



AAA CENTER FOR DRIVING SAFETY & TECHNOLOGY



2018 VOLVO XC90 MOMENTUM

INFOTAINMENT SYSTEM* DEMAND RATING

High Demand



The 2018 Volvo XC90 Momentum's Sensus Connect infotainment system* placed high demand** on drivers in the study. Lengthy interactions were required to send text messages and engage the navigation system guidance, leading to overall high cognitive (mental) demand.

Standard and Optional Features in the Volvo XC90

	Momentum	R-Design	Inscription	Excellence
○ Optional				
● Standard				
Android Auto	●	●	●	●
Apple CarPlay	●	●	●	●
Mobile App Support	●	●	●	●
Text Messaging	●	●	●	●
Navigation	●	●	●	●
Touch Screen	●	●	●	●
Gesture Control				
Heads-Up Display	○	○	○	●
Voice Commands	●	●	●	●
Console Control				

Additional trim levels available.

ABOUT THE STUDY

Researchers evaluated 2017 & 2018 vehicles' infotainment systems* to measure overall demand** placed on a driver when using voice command, touch screen and other interactive technologies to make a call, send a text message, tune the radio or program navigation, all while driving.

STRENGTHS

- Drivers are only able to reply to text messages in their inbox with the voice command system while driving.

WEAKNESSES

- Drivers are able to dial numbers and access the entire contact list while driving.

* Infotainment System: Vehicle system that combines entertainment and information content

**Overall demand measured: visual (eyes-off road), cognitive (mental), and time-on-task

VEHICLE OVERVIEW: CONTROLS AND DISPLAYS



VOICE COMMANDS



STEERING WHEEL COMMANDS



INSTRUMENT CLUSTER



CENTER STACK

INFOTAINMENT SYSTEM

The Volvo Sensus Connect In-Vehicle Infotainment System offers the following features:

CALLING AND DIALING



A phone can be paired to Sensus Connect through the center stack touch screen interface. Once the phone is paired, the driver can use the steering wheel buttons to scroll through contacts and recent calls and access the keypad on the center stack to initiate a phone call. The driver can alternatively access the touch screen on the center stack or use voice commands to perform any of the aforementioned tasks.

The voice command system allows calls to be made in a one-shot style interaction (i.e., “Call John Doe at work”) without multiple steps required by the system. This style of command allowed drivers to place phone calls in 16 seconds⁺ on average. When making a phone call through the voice command features, the system will read back the driver’s selection for clarification before initiating the call. While interactions were quick, drivers still experienced high cognitive (mental) and visual (eyes-off-road) demand. Researchers[^] noted this could be attributed to drivers looking for visual feedback displayed on the screen.

Drivers were subjected to moderate levels of demand when using the Volvo XC90’s touch screen to place calls and dial phone numbers. There are no motion restrictions on the touch screen so drivers are able to dial numbers and access the entire contact list while driving. Although these functions required high cognitive demand, the ease of access to them allowed drivers to quickly dial numbers and place calls to contacts in 14 seconds⁺ on average. Only moderate visual (eyes-off-road) demand was necessary to perform these functions due to the visibility of phone functions and easily accessible favorite contacts.

TEXT MESSAGING



With a connected phone, drivers can use the voice command system to freely dictate, edit and reply to any text messages in the inbox. Researchers[^] noted that dictation through Sensus Connect is very accurate in interpreting the driver’s message. By prompting the voice command system, drivers have messages read aloud and then have the option to reply. The text message and inbox are not displayed via the touch screen unless prompted by the driver via voice command to view them.

Replying to text messages in the Volvo XC90 placed overall high demand on drivers and took 34 seconds⁺ on average. Drivers can freely dictate a message, which can lead to lengthy interactions and generate high levels of cognitive (mental) and visual (eyes-off-road) demand.

AUDIO ENTERTAINMENT



The 2018 Volvo XC90 Sensus Connect provides access to standard audio sources: FM, AM, SXM radio, CD, USB, auxiliary and Bluetooth audio connectivity. There is limited functionality via the steering wheel, only allowing drivers to complete tasks such as skipping songs or changing the audio source.

The high visual (eyes-off-road) demand drivers experienced using the center stack for audio controls is attributed to an unintuitive and overly extensive menu design. For example, drivers can access audio entertainment via the touch screen by expanding the audio banner. A menu ribbon along the right side of the banner shows menu options for the current selected source. A menu option titled “Library” provides access to favorite presets in radio sources and displays the media library when a media device is selected. In all sources, the library menu allows for free searching using a QWERTY

⁺ Compared to a recommended maximum of 24 seconds

[^] Researchers with expertise about how humans interact with technology evaluated the usability of the infotainment system in stationary vehicle

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keyboard and a draw pad directly on the touch screen. No manual controls, such as a tuning knob complement the touch screen interface; instead, drivers must use the sliding tune bar on the touch screen.

Audio functions, such as skipping a song, changing the radio station and using audio sources like the iPod or radio are accessible via voice commands. Although using voice commands allowed for quick interactions, lasting an average of 17 seconds⁺, Sensus Connect experiences extended lag time, while announcing it is “Searching music and media”, contributing to the high levels of visual (eyes-off-road) and cognitive (mental) demand drivers experienced.

The Volvo XC90’s audio entertainment system generated an overall moderate level of demand on drivers.

TURN-BY-TURN NAVIGATION SYSTEM



The turn-by-turn navigation system is accessible via the center stack touch screen, steering wheel and voice commands. Via the touch screen, the driver can look at recent locations navigated and saved locations, search for locations with keywords and manually input addresses. By using steering wheel controls, the driver can navigate to points of interest such as driver’s home and recent locations. The steering wheel can also be used to cancel navigation and mute guidance options.

While the vehicle is in motion, drivers can access all navigation features including the large category and subcategory menu, manual address input, as well as a full QWERTY keyboard for search functions. Once a desired location is selected, drivers are presented with an abundance of information regarding the destination, such as the address, phone number, longitudinal coordinates and a map preview. Navigating using the multi-step menu structure required drivers to take an average of 28 seconds⁺ to complete a task and experience overall high cognitive and visual demand.

The voice command system allows drivers to search for nearby locations or points of interests. Drivers can quickly find locations by saying “Find POI” followed by the desired category or name of the establishment. The Sensus Connect system often inaccurately processed commands and was prone to errors. For example, when searching for a category, it may default to searching for locations with the exact name of the category (i.e., only displaying an establishment named “The Grocery Store” rather than all grocery stores in the proximity). In many cases, this provides locations far outside the vehicle’s vicinity. Researchers[^] noted that the error-prone system and inaccurate processing can lead drivers to have lengthy interactions times – 38 seconds⁺ on average – and to experience high levels of cognitive (mental) and visual demand.

VEHICLE CONTROLS AND DISPLAYS

VOICE COMMANDS

The 2018 Volvo XC90 comes equipped with a voice command system that allows drivers to access audio entertainment, text messaging, phone calls and navigation. Pressing the designated voice command button on the steering wheel activates the system, which greets the drivers with a beep in lieu of an introduction. When the voice command system is ready to listen, an icon will appear on the forward display prompting the driver to begin speaking.

INSTRUMENT CLUSTER

The instrument cluster located behind the steering wheel features a 12.3-inch display with two large circular LCD gauges, containing a speedometer, odometer, tachometer, fuel gauge and the vehicle’s current gear. The gauges on the display are dynamic, moving around as functions are accessed and engaged. Drivers can access trip information, media sources, recent phone calls and recent navigation on this display using the directional pad on the steering wheel. Voice commands and newly played songs also appear on this display.

⁺ Compared to a recommended maximum of 24 seconds

[^] Researchers with expertise about how humans interact with technology evaluated the usability of the infotainment system in stationary vehicle

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STEERING WHEEL CONTROLS

The steering wheel contains 14 buttons, seven on each side. The button on the right side can be utilized by rocking it up or down to access voice commands and the menu. Following distance can be adjusted by using the mirroring left side rocker. Pilot Assist and cruise control functions can be accessed via the four-point rocking button on the left side of the steering wheel. The other four-point rocking button acts as a directional pad and can be used to scroll through menus.

CENTER STACK

The center stack is equipped with a 9.2-inch full-color touch screen providing the driver information about time, navigation, audio entertainment, phone connectivity, phone calling and HVAC information. The touch screen is angled upwards and can become hot from facing direct sunlight, which makes the driver experience uncomfortable. Beneath the touch screen there is a manual home button along with a standard hazard button, defrosters, volume, seek/skip and play/pause.

The home screen is organized into expandable and collapsible banners that are inconsistent and do not follow platform conventions. Each menu expands to show a small submenu formatted in a ribbon on the left side of the screen. Unused banners are collapsed but are still visible and show minimal information. Each banner is color coordinated; however, the colors are muted.

HVAC information is displayed along the bottom of the touch screen with dual climate controls. There are two manual buttons for front and rear defrost, with all other functions housed on the touch screen. Drivers can tap on their respective side's temperature to adjust via a scrolling temperature bar. Seat heaters (and the steering wheel on the driver's side) can be turned on and set to three different temperatures by tapping the icons. Dual controls are limited to seat heaters and temperature, and a five-level fan speed and airflow options are available in an unconventional format on the touch screen.

VEHICLE SALES SUMMARY

The 2018 Volvo XC90 is the 123rd bestselling vehicle in the United States, with 31,609 vehicles sold in 2018¹.

¹ Source: Auto sales data and statistics at goodcarbadcar.net; data updated to 1/04/2019.

+ Compared to a recommended maximum of 24 seconds

^ Researchers with expertise about how humans interact with technology evaluated the usability of the infotainment system in stationary vehicle

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