



## AAA CENTER FOR DRIVING SAFETY & TECHNOLOGY



### 2017 TESLA MODEL S 75



### INFOTAINMENT SYSTEM\* DEMAND RATING

#### Very High Demand



The Tesla Model S 75 infotainment system generated a very high demand rating in the study. The system was very highly demanding on drivers when placing phone calls, tuning the audio system and programming the navigation. Interacting with the infotainment system leads to very high distraction from the forward roadway.

Standard and Optional Features in the 2017 Tesla Model S

○ Optional

● Standard

	75	75D	100D	P100D
Android Auto				
Apple CarPlay				
Mobile App Support	●	●	●	●
Text Messaging				
Navigation	●	●	●	●
Touch Screen	●	●	●	●
Gesture Control				
Heads-Up Display				
Voice Commands	●	●	●	●
Console Control				

### ABOUT THE STUDY

Researchers evaluated 30 new 2017 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 down the road.

### STRENGTHS

- Voice system accepts a wide range of intuitive phone-related commands and processes them quickly.

### WEAKNESSES

- While the car is in motion, drivers can search the internet.
- Using voice commands to place a call takes longer than recommended.
- With extensive information displayed, the touch-screen audio menu and internet radio submenus can be difficult for drivers to efficiently search.

\* 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 Tesla In-Vehicle Infotainment System offers the following features:

## CALLING AND DIALING



The Tesla Model S 75 infotainment system allows drivers to dial numbers and call contacts using voice commands or the center stack when a phone is paired over Bluetooth. The touch screen displays step-by-step pairing instructions that make it easy for drivers to pair a phone. Some limited phone functionality is also available using steering wheel buttons. The Model S does not restrict any phone functionality while in motion, leaving the phonebook and dial pad fully accessible to drivers.

Drivers using either voice commands or the center stack touch screen to place phone calls were met with very high demand. Using voice commands took drivers 31 seconds<sup>♦</sup> on average to complete the phone task, and imposed high cognitive (mental) demand and very high visual (eyes-off-road) demand. Researchers<sup>^</sup> found dialing a number via voice commands to be a frustrating and error-prone process, with the system often cutting off the voice input even if there were no pauses in speech. The voice commands also do not differentiate between types of numbers. For example, if a contact had a mobile and work number, drivers could not use voice commands to specify calling the work or mobile number (e.g. “call Jon Smith work”). Instead, a driver must use steering wheel buttons to scroll through available numbers.

Although drivers were able to call a contact and dial a number quickly using the touch screen, they did so at the cost of very high visual (eyes-off-road) and high cognitive (manual) demand. While the 17-inch touch-screen size is impressive, especially with its quick response to manual input, an excessive amount of information is accessible on the screen. For example, drivers are able to scroll through the full contacts list.

## AUDIO ENTERTAINMENT



The audio entertainment system includes: AM and FM radio; Bluetooth; and live streaming from the internet via the Slacker Radio application. The Slacker Radio application allows drivers to create customized radio stations as well as play individual song selections. The center stack touch screen provides access to all audio sources, while voice commands give access only to Slacker Radio. The touch screen presents each Slacker Radio station as a thumbnail with a radio station logo or album cover. To play an AM or FM radio station, drivers must use the touch screen frequency tuning bar or preset favorites.

Selecting a new audio source using either voice commands or the touch screen required very high levels of visual (eyes-off-road) demand. While the large touch screen may be aesthetically appealing, presenting dense visual information with many options led to increased visual and cognitive demand on the driver.

According to on-road data, drivers using voice commands to control the audio entertainment were met with high cognitive (mental) and very high visual (eyes-off-road) demand, and tasks themselves were lengthy to perform. Drivers had difficulty using the voice commands to control the Tesla’s Slacker Radio due to the setup of the internet radio interface. Researchers<sup>^</sup> noted the system will either play the actual song requested or will create a radio station instead, an inconsistency that may frustrate drivers.

<sup>♦</sup>Compared to a recommended maximum of 24 seconds.

<sup>^</sup>Researchers with expertise about how humans interact with technology evaluated the usability of the infotainment system in stationary vehicles.

## INFOTAINMENT SYSTEM (CONTINUED)

### AUDIO ENTERTAINMENT (CONTINUED)

Likewise, audio entertainment tasks using the touch screen were time-consuming and imposed very high cognitive (mental) and very high visual (eyes-off-road) demand. Tuning AM and FM stations required prolonged visual attention and precise manual selections as drivers attempted to drag their finger along the small tuning bar to the desired radio station. When using the Slacker Radio application, drivers typed in their desired selection with a full-onscreen keyboard and then searched through several sub-categories to find the desired media.

### TURN-BY-TURN NAVIGATION SYSTEM



The turn-by-turn navigation system, powered by Google Maps®, provides directions to selected addresses and points of interest via voice commands and the center stack touch screen. When navigation is active, directions also display on the instrument cluster. In addition to offering standard turn-by-turn directions, Tesla navigation also shows electric charging stations along the route and automatically directs the driver to those stations if the vehicle does not have enough battery to arrive at the destination. Navigation options are not locked out while driving.

In the on-road study, drivers incurred overall very high levels of demand when using the navigation system. Using voice commands to control navigation led to long task times, 23 seconds♦ on average, and high visual demand. The Google Maps® interface is familiar to many drivers and visually similar to many smartphone applications for navigation. However, the system only accepts a limited number of voice commands to access navigation. Once a driver gives a command, they are directed to the touch screen to complete their selection, and are sometimes required to select from up to 20 destination choices.

Using the touch screen to access navigation functions placed high cognitive (mental) and very high visual (eyes-off-road) demand on drivers and led to lengthy task times, an average of 26 seconds♦. As drivers searched for a destination with the touch screen, the map and selections were occasionally slow to load. Similar to voice commands, when using the touch screen, drivers were required to select from up to 20 different destinations in order to begin navigation.

Once the navigation system was accessed, the cloud-based speech engine did allow for natural and familiar address entry using voice.

♦ Compared to a recommended maximum of 24 seconds.

## VEHICLE CONTROLS AND DISPLAYS

### VOICE COMMANDS



The Model S includes a voice system that allows drivers to access calling and dialing, audio entertainment and turn-by-turn navigation with spoken commands. Drivers can activate the voice system by pressing the designated voice command button on the steering wheel. Unlike similar systems in many other vehicles, the voice system does not reply in a synthetic voice but displays its status and responses on the instrument cluster. This feature includes a speech-to-text function which displays the exact voice input it received onto the cluster display, similar to a Google voice search.

### INSTRUMENT CLUSTER



The instrument cluster, located behind the steering wheel, consists of a 12.3-inch full-color display accessible via steering wheel buttons. The screen displays vehicle information, including a digital speedometer, advanced driver-assistance systems, audio entertainment and vehicle status across three different, though seamlessly connected, sections. Each section displays highly detailed and interactive graphics.

### STEERING WHEEL CONTROLS



The steering wheel has six buttons and dials that provide access to the cluster display, audio entertainment and the voice recognition system.

### CENTER STACK



The center stack contains a 17-inch full-color touch screen that houses controls for the vehicle's phone, audio entertainment and turn-by-turn navigation systems, as well as a wide selection of other controls, such as a calendar, internet browser and backup camera. Drivers can navigate through different submenus using the upper menu and select climate settings using the lower menu. The touch screen offers advanced functionality, including a split-screen feature that lets drivers view two menus at once.

## VEHICLE SALES SUMMARY

The 2017 Tesla Model S is the best-selling vehicle in the Electric Vehicle segment (137th best-selling vehicle overall), with 29,421 units sold during 2016<sup>1</sup>.

<sup>1</sup> Source: Automotive News at [autonews.com](http://autonews.com); Wall Street Journal at [wsj.com](http://wsj.com); Forbes at [forbes.com](http://forbes.com); FleetCarma at [fleetcarma.com](http://fleetcarma.com) – data updated to 6/25/2017.