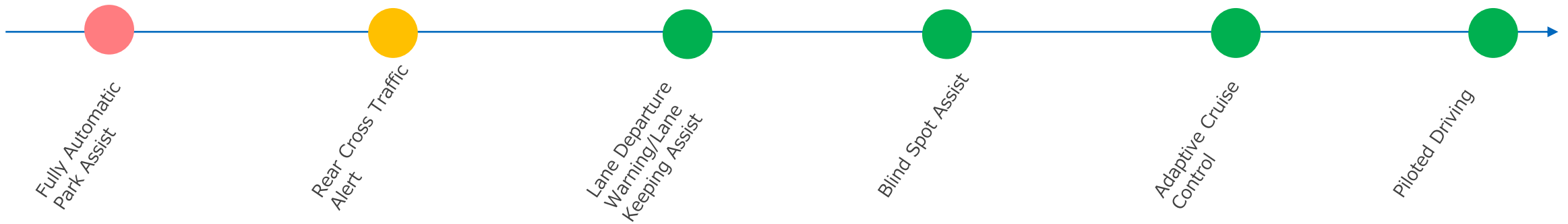
RCTA activation is automatic when reverse gear is engaged. However, the system is bundled with BSM and cannot be turned ON or OFF independently. The audio warning is prioritized but the visual warning falls short of the expected level.

LKA provides lane tracking status clearly and is communicated via the main ADAS display, HUD and repeater icon to ensure it is always shown. The correct color logic is given for warnings; however, some confusing button labelling prevents it from being as intuitive as it could be.

BSM operates mostly as expected, with prioritized audio warnings when indicating into the path of detected vehicles. The system could be improved by utilizing the ISO icon in the side mirrors.

ACC is controlled via buttons on the steering wheel. A good level of visual feedback is given in the cluster and HUD using correct color logic. However, the system is let down by a poor level of support in stop & go traffic.

Overall PD provides good visual support in the cluster and HUD with clear graphics. Status is clearly communicated at all times. Hands-off warning is clear and robust, however it fails to cancel after three attempts of warning.



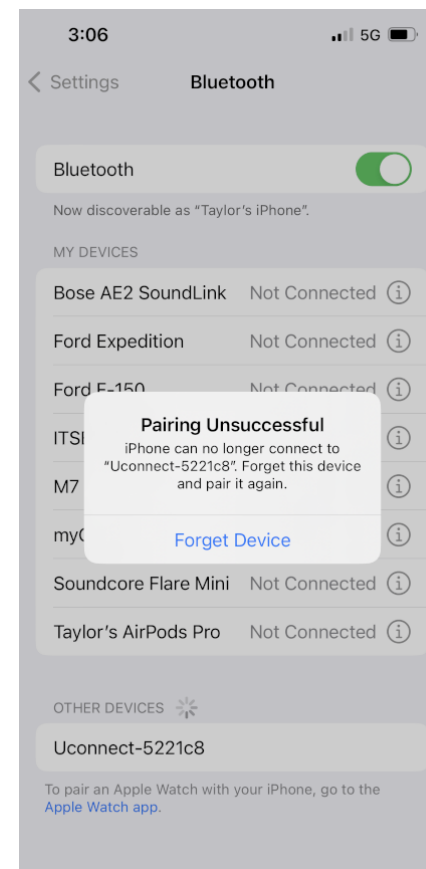


# Bluetooth pairing issues

## 1. Phone

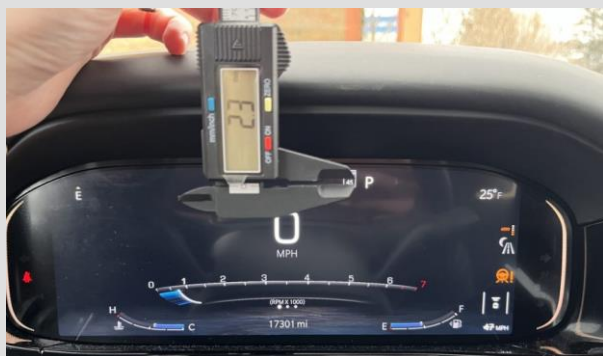
On multiple occasions, the user was unable to pair a mobile device to the system via Bluetooth. Even after following the correct on-screen instructions, the mobile device displayed a message indicating the system could not pair successfully. The user was forced to restart the Bluetooth pairing process by turning off and on Bluetooth on the mobile device.

Frequency	Low	Medium	High
Severity	Minor	Major	Critical





# Display reading distance & text size



Central display text is well above target size

## Mixed results across HMI

### Instrument cluster text size is too small

In the central display, text such as that for temperature readout is 3.8mm in height. This is above the target size of 3.5mm and scores "Low/no risk".

In the instrument cluster, text for speed sign recognition is 2.3mm in size. This falls below the target size of 4.1mm but still scores an acceptability rating of 'Acceptable' as the icon is distinctive enough to be recognisable as a speed limit without always having to read the text. As a result it scores "Emerging risk".

Display	Reading distance	Text size	Target size	Final Rating
Central display	69cm	3.8mm	3.5mm	Low/no risk
Instrument cluster	71cm	2.3mm	4.1mm	Emerging risk

Display	Severity / Driver distraction Rating	Acceptability Rating
Central display	Low/no risk	Acceptable
Instrument cluster	Significant risk	Acceptable



# Perceived Quality: Tactile

Level 1

## Tactile

**Stiffness & looseness:** All fixtures, fittings and surfaces demonstrate a good level of rigidity and solidity including regular touchpoints and surfaces lower down within the cabin not regularly felt by users.

**Force feedback:** Good quality feedback is felt from most buttons and knobs, however the level of haptic feedback is inconsistent across the HMI. Lower console buttons provide subtle haptic feedback (LKA, FAPA etc). The memory seat buttons on the door card have harsh haptic feedback that vibrates the entire panel. No feedback is provided for seat heaters/ventilation buttons. As a result misoperation is frequent.

**Material quality:** Most surfaces and materials give the expected sensation of high quality including real wood paneling with inlaid branding and a real metal gear selector. High gloss, black plastic is used in the cabin and feels cheap and often results in misoperation due to fingerprint build up.

**Material harmony:** Material quality remains high throughout the cabin, low down on the door cards and rear seat rows. Turn signal stalks feel cheap and appear to be from a lower segment vehicle, however this is only a minor point. Hard, gloss black plastic around the central display feels cheap, collects fingerprints and dust easily and is inconsistent throughout the cabin.

**Geometric & Positioning:** All switches and buttons look and feel solid. This is fitting for the cars aesthetic and overall brand appeal.

SBD viewpoint

### Level 2 scoring

Stiffness & looseness	Force feedback	Material quality	Material harmony	Geometric & positioning
Good	Fair	Fair	Good	Good





# Amazon services offering

SBD viewpoint

The system features multiple services provided by Amazon. These include Alexa voice assistant and Amazon Fire TV. These services can be accessed with an Amazon account and when connected to a Wi-Fi hotspot connection.

- When enabled and connected to a Wi-Fi source, Alexa can be interacted with by either using a wake-word or by pressing the steering wheel button. Alexa can complete more integration use cases compared to the native system when enabled.
- Amazon Fire TV can be accessed via the central display, passenger display and two rear seat entertainment displays. The rear seat entertainment displays can be interacted with using touch or via dedicated remote control.

Amazon Alexa provides an effective alternative to the native voice recognition system. Alexa can successfully complete some use cases that the native system fails, however the user must go through the process of enabling Alexa, connecting to the hotspot and signing into their account to use it. Amazon Fire TV provides an entertainment features that is likely to be popular with most users and provide a degree of wow factor.



Amazon services

UX impact	Major negative	Minor negative	Minor positive	Major positive
-----------	----------------	----------------	----------------	----------------



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The complex block is a rectangular thumbnail with a white border. The top portion shows a photograph of a car's interior dashboard, featuring a steering wheel, a large central infotainment screen, and a smaller screen on the center console. Below the image is a blue banner containing the SBD logo on the left, the text 'March 2023 In-Car HMI UX Evaluation & Benchmarking Jeep Grand Wagoneer' in the center, and the alphanumeric code '635-23(23a)' on the right. At the bottom of the thumbnail is a blue button with the text 'Request price' and a white right-pointing chevron symbol.





# 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](mailto:info@sbdautomotive.com) or discuss with your local account manager below.



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