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In-car HMI UX Evaluations

#635

In-Car HMI UX Evaluation & Benchmarking

Hummer EV

In this edition, the UX team is testing the Hummer EV Pickup.

The Hummer EV Pickup returns impressive scores for both functionality and user experience (UX), with a higher UX result than the majority of vehicles evaluated the past two years, including many industry leaders. Notably it scores far better for UX than the Rivian R1T, also an all-electric truck in the premium segment, mainly due to the Hummer demonstrating a higher level of stability. However, a notable step down in terms of both functionality and UX is evident compared to the Cadillac Escalade; disappointing considering both models are from the same OEM..

COVERAGE



GLOBAL



NA



CHINA



EUROPE

FREQUENCY



ANNUALLY



QUARTERLY



CARS PER YEAR

PUBLICATION FORMAT



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POWERPOINT



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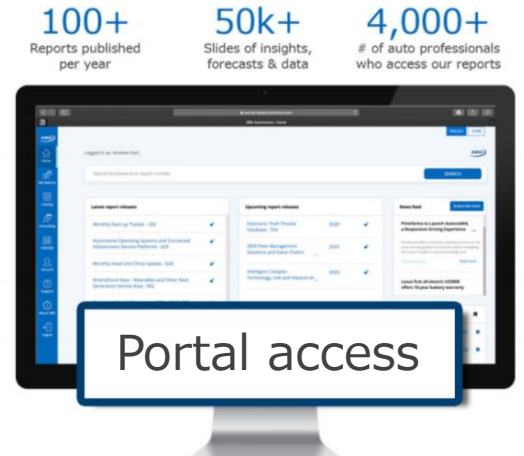
Scoring

- > **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.

This research is useful for



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In-Car HMI UX Evaluation & Benchmarking Hummer EV

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Introduction



Aim of this report

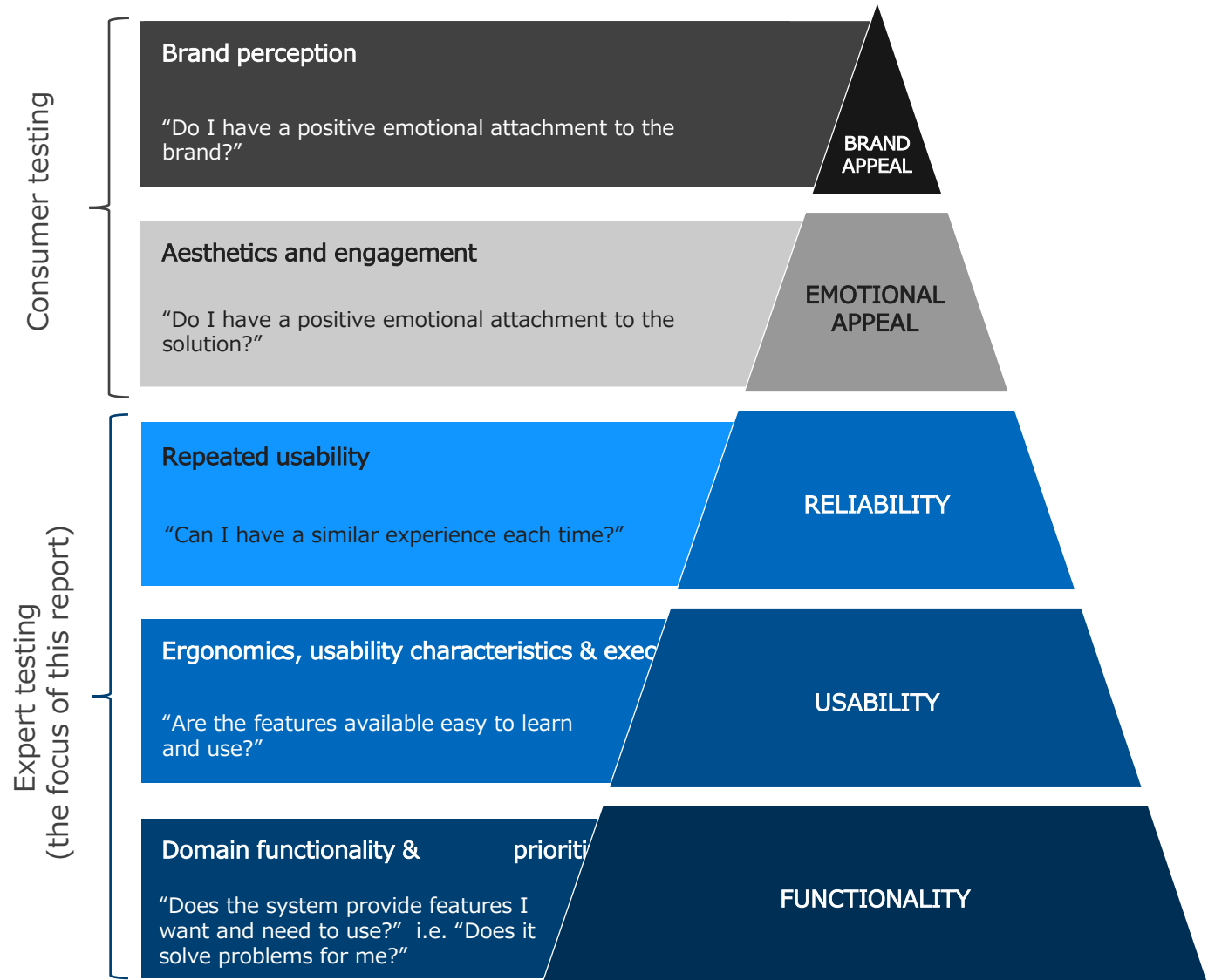
Welcome to the 2022 HMI benchmarking report series. This report has been created to provide a fair, unbiased and objective view of the latest in-vehicle HMI solutions in the European, US and Japanese markets. Evaluations are carried out by SBD usability experts with a deep understanding of CASE domains 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 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





2022 vehicle list

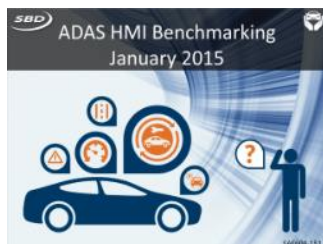
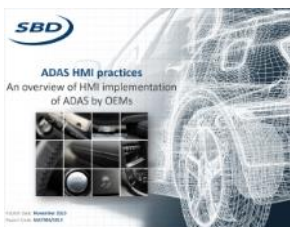
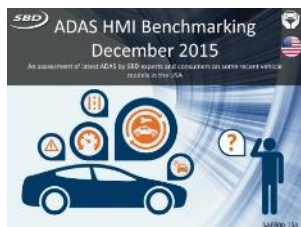
SBD has chosen six cars to evaluate in 2022, based on two selection categories. New/interesting UX focuses on systems with to never-seen-before features or functionality, or the implementation of a solution that has previously been a challenge or pain-point for end-users. New mass-market UX includes 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.

Cars tested					Awaiting test
					
Lucid Air	Rivian R1T	Renault Megane E-Tech	Xpeng P5	GMC Hummer EV	Lexus NX
<ul style="list-style-type: none">▪ Potential disruptor▪ Multiple displays▪ US market test	<ul style="list-style-type: none">▪ New disruptor▪ Appears to have an innovative approach to HMI▪ US market test	<ul style="list-style-type: none">▪ LG's new Android Automotive IVI▪ French market test	<ul style="list-style-type: none">▪ High level of ADAS▪ Advanced voice recognition▪ Configurable avatar▪ China market test	<ul style="list-style-type: none">▪ GM's new Android OS system▪ Unreal Engine graphics▪ US market test	<ul style="list-style-type: none">▪ New Lexus system▪ Cloud-based navi▪ New voice recognition▪ German market car, UK test



SBD experience through years of testing in-car solutions

Over the last nine years SBD has evaluated 96 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 full 140 page report



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Few delight features, some performance features cumbersome

Delight

- Unreal Engine graphics shown in the cluster and central display added some level of delight and a unique experience to some screens and animations.
- The 'WTF' feature allows the user to experience the full power of the vehicle's battery under acceleration. This certainly provides an element of wow factor, but is not unique in the EV sector.
- Although the vehicle has several minor wow features, the main feature is 'CrabWalk'.

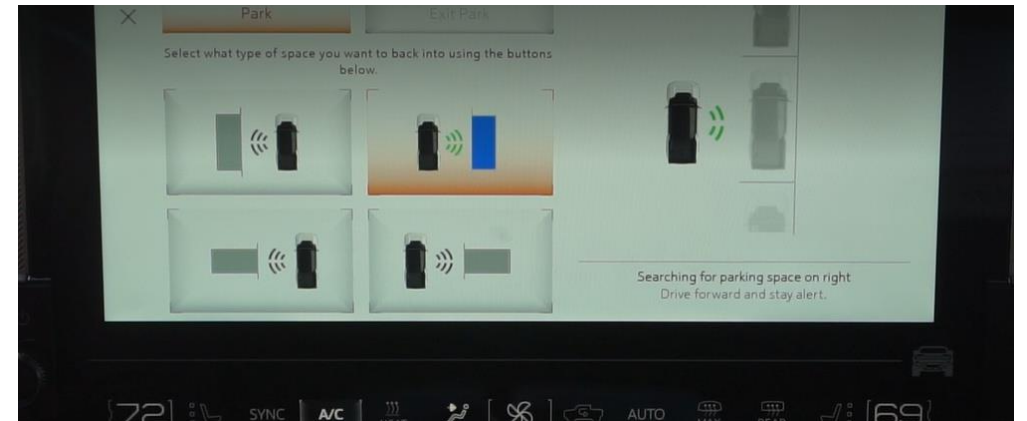


CrabWalk

The main delight feature in the Hummer EV is the 'CrabWalk' feature. This enables the vehicle to crab diagonally. Although the use cases for this feature may be limited in day-to-day usage, it provides a wow-factor element to the user experience and gives something unique to the brand. The feature is also easy to engage and use. Integrating this feature into FAPA may add to the wow factor.

Performance

- In most cases, the performance features in the Hummer EV offer clear and intuitive feedback for the user.
- One element to be considered for a future update would be the inclusion of a HUD. This would potentially reduce elements of driver distraction and allow for some 'wow factor' to be added.
- Performance features like ACC suffer somewhat from poor iconography consistency between button and cluster and a lack of dedicated ADAS display.



FAPA activation is cumbersome

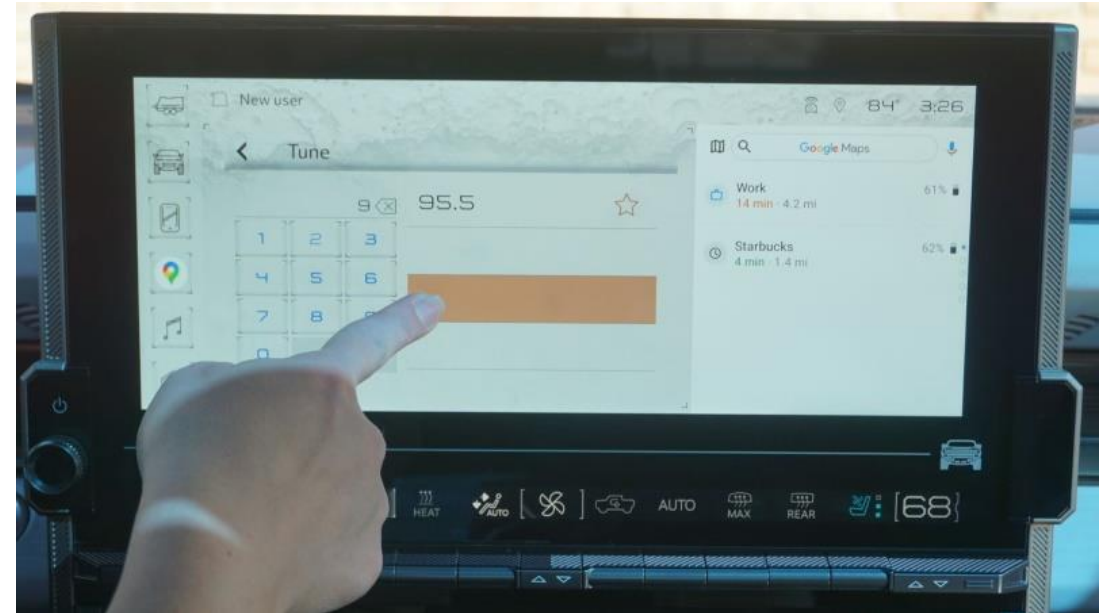
In order to activate FAPA, the driver must engage in a multi-step process via the central display to choose from a selection of parking options before the system can begin the procedure. It was noted that this may become an issue when using the system in time-sensitive scenarios e.g. sat in a traffic lane waiting to parallel park into on-street parking.

Issue with direct tune radio frequency entry

2. Radio

An issue was experienced using direct tune with FM radio stations. Three presets were stored, all starting with "9." Occasionally when typing "9" in direct tune a favorites list on right side was shown, but only one option was given. It had the appearance of a list where other options listed below would be clickable. It appears this should show a list of saved presets.

Frequency	Low	Medium	High
Severity	Minor	Major	Critical



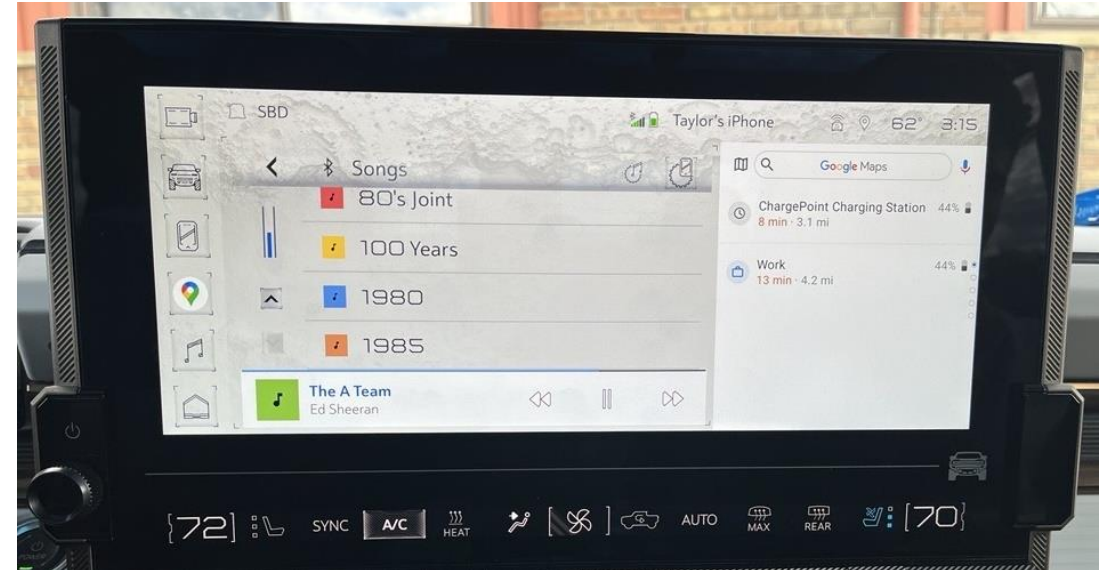


System froze in Bluetooth audio menu

1. Media

The system froze in Bluetooth audio menu for almost a minute while the tester was trying to use the back button.

Frequency	Low	Medium	High
Severity	Minor	Major	Critical



Key lowlights



Lack of support around central display

No support when using central display

Lack of support for user's hand when using central display

When the user is interacting with the central display, there is no surface or support for them to rest their hand on. This is a particular issue due to the near vertical positioning of the central display.

Similarly, the centre console arm rest is too far rearward in order to provide any elbow support for the driver when using the central display. This leaves the driver suspending their arm in mid air, likely causing discomfort over time.



Perceived Quality: Tactile

Level 1

Tactile

SBD viewpoint

Stiffness & looseness: Tolerances in buttons and switches were found to be consistently tight throughout.

Force feedback: A lack of haptic feedback when interacting with buttons and switches. In addition, the natural feedback felt from each component was also lacking due to the quality of plastics, resulting in a somewhat cheap sensation from some buttons.

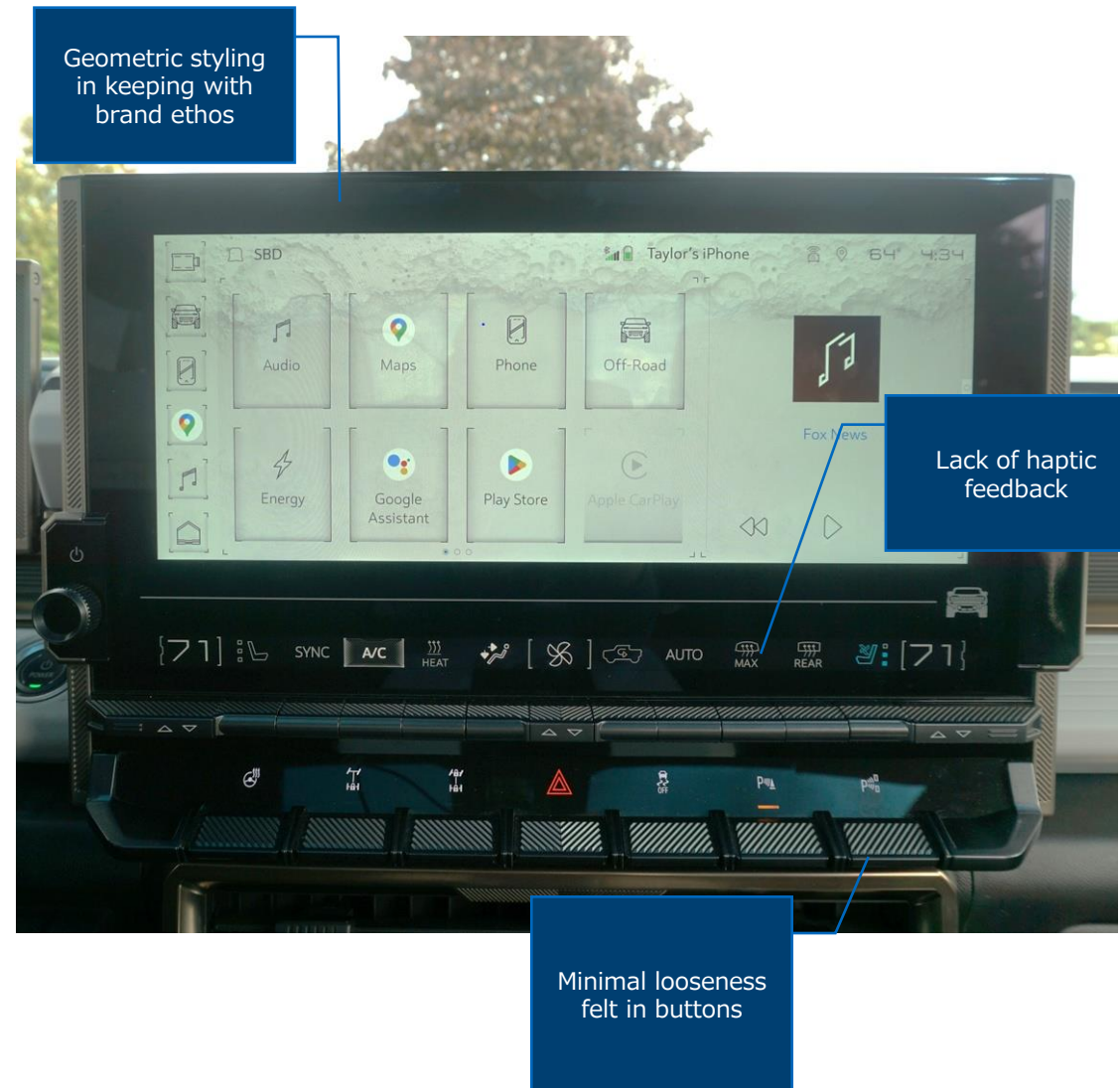
Material quality: The quality of plastics throughout the cockpit including frequent touched inputs fell below expectations in terms of look and feel, particularly for a premium segment vehicle.

Material harmony: Although the tactile quality of the materials presented issues, the consistency throughout the cabin is strong.

Geometric & Positioning: The positioning and geometric style of the HMI components are in keeping with the overall brand ethos.

Level 2 scoring

Stiffness & looseness	Force feedback	Material quality	Material harmony	Geometric & positioning
8	6	5	6	7





SAE Level 0 ADAS: System usage

System usage: LKA



Good level of visual warning shown in cluster

System usage: BSM



Good visual warning shown in corresponding side mirror

System usage: RCTA



Good pedestrian detection in central display

System usage: LKA



ADAS display



Repeater icon

Icon loses detail when ADAS display not chosen

System usage: BSM

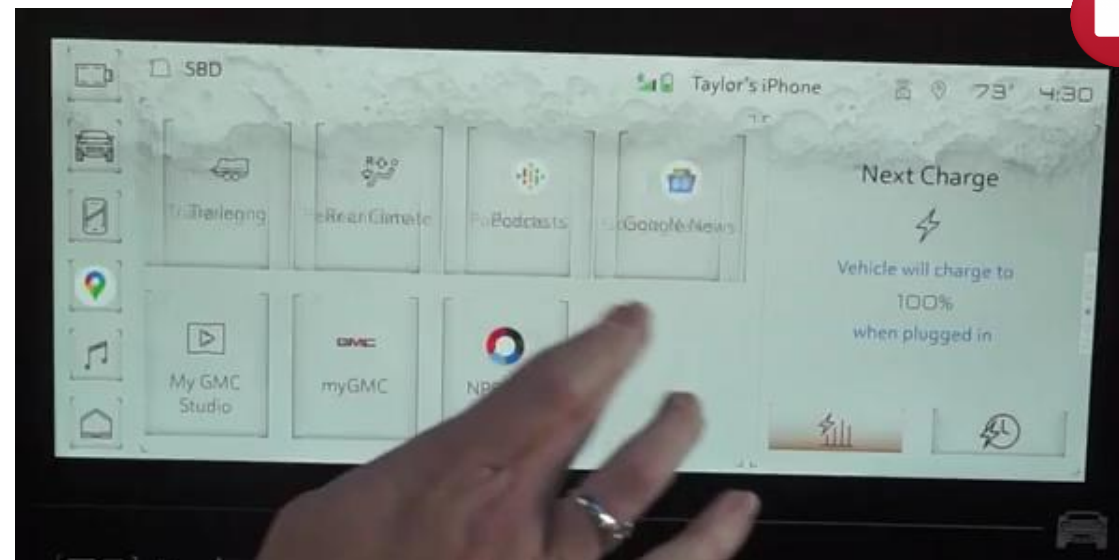


Non-ISO icon used in mirror

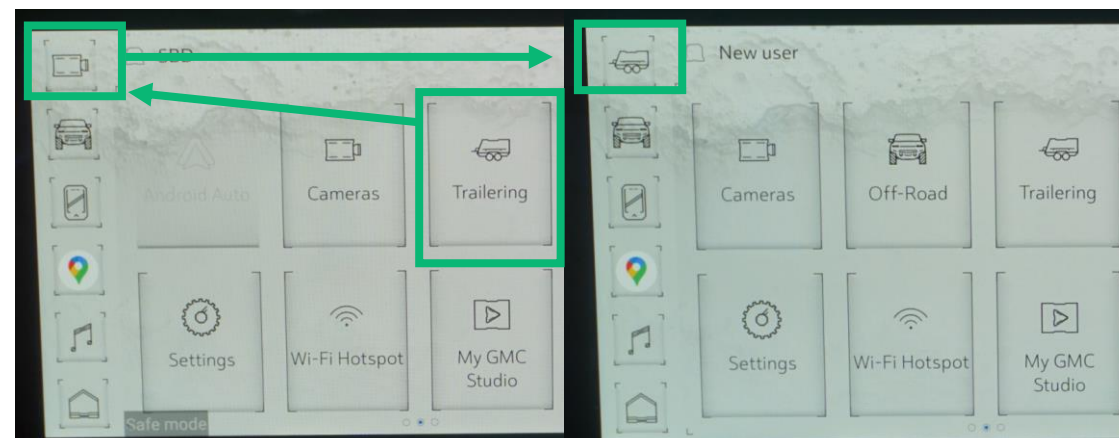


App layout on home screen can be customized

Category	Infotainment				
Description	Customization of apps on home menu creates user convenience				
SBD viewpoint	<p>Users are able to customize the selection of menu shortcuts on the home page and down the left hand side of the central display.</p> <ul style="list-style-type: none">Customization of this menu allows users to choose from features they regularly use and create shortcuts for them within easy reach. This makes for an intuitive and convenient UX.Features such as surround view camera and trailer assist can be configured as a shortcut in the left hand menu bar. This bar is a constant feature across all menus in the central display and so shortcuts on this bar will always be accessible. <p>Customizing the central display with frequently used features and linking this to a user account lets users to personalize their own experience and convenience levels.</p>				
UX impact	Major negative	Minor negative	No impact	Minor positive	Major positive



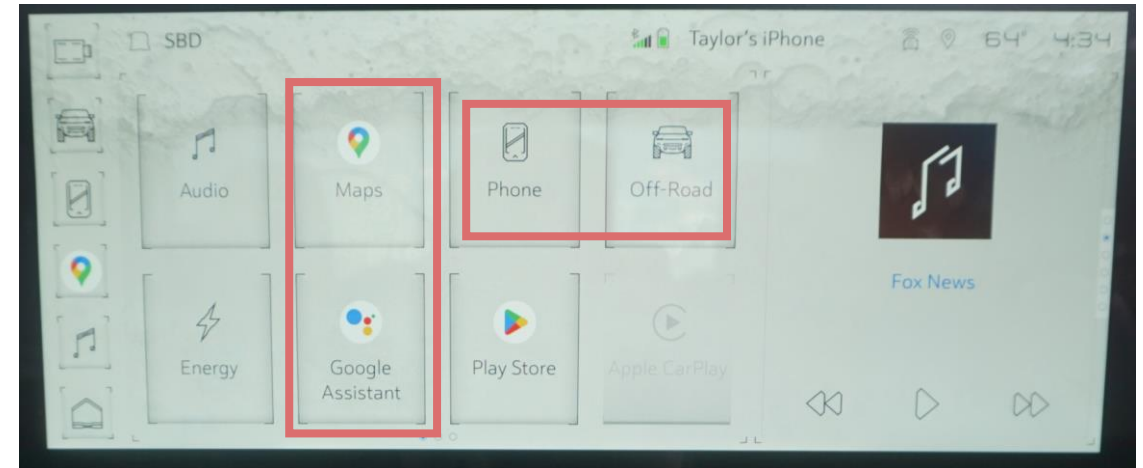
Apps are easily moved around the home screen to the user's preference



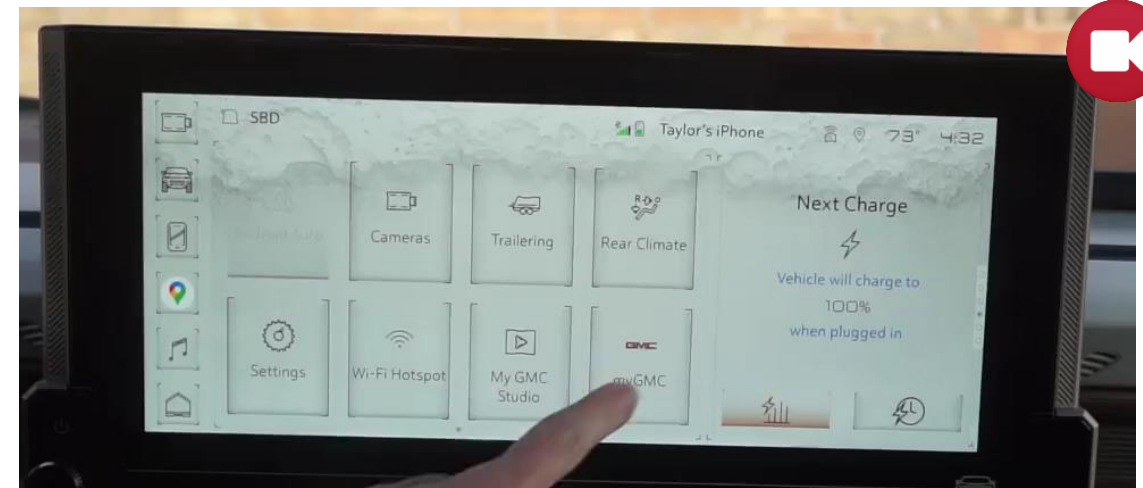
The left-hand side of the central display can be customized

GAS apps and Unreal Engine clash with native system

Category	Infotainment				
Description	Disjointed look and feel throughout system				
SBD viewpoint	<p>Due to poor integration, it is obvious that the infotainment system is composed of a number of different elements, namely the native system, GAS apps, Unreal Engine clips and the instrument cluster.</p> <ul style="list-style-type: none"> The look and feel of the core system is a pale/dark (depending on day/night setting) moonscape background overlaid with flat icons with a sketched appearance. System apps including Google elements of the system use their native icons which conflict harshly with this, resulting in a very disjointed appearance. Unreal Engine has been used for several short sequences within the system such as when activating CrabWalk or switching between drive modes. Unfortunately, the look and feel of the content has absolutely nothing to do with the native system, resulting in the animation looking completely out of place. The transitions to the animation and back to the system are also not smooth, which only makes the inconsistency more pronounced. (See the Unreal Engine graphics here) Some apps e.g., Google Maps and Play Store use their native background (example seen here) which is not consistent with the moonscape and results in the appearance of the app running as a disjointed overlay to the system. <p>Overall, this approach results in a system with very clear 'seam lines' between different elements which are apparent in multiple different areas. This has the effect of lowering the perceived quality of the system and results in a disjointed experience and the impression of a poorly implemented system.</p>				
	UX impact	Major negative	Minor negative	No impact	Minor positive



Google's native icons contrast between surrounding apps



Video: inconsistencies between different sections and poor transitions can be clearly seen





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Garren Carr
North America
garrencarr@sbdautomotive.com
+1 734 619 7969

Luigi Bisbiglia
UK, South & West Europe
luigibisbiglia@sbdautomotive.com
+44 1908 305102

SBD China Sales Team
China
salesChina@sbdautomotive.com
+86 18516653761

Andrea Sroczynski
Germany, North & East Europe
andreasroczynski@sbdautomotive.com
+49 211 9753153-1

SBD Japan Sales Team
Japan, South Korea & Australia
postbox@sbdautomotive.com
+81 52 253 6201