

FINAL REPORT

**FOCUS GROUPS IN SUPPORT OF AN OPERATOR DROWSINESS
MONITORING SYSTEM**

**US DOT University Transportation Center
ITS Implementation Center Research Project**

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INTRODUCTION

Project Overview

According to National Safety Council figures, motor-vehicle-related crashes were the leading cause of unintentional death in the United States from 1969-2005 (National Safety Council, 2007). A common cause of motor-vehicle-related crashes is falling asleep while driving (Reyner & Horne, 1998). The Virginia Tech Transportation Institute (VTTI) is working on a Federal Motor Carrier Safety Administration (FMCSA) funded study to develop a prototype Operator Drowsiness Monitoring System (ODMS) to quantify driver drowsiness and provide a real-time warning to truck drivers when they become drowsy.

It is envisioned that cameras, sensors, and a driver-system interface will be integrated into a single unobtrusive unit. This ODMS will use an algorithm to determine if a driver is drowsy and then provide an alert to the driver or vehicle in sufficient time to mitigate or prevent a drowsiness-related crash. The purpose of this focus group project was to gather information from users (i.e., commercial motor vehicle (CMV) drivers) that can be used to develop the ODMS. The ODMS will be used by CMV drivers who work within the organizational, technological, and environmental subsystems that impact how they carry out their jobs. For this reason, a socio-technical system (STS) approach or model was used to provide a better understanding of CMV driver perceptions. Driver opinion of the ODMS and the systems in which they will operate was also studied. Gaining this insight is critical in designing an ODMS that is accepted and trusted by CMV drivers.

Driver Drowsiness

Two focus groups were conducted to gather information on, among other things, drowsiness experienced by CMV drivers and how various elements of their job (i.e., driver behavior, organizational design, technologies, and environment) affect the potential countermeasures they choose to combat drowsiness. As drowsiness is the impairment being explored, it is important to have an operational definition of drowsiness and to distinguish it from fatigue, as these terms are often used interchangeably.

Drowsiness is defined as “feeling abnormally sleepy during the day – often with a strong tendency to actually fall asleep in inappropriate situations or at inappropriate times.”(National Institutes of Health [NIH], 2006). Drowsiness can be caused by medications, sleep deprivation, sleep disorders or other medical conditions (NIH, 2006). Drowsiness is also tied to a natural occurrence in the human body called the “circadian rhythm.” The human body functions on a 24-hour circadian rhythm and most people experience two sleepy periods: (i) the first during the middle of the night and (ii) the second between 2:00 to 4:00 p.m. (Stutts, Wilkins, & Vaughn, 1999). An illustration of the circadian rhythm is shown in Figure 1 (cited in Olson, 2006; p.6).

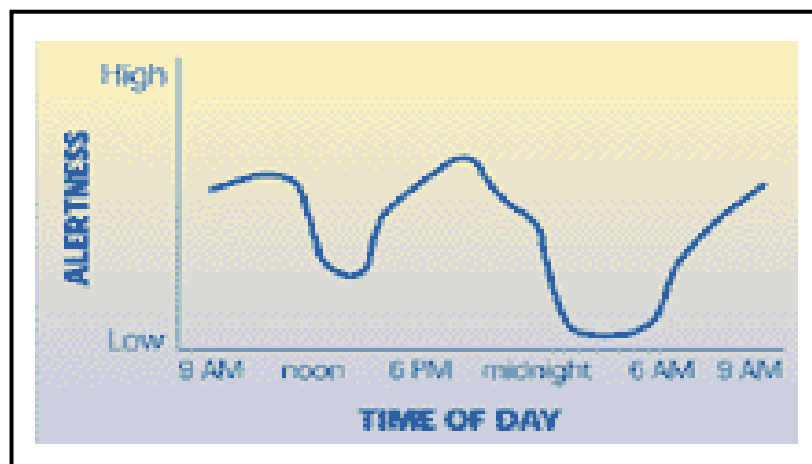


Figure 1. Average circadian rhythm pattern for humans.

Many sleep-related crashes occur during these two drowsy periods. For instance, a recent naturalistic driving study by Olson (2006) found there were more drowsiness-related critical incidents between 2:00 and 2:59 p.m. than during other time periods. Drowsiness adversely affects driving performance in numerous ways. For example, when a driver becomes drowsy, he or she may become inattentive and allow his or her vehicle to drift (Eberhart, Hu, & Foresman, 2000).

Fatigue is technically different than drowsiness though it can manifest itself with some of the same adverse effects behind the wheel. Fatigue is defined as “a lack of energy and motivation” (NIH, 2006) or “a subjectively experienced disinclination to continue performing the task at hand” (Brown, 1994; p. 298). Fatigue can be physical or psychological. For example, a short-haul trucker who must load and un-load his or her truck numerous times during a shift could

experience physical fatigue. Conversely, a long-haul trucker who must drive long distances at night may experience mental fatigue. Among other problems, fatigue can reduce driver vigilance and increase driver reaction time to critical incidents (Hanowski, 1998).

While a person can become fatigued without being drowsy, physically or mentally demanding tasks can reveal a person's level of sleepiness. For example, Roth, Roehrs, Carsadon, and Dement (1994) observed that "heavy meals, warm rooms, boring lectures, and the monotony of long-distance automobile driving unmask the presence of physiological sleepiness but do not cause it" (cited in Stutts, Wilkins, & Vaughn, 1999; p. 7). Thus, while driver fatigue and drowsiness are somewhat related and both cause progressive loss of attention to the road and traffic demands (Brown, 1994), the focus of this project was on the causes of driver drowsiness and drowsiness countermeasures rather than driver fatigue.

Socio-Technical Systems (STS)

The ODMS will be used by CMV drivers who work within certain organizational, technological, and environmental subsystems, which will in turn impact how they perform their jobs. For this reason, an STS approach or model was used to better understand the internal and external stressors that impact the CMV drivers who will be using the ODMS.

The STS model, as defined by Hendrick and Kleiner (2001; as cited in Olson, 2006),

“...views organizations as transformative agencies; they transform inputs into outputs. Sociotechnical systems bring three elements to bear on this process: a technological subsystem, personnel subsystem, and a work system design consisting of organizational structure and processes. These three elements interact with one another and the external environment in which the organization depends for its survival and success.” (p. 73)

According to this definition, the STS model can be broken down into four subsystems:

(i) technology, (ii) driver, (iii) organizational design, and (iv) environment (Figure 2).

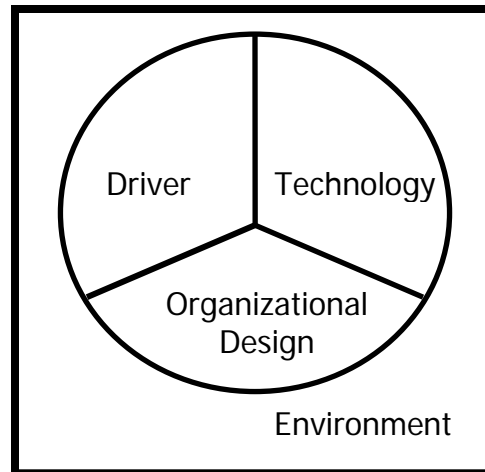


Figure 2. Socio-technical systems model.

These subsystems do not function independently but have a reciprocal influence. For example, the flexibility of the fleet's sleep hygiene policy (organizational design) impacts the driver's ability to rest as needed (driver). Consider a fleet policy that does not allow drivers to nap when needed. An example of this situation was found in the FMCSA-sponsored Local/Short Haul study (Hanowski, Wierwille, Garness, & Dingus, 2000). In this study, the driver's ability to get restorative rest was impacted (i.e., not facilitated) by company policy.

This focus-group study used the STS model as a framework for organizing and exploring important issues such as company napping policies and how they impacted the ability of the driver to rest. Table 1 briefly describes each of the subsystems of the STS model and provides project-related examples.

Table 1. Description and project-related examples of the four STS subsystems.

Subsystem	Description	Project-Related Examples
Technology	Tools and machines used in the work process (Daft, 1995).	Machines used to stay alert (e.g., radio, air conditioning).
Driver	Characteristics of drivers operating the trucks (i.e., degree of skills/training required, cognitive complexity of work performed, personal factors) (Hanowski, 1998).	(1) Personal factors (e.g., sleep habits, medical conditions). (2) Techniques used to stay alert (e.g., drinking coffee, napping). (3) Training/education on the importance of not driving while drowsy and on proper sleep hygiene.
Organizational Design	Structure of an organization including the management system (i.e., who is managed, what is managed, and what is used to manage) (Hanowski, 1998).	Fleet policies and practices (e.g., formal and informal napping policy, scheduling practices).
Environment	External forces such as economics, competition, politics, and legalities (Hanowski, 1998).	(1) Federal policies and regulations (e.g., hours-of-service regulations). (2) Access to safe and quiet places to sleep.

Interview Guide

The STS model was used as a framework for developing questions in the Interview Guide for the focus groups. Some of the primary issues regarding drowsiness and drowsiness countermeasures found in the literature are cited in the table in Appendix A. The information in this table is organized by STS subsystem and contains some of the questions that were incorporated into the Interview Guide to address issues found in the literature. These questions served as a springboard for open discussions with focus-group participants regarding the countermeasures they used to combat their drowsiness and the reasons they may continue to drive when they are drowsy.

The data gathered during the focus groups will affect the development of the ODMS. The goal of using the STS model was to help the researchers who are developing the ODMS to achieve “joint optimization” between the ODMS and CMV drivers. Joint optimization is a process by which “social and technical systems are designed to fit the needs of one another” (Daft, 1995; p. 148). The focus groups generated information that can now be used to develop an ODMS that more accurately reflects the behaviors, circumstances, and decisions of CMV drivers.

METHODOLOGY

The approach to conducting the focus groups followed a simple four-step process. The steps included:

1. Identify sample of potential focus-group participants
2. Recruit participants for focus groups
3. Conduct focus groups
4. Transcribe and analyze data

Each of these steps is briefly described below.

Identify Sample of Potential Focus-Group Participants

Potential participants were identified using an internal VTTI participant database (they either consented to participate in prior VTTI studies or indicated a desire to participate in future VTTI studies.) Snowballing was also used to recruit new participants not identified in the VTTI database (i.e., during the screening process, truck drivers were asked if they knew other truck drivers who might be willing to participate in the focus-group meetings).

Regional and long-haul drivers were targeted for the focus groups as it was believed these drivers had the most experience driving long distances and driving at night. For the purposes of the focus groups, a regional driver was classified as someone who made deliveries 200 to 500 mi away from his or her home base, while a long-haul driver was classified as someone who made deliveries more than 500 mi from his or her home base. This classification was based on categories from the 1997 Vehicle Inventory and Use Survey published by the U.S. Census Bureau (1997; as cited in Williams, Allen, Lepofsky, Murray, Wahl, Vercoe, Keppler, & Moses, 2004; p.B-3). The census categories were slightly modified to simplify the screening process for these focus groups (Table 2).

Table 2. Range of operation definitions.

U.S. Census Category	Number of Miles	Focus Group Category	Number of Miles
Long range medium	201-500	Regional	200-500
Long range	More than 501	Long Haul	More than 500

Two focus groups were scheduled to be held at VTTI on different days; one for regional drivers and one for long-haul drivers. During recruitment, participants were classified and assigned to either the regional or the long-haul focus group depending upon the length of their current delivery routes as shown in Table 2.

Recruit Participants for Focus Groups

Drivers from the VTTI database were contacted by researchers via telephone. A consistent standardized screening protocol (Appendix B) was used by researchers to screen potential focus-group participants. During the screening call, potential participants were briefly informed about the purpose of the study, length of participation required (approximately 2.5 h), and compensation (\$80 cash). After answering questions, the researcher asked potential participants several screening questions. To participate in the focus groups, all drivers had to meet the following criteria: (i) be currently employed as a long-haul or regional truck driver (see definition above), (ii) hold a valid Class A Commercial Drivers License (CDL), (iii) be available during the time the focus groups were held, and (iv) be able to speak and understand the English language. Drivers who did not meet these criteria were thanked for their time.

A total of 140 people were called via the telephone. Of these, 15 (10.7 percent) agreed to participate. Of the 125 people that did not agree to participate in the focus groups, 63 people (50.4 percent) did not meet one or more of the study requirements, while the remaining 62 people (49.6 percent) refused to participate, no longer resided at the phone number listed, did not return the researcher's call, or returned the researcher's call after the focus group session had been filled. Only one driver recruited from the participant database agreed to ask a friend if he or she would like to participate. This driver gave the researcher the names of two co-workers he thought would be interested in participating. Of the two names collected via snowballing, only one driver met the screening criteria and agreed to participate.

Individuals who agreed to participate in the focus groups were sent a confirmation letter (Appendix C) including directions to the focus group site, time of the focus group, the type of refreshments provided, and information about compensation. Two days prior to each focus group, participants were called and reminded of the time of the focus group.

Of the 16 people recruited for the focus groups, a total of 13 people (81 percent) participated. Two participants did not attend the long-haul group and one did not attend the regional group. One driver alerted the research team in advance that he would be unable to attend, while the other two participants did not provide a reason for missing the session.

Conduct Focus Groups

The two focus groups were held on different days in a conference room at VTTI in Blacksburg, VA. Each focus group lasted 2.5 h. Participants were greeted and escorted to the designated VTTI conference room. Six male drivers participated in the long-haul focus group, while seven male drivers participated in the regional focus group.

Focus-group participants were given an Informed Consent Form (ICF) (Appendix D) and asked to read the ICF and voice any concerns or questions to the researcher. All participants agreed to the terms of participation and signed the ICF. A copy of the signed ICF was also given to participants to take home. Participants were reminded that they may refuse to answer any questions and leave at anytime.

During the 2.5-hour focus group, researchers followed an Interview Guide (Appendix E). Both focus groups used the same Interview Guide. The first 15 min of each focus group were spent on greetings and logistics (e.g., ICFs, purpose of the meeting, confidentiality commitment on the part of VTTI, logistics, and ground rules). The remainder of each focus group was divided into six parts, described below:

- **Part 1: Typical Work Day.** Participants were asked questions about their typical 24-hour work day (i.e., when do you sleep, what hours do you work etc.?)
- **Part 2: Countermeasures.** Participants were asked to discuss strategies they use to stay awake and were then asked to place these strategies in the order in which they would use them.
- **Part 3: ODMS Warning.** Participants were given background information on an ODMS. Then they were asked to imagine the ODMS in their truck cab and to describe what the ODMS would need to “do” or “say” to get them to pull over when the ODMS

warned them of drowsiness. Researchers collected these ideas and had participants rank their top ideas.

- **Part 4: ODMS Barriers.** Again, participants were asked to imagine the ODMS in their truck cabs. However, this time they were told to imagine a situation where the ODMS alert occurred while they were driving down the road at the end of a long day. Participants were asked to indicate what would prevent them from pulling over and seeking rest. Participants were then asked to group their ideas into common themes and rank the top idea that would prevent them from pulling over.
- **Part 5: ODMS Demonstration.** Participants were shown a potential prototype of the ODMS located in a truck cab and then asked to voice any concerns regarding the device (i.e., its location in the cab, etc.).
- **Part 6: Commercial Vehicle Driver Questionnaire.** Participants were given a brief questionnaire (Appendix F) that assessed the prevalence of drowsiness during a typical work day.

Transcribe and Analyze Data

The focus groups were audio recorded as a backup to researcher notes and written comments from participants. Tapes were made into transcripts but no individual names were attached to any comments. Tapes were erased after analysis was completed.

Data analyses, where applicable, followed the STS model (Figure 2). Results from Part 4 (ODMS Barriers) and the last question of Part 6 (Commercial Vehicle Driver Questionnaire) were analyzed using the STS model subsystems: (i) technology, (ii) driver, (iii) organizational design, and (iv) environment.

In Part 4 (ODMS Barriers), participants were asked what, if anything, would prevent them from pulling over if the ODMS warned them they were drowsy. Responses were categorized by driver, technology, organizational design, or environmental barriers. By using the STS model, researchers gained a better understanding of what types of barriers may prevent drivers from pulling over and resting once they have received a warning from the ODMS that they are drowsy.

The last question of Part 6 (Commercial Vehicle Driver Questionnaire) was considered, in part, using the STS model. Participants were asked at the end of their questionnaires if they had any thoughts or ideas they would like to share with researchers regarding the ODMS. The types of issues raised by participants were categorized and analyzed, where possible, by STS subsystems.

RESULTS

Researchers analyzed the written responses of the participants on the questionnaire and activities during the focus groups, as well as their oral responses on the transcripts. The results gleaned from these data sources are described below.

Part 1: Typical Work Day.

Participants were asked questions about a typical 24-hour work day (e.g., how long do you sleep, how long a break do you take?). A list of responses to these introductory questions is found in Appendix G. While the introductions were intended to serve primarily as a warm-up, questions were also designed to explore the sleep and break habits of the participants. A discussion of the participants' sleep and break habits is provided below.

The duration of sleep per day during the work week varied considerably among participants (Table 3). Participants were asked about hours of sleep per day because it was assumed that some of the participants would be working at night and sleeping during the day. One participant described an irregular sleep pattern indicating that he 'catnapped' 45 min each day for 2 to 3 days and then slept 8 to 9 h before beginning his catnapping pattern again.

Table 3. Hours of sleep participants said that they got per day during a typical work week.

Participant	Hours of sleep per day	Average Hours
P1	5-6	5.5
P2	3-5	4
P3	no more than 6	6
P4	5-7	6
P5	5-6	5.5
P6	Catnap (45 min) for 2-3 days and then sleep 8-9 hours and get up and start cycle again	N/A
P7	5-6	5.5
P8	6-7	6.5
P9	5-6	5.5
P10	No answer	N/A
P11	6-8	7
P12	4-6	5
P13	6-7	6.5

Figure 3 is a scatter graph of the approximate hours of sleep that participants said that they received per day. In this graph, participant responses from Table 3 are averaged (i.e., 5 to 6 h of

sleep is averaged to 5.5 h of sleep). The participant who said he catnapped is not included in this graph.

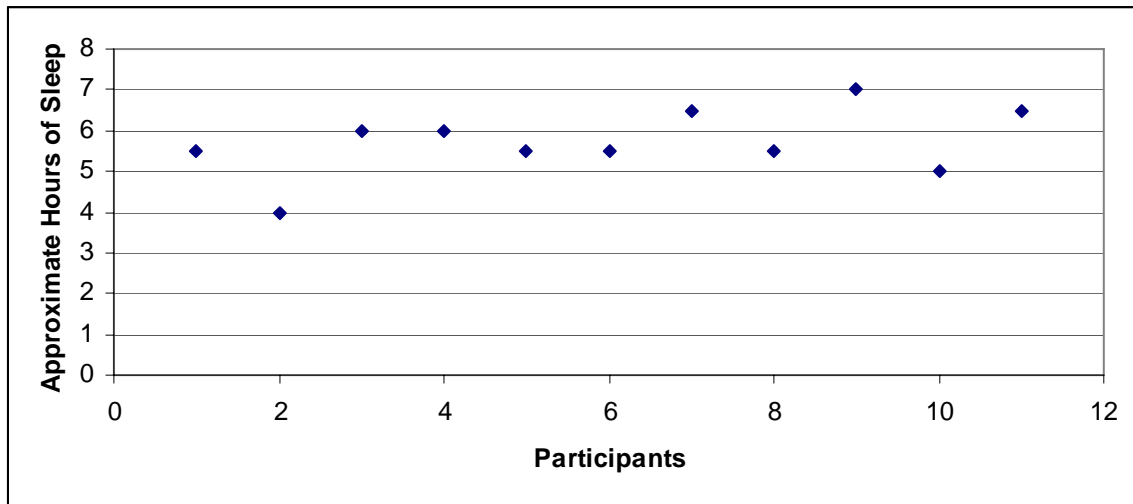


Figure 3. Approximate hours of sleep participants received per day.

Based on these responses, only one participant averaged enough sleep per day based on the recommendation by the National Sleep Foundation. Most adults require 7 to 9 h of sleep per day. When people do not get adequate sleep, they accumulate sleep debt which can cause safety problems on the road (National Sleep Foundation, n.d.).

Participants were also asked during the focus group introductions to describe their typical break patterns (i.e., how long they drove before they took a break and how long a break they took). Only one participant mentioned using his breaks to nap or sleep. This particular driver said he scheduled nap breaks as part of his regular work shift. He also planned his nap breaks during times that he knew he was likely to be drowsy. This driver was the exception; most participants said that they took short breaks (30 min or less) only when necessary to use the bathroom, fuel up, or have a meal.

Part 2: Countermeasures.

Participants were asked to discuss the countermeasures or strategies they used to stay awake when they were drowsy while driving. A ranking of the countermeasures used by participants is found in Table 4. The number-one strategy mentioned by 69 percent of participants was the use of stimulant or energy drinks (i.e., coffee, soda) to stay awake. Other popular strategies

mentioned by roughly half of the participants (46 percent) included rolling down the window, adjusting the radio, talking on the CB, and getting out of the truck and walking.

Table 4. Countermeasures used to stay awake when drowsy.

Rank	Strategy	Total	Percentage
1	Have Stimulant/Energy Drink (coffee)	9	69%
2	Get Fresh Air (roll down window)	6	46%
	Adjust Radio (turn up, change station)	6	46%
	Talk on CB (run with another truck)	6	46%
	Get out and walk (around truck, to restroom, do safety check)	6	46%
3	Eat snack	4	31%
4	Turn up AC	3	23%
5	Cat nap (15 to 20 min)	2	15%
	Chew gum or ice	2	15%
	Talk to self and/or play mile games (e.g., work out miles to destination in my head)	2	15%
6	Sleep 2 h	1	8%
	Eat candy (sugar)	1	8%
	Have cold drink	1	8%

Few of the strategies mentioned by participants, such as listening to the radio or adjusting the air conditioning, work well for anything except mild sleepiness (Eberhart et al., 2000). Only two participants mentioned napping, a strategy that might be an effective countermeasure to maintain performance in individuals with limited sleep (Eberhart et al., 2000). Only one participant said that he pulled over and slept for 2 h when he got very drowsy. He called this strategy the “final result” as this was the final strategy he used to cope with his drowsiness.

Part 3: ODMS Warning.

During Part 3, participants were given background information on an ODMS and shown a demonstration model of the eye-closure monitoring technology. They were asked to imagine that the ODMS was in their truck cabs and to describe what the ODMS would need to “do” and/or “say” to get them to pull over when the ODMS warned them that they were becoming drowsy while driving. Though researchers did not provide either group with suggestions for how the ODMS should operate, both the long-haul and regional groups came up with similar scenarios for what the ODMS needed to “do” and/or “say” to get them to pull over. Below is a brief description of the scenarios provided by each of the focus groups.

- **Long-Haul Scenario:** The long-haul focus group concluded that when drowsiness is first identified by the ODMS, an alarm should sound. This alarm should start off softly (e.g., like a ring tone) and continue to get louder until it sounds like a siren or horn. Then, if the driver ignores multiple warnings, after 15 to 20 min of sounding the alarm, the truck should shut down. Participants said that an override needs to be available in case there is no safe place to pull off.
- **Regional Scenario:** The regional focus group concluded that when drowsiness is first identified by the ODMS, an annoying or uncomfortable alarm or voice should come on in their cabs that can not be shut off until they engage the parking break of the vehicle. Once the parking break is engaged, the truck should be disabled for a certain period of time or until, via technology, it can be determined that the driver is alert enough to drive.

Results from Part 3 should help the researchers developing the warning system for the ODMS. The two focus groups were consistent in wanting a warning that was ongoing and increasingly loud or annoying. Audible alarms and horns were popular options although other ideas were voiced including “flashing lights” and “a puff of air.” One participant said the system “should have an audible alert and then a visual alert.”

Part 4: ODMS Barriers.

Participants were asked during Part 4 to imagine the ODMS in their cabs. However, this time they were told to imagine a situation where the ODMS alert occurred while they were driving down the road at the end of a long day. Participants were asked to indicate what would prevent them from pulling over and resting.

During this activity, participants were first asked to brainstorm and compile a list of all of the barriers that would prevent them from pulling over. After brainstorming, the ideas were grouped into clusters of common ideas. Appendix H provides a listing of all of the ideas from the brainstorming session by focus-group type (i.e., regional versus long-haul). Table 5 is a combined (i.e., regional and long-haul) listing of all of the ideas from the brainstorming session shown as the participants’ wrote them, labeled by cluster, and organized by STS subsystem.

Table 5. Barriers to pulling over by STS subsystem.

STS Subsystem	Cluster	Brainstorming Idea
ENVIRONMENT	No place to park	Where do you park?
		No where to pull off
		Two lane road, can't stop
		Charge money for parking
		No parking available in truck stops
		Lack of truck parking
		No place to stop
		Would have to be a safe and legal place
		No safe place
		No room in rest area or truck stop
		No parking in a big city
		Lack of places to stop
		No place to stop
		Legal parking area
	Hours of Service	Hours of Service
		Hours on duty screwed up
		Up against your hours
	Parking Tickets	Fear of retaliation from local law enforcement
		State police \$80 ticket parking on/off ramp
		Getting a ticket
	Prostitutes	Prostitutes
Lot Lizards beating on door		
Weather	Weather—don't want to get stuck in bad weather	
Traffic	Traffic—can get sleepy in heavy traffic	
Placarded Load	Placarded load unable to park (hazmat)	
ORGANIZATIONAL DESIGN	Being on Time	Load has to be there
		Shippers hold us up
		Load needs to be delivered
		Is load going to be delivered on time?
		Service—need to get package to next person for delivery
		Truck waiting for you
	Time of delivery	
Company Monitors	Company Monitors	
TECHNOLOGY	False Alarm	Not being sleepy and get a false alarm
DRIVER	Family Emergency	Family Emergency

As can be seen in Table 5, participant ideas covered each of the subsystems in the STS model with the majority of the comments falling under the Environmental subsystem (Figure 4). Environmental barriers to pulling over ranged from having no place to park to being stuck in traffic. Several of the barriers mentioned fell under the subsystem Organizational Design. These responses dealt mainly with feeling pressure from trucking companies and shippers to be on

time. Driver barriers to pulling over (i.e., family emergencies) were only mentioned by one driver.

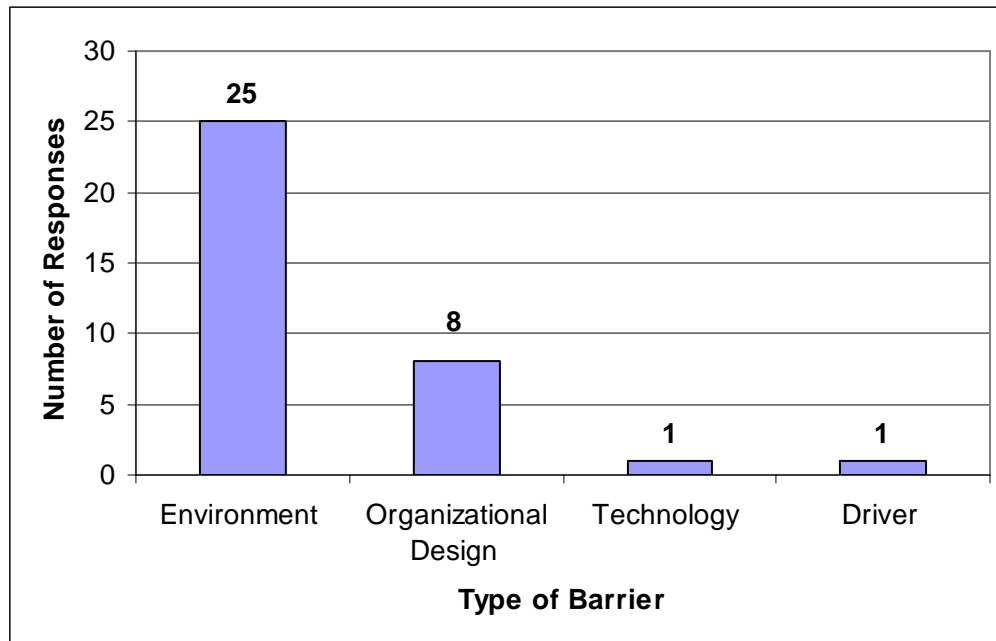


Figure 4. Barriers to pulling over by STS subsystem.

While technology barriers to pulling over were only mentioned by one participant during the brainstorming session, this issue is an important one that needs to be considered by the team developing the ODMS. One participant said he would not pull over if he felt the technology was giving him a false alarm. This participant said he would only trust his own judgment concerning his level of drowsiness, “I’m not gonna pull over because it’s a machine. I mean I’m gonna go by my body [sic].” The team developing the ODMS must understand the importance of accurate warnings and the consequences of false alarms. Also, ODMS developers must consider how to train the drivers using the ODMS so the drivers trust the warnings they receive are accurate.

Finally, participants were told to consider all of the ideas discussed during the brainstorming activity and to write down the one thing that would prevent them from pulling over after receiving a warning from the ODMS indicating that they are drowsy. Table 6 provides a ranking of participant responses to this question. The number of responses provided for each type of barrier (i.e., lack of parking, being on time, etc.) is shown by focus group type (i.e., regional and long-haul). The STS subsystem that each barrier falls under is also provided in Table 6.

Table 6. Primary barrier to pulling over by STS subsystem.

Rank	Barrier	Long Haul	Regional	Total	Percentage	STS Subsystem
1	Lack of Parking	3	6	9	69%	Environment
2	Being on time	2	1	3	23%	Organizational Design
3	Hours of Service Regulations	1	0	1	8%	Environment

As indicated in Table 6, 69 percent of the participants said a lack of parking was the number-one barrier that would prevent them from pulling over after an ODMS warning indicated that they were drowsy. Parking is a barrier that falls under the Environmental subsystem in the STS model. Studies have shown the amount of parking available where truck drivers can stop and sleep without being interrupted is insufficient, a problem which may cause truck drivers to return to driving without enough sleep (National Sleep Foundation, n.d.).

Participants from both the regional and the long-haul groups discussed how hard it is to find parking when they are drowsy. As one driver said, “if you ain’t in a truck stop most of the time by five o’clock in the day, you ain’t gonna find a place to park. You can’t stay in the rest area for more than 2 hours, if you do you get a ticket. And if you’re tired and pull off on a ramp or something, a state trooper come by 15 to 20 minutes, wakes you up, give you a hundred-some dollar ticket [sic].”

Current Hours of Service (HOS) regulations, also an issue that falls under the Environmental subsystem, were mentioned by one participant as the primary barrier to pulling over. As one participant explained, his “hours on duty will be screwed up [sic]” if he stops to rest. Under current HOS regulations, a driver may drive 11 h after 10 h off and may not work longer than 14 h in a shift. Under old HOS regulations (in effect from 1938 to January 3, 2004) CMV drivers were allowed to be on-duty for 15 h, 10 of which could be used for driving and then they had to take an 8-hour break (Olson, 2006).

Participants said that the old HOS regulations allowed them more flexibility to take a break when they felt they needed to rest. It would appear that under new HOS regulations, an increase in drive time (i.e., 10 to 11 h) coupled with a decrease in shift length (i.e., 15 to 14 h) has led to less

flexibility for some drivers to stop and rest during their shifts. Several participants said they feel they must lie on their log books because of the way the current HOS regulations are structured. One participant said, “There’s nobody on the road today that does not lie. And I don’t care if he’s a Baptist preacher and he drives a truck and he say, ‘Oh, I drive compliant.’ He’s lying. Everybody today has to lie on that log book [sic].”

Pressure to be on time to deliver loads was mentioned by 23 percent of participants as the number-one barrier to pulling over. This issue falls under the subsystem Organizational Design in the STS model. One participant described how his trucking company schedules him so tightly that if he stops to rest, even for a few minutes, he will be late. He said “yeah a lot of time, you know, you’re 45 minutes from your destination and 48 minutes from the end of your hours on your log book—which is the way a lot of these companies will run you—right up against your hours to get to your destination and then expect you to sleep while you’re unloading or something like that [sic].”

Several drivers said that the current HOS regulations limit their ability to stop because their trucking companies schedule them so tightly. For this reason, participant problems with HOS regulations are debatably as much an Organizational Design barrier as an Environmental barrier. If trucking companies want drivers to be safe, they must not schedule their 14-hour shift so tightly that they do not have adequate time to stop and rest if necessary.

Figure 5 shows the importance of Environment (i.e., parking) and Organizational Design (i.e., being on time) in potentially discouraging drivers from pulling over after they receive a warning from the ODMS that they are too drowsy. In Figure 5, HOS regulations are shown in stripes because of the apparent overlap of Organizational Design and Environment on this issue for some participants.

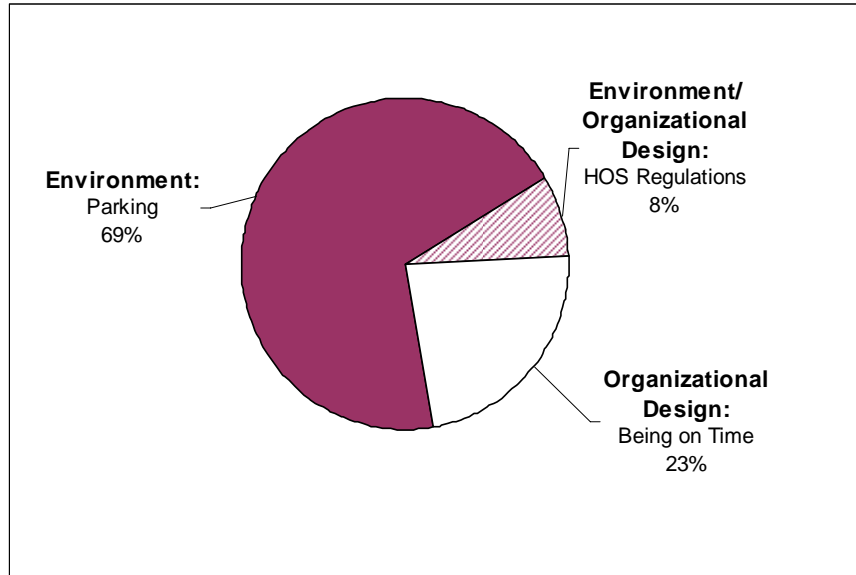


Figure 5. Barriers to pulling over.

Part 5: ODMS Demonstration.

During the ODMS demonstration, participants were shown a potential prototype of the ODMS in an actual truck cab and then asked to voice their concerns regarding the device. Figure 6 shows the device in an actual truck cab as participants saw it during the focus-group session.



Figure 6. ODMS in-cab demonstration.

The primary complaint voiced by participants in both groups was with placement of the technology. Participants shared concerns about the placement of the technology which is currently located directly in front of the drivers (Figure 6). This placement is necessary in order for the technology to accurately detect drowsiness. Many of the participants did not want the monitor located directly in front of them because they felt that it would be distracting, irritating, or would hamper visibility during bad weather or while parking. One participant said, “drivers need to see the whole outline of that hood. There are places where you pull in where you have to have that bumper right up against whatever [sic].”

Participants had several suggestions for where they would like to see the technology placed in the cab. Some participants said that the ODMS should be located to the side, possibly in the upper A-pillar trim or overhead near the sun visor area. One participant said, “I’d rather it be out of sight and out of mind so that I can focus [sic].” Several participants suggested integrating the technology into the dashboard so that it becomes part of the truck rather than something sitting up on top of the dashboard. One driver suggested, “if you make it into the dash, you wouldn’t think nothing about it [sic].”

Part 6: Commercial Vehicle Driver Questionnaire

At the end of the focus-group sessions, participants were given a brief exit questionnaire to complete that was designed to assess the prevalence of drowsiness during their work day. See Appendix F for the Commercial Vehicle Driver Questionnaire given to participants and Appendix I for a complete list of results from this questionnaire.

There were several findings from the questionnaire that may be useful to the ODMS design team. The first is that during a typical work day, participants said they feel most drowsy during the night (5 of 13) and during the afternoon (2 of 13). Figure 7 provides a breakdown of participant responses to this question. Participants defined night in a variety of ways including: 1:00 a.m. to sun-up, dark hours, between 3:00 to 6:00 a.m., close to midnight, and 1:00 to 1:30 a.m. Participants defined afternoon as: midday to 3:00 to 4:00 p.m. and early afternoon. The times cited by participants aligned with the sleepy periods most people experience each day. The

human body functions on a 24-hour circadian rhythm and most people experience two sleepy periods: (i) the first during the middle of the night and (ii) the second between 2:00 to 4:00 p.m. (Stutts et al, 1999). Drowsiness was also mentioned as being experienced toward the end of a shift (4 of 13) and after eating a meal (4 of 13).

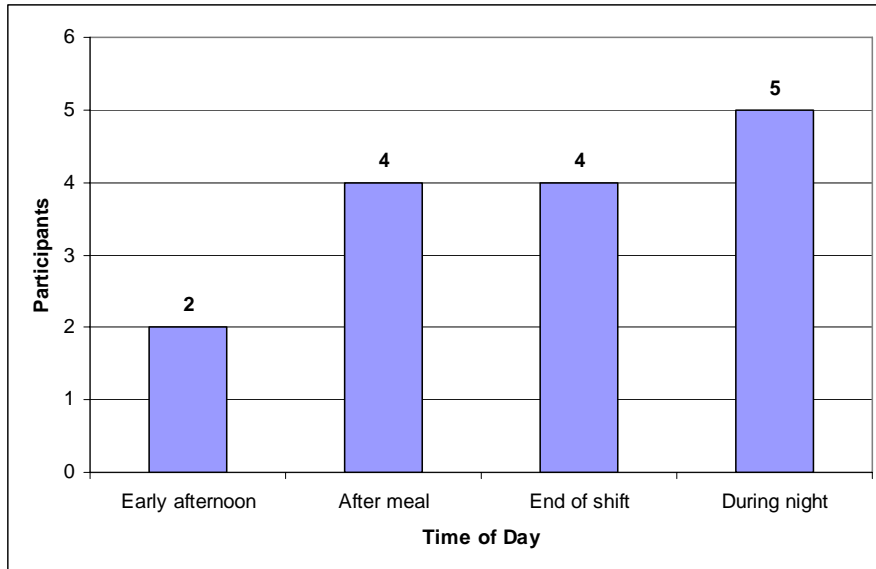


Figure 7. Part of typical work day when most drowsy.

*More than one response was provided by some participants.

Another key finding from the questionnaire was that over half of the participants said they have fallen asleep while driving their trucks (Figure 8).

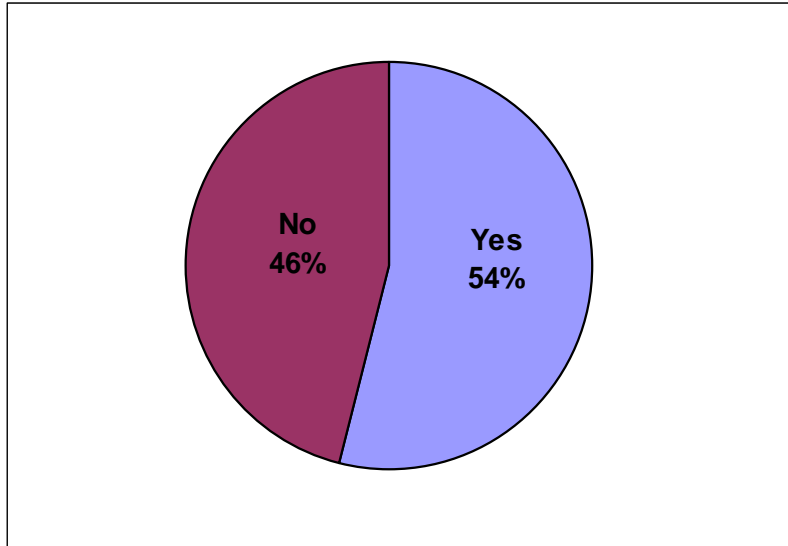


Figure 8. Percentage of participants who said they have fallen asleep while driving their trucks.

Finally, participants were able to write at the end of the questionnaire any ideas or thoughts they wanted to share with researchers regarding the ODMS. The primary comment (4 of 13) shared by participants is that the ODMS will not change the constraints and pressures (i.e., personal, environmental, and organizational design) under which they work. Participants said the ODMS will not change the fact that they can not find a place to park or that their trucking companies and shippers need them to deliver loads on time. As one participant said, “It all comes back to economics. If a company and driver can make a reasonable living by stopping regularly and following all of the laws, drowsiness would not be a problem or issue.”

Several participants (3 of 13) shared thoughts about how the ODMS should work. For instance, one participant said the ODMS should provide an “early warning” and “not wait til driver is completely fatigued before alerting [sic].” Another participant said he wants to be able to “set different sounds” for the warning and that the monitor should “maybe alert company of actions of driver [sic].”

Results from these focus groups will be given to the team that is designing the ODMS as well as FMCSA. It is the hope of the focus-group research team that these results can help the design team develop an ODMS that can help truck drivers avoid accidents caused by drowsiness. The

participants involved in these focus groups made it very clear that they do not want to drive while they are drowsy. Yet the constraints they described can not be overlooked if the ODMS is to be successfully implemented (i.e., drowsiness is identified, a warning alerts drivers that they are drowsy, and drivers pull over for restorative rest). Recommendations for the ODMS design as well as how the ODMS may be more effectively implemented are provided in the following section of this report.

RECOMMENDATIONS

These focus groups were conducted so the team developing the ODMS could better understand how to achieve “joint optimization” between the ODMS and CMV drivers. “Joint optimization” is a process by which “social and technical systems are designed to fit the needs of one another” (Daft, 1995; p. 148). Achieving “joint optimization” is critical to effective implementation of the ODMS (e.g., truck drivers will pull over and seek restorative rest after receiving a warning that they are drowsy). Below is a list of recommendations for how to make implementation of the ODMS more effective.

1. Make the ODMS more sensitive to drowsiness during circadian sleepy periods and at the end of shifts.

Several participants stated on their exit questionnaires they tend to feel drowsy at night (midnight to sun-up) and during the afternoon (12:00 to 4:00 p.m.). These periods roughly coincide with circadian sleepy periods. The human body functions on a 24-hour circadian rhythm and most people experience two sleepy periods: (i) the first during the middle of the night and (ii) the second between 2:00 to 4:00 p.m. (Stutts et al, 1999). Some participants also said that they got drowsy at the end of their shifts. These time periods (i.e., during circadian sleepy periods and ends of shifts) could be pre-programmed into the ODMS so that it is more sensitive to the signs and signals of drowsiness during these periods when drivers are more likely to be drowsy.

2. Locate the ODMS in a place where it is not an annoyance to drivers and does not hamper their visibility.

Most of the participants did not like the location of the ODMS on top of the dashboard. They thought that it would be distracting and possibly dangerous in its proposed location (Figure 6). Suggestions for better placement included incorporating it into the dashboard or putting it somewhere (i.e., the upper A-pillar trim or overhead near the sun visor) where it cannot be seen. While these suggestions may not be technologically feasible at this time, they may be possible as new technologies emerge. In the meantime, the most important thing is that the ODMS is in a position to accurately assess driver drowsiness while not hampering the truck driver’s visibility.

3. Use a variety of condition changes in the cab to warn drivers that they are drowsy.

There are many possible ways the ODMS can warn or alert drivers that they are becoming drowsy. One possible way is to change conditions in the truck cab. Participants in the long-haul focus group discussed how changing the environment within their cabs was a way they try to ward off drowsiness. They said the cab environment could be changed by turning up the radio, changing the radio station, rolling down the window or blasting the air conditioning. One participant said that he found it helpful to “change the environment within the parameters of the truck to a degree by changing the radio station even over to news or whatever [sic].”

The two focus groups were also consistent in wanting a warning that was ongoing and increasingly loud or annoying. Audible alarms and horns were popular options, though other ideas included “flashing lights” and “a puff of air.” One participant said that the system “should have an audible alert and then a visual alert.”

Thus the research team developing the ODMS may want to consider using condition changes in the cab as a means of alerting drivers that they are becoming drowsy (i.e., temperature change, noise level change, light level change, movement of air, etc.). Also, these condition changes could be varied so that drivers do not become too accustomed to any one type of alert. Several participants said that when they become accustomed to a particular type of warning (i.e., seat belt alarm) that they can ignore it. And finally, the condition changes need to become increasingly annoying so that the truck drivers ultimately heed the warnings and pull over to rest.

4. Make the ODMS warning so annoying that drivers are forced to pull over to rest.

It was obvious from the comments made in each of the focus groups that participants feel great pressure to keep driving even when they are tired. It was also clear that safety is very important to these drivers. Most participants said if they are too tired to drive they want to be forced to make the safe choice and pull over. As one driver said, “If I am tired and I’ve got to pull my truck off and I don’t want to, I’m refusing to, but I need to, by all means, do something to get me off the road because I don’t want to hurt me or somebody else [sic].” For this reason, many of the drivers said that the ODMS should annoy them so completely that they must stop. The

suggestion was made by one driver that “whatever you’re gonna do, it’s gonna have to be annoying and you can’t be able to shut it off until you pop your brakes [sic].”

5. Involve drivers in testing the ODMS technology.

Once the design phase is over, drivers should be involved in testing the ODMS. A combination of road testing as well as focus-group discussion is recommended. Not only does such involvement provide researchers with important data, participants want to be involved in developing and testing technology that will increase their safety on the road and directly impact them. One driver said in his exit questionnaire that “I would like to know when this monitoring system is going to be tested. I would like to see everyone in these classes get to test the monitoring system on the road.” Any testing of the ODMS on the road should be combined with focus groups where participants can share with researchers, via in-depth discussions, their impressions of the technology along with suggestions for improvement.

These research activities (i.e., road testing and focus groups) also provide an opportunity for education and outreach. One focus-group participant described how he had discussed with other truck drivers at a truck stop how he was going to be involved in a focus group regarding drowsy driving. While research activities such as focus groups are useful for gathering data, they can also be used as platforms for sharing educational and outreach information with truck drivers about the importance of stopping to rest if they become drowsy while driving. Thus it is suggested here that any post-design focus groups conducted with truck drivers should include an element of education and outreach on how to prevent drowsy driving accidents.

6. Educate truck drivers on how the technology works and inform them about the likelihood of a false alarm.

Education on how the ODMS works and the likelihood that it will give a false alarm should be provided to the truck drivers who will be using the monitor. One participant in particular was very adamant that he would not trust the ODMS to assess his drowsiness and only he can determine if he is too tired to drive. He said, “The bottom line is my judgment. I know my body better than that thing does or anybody else does. . . we’re trying to make something that is subjective and common sense, if you will, into an objective thing that circuitry can do. You

can do lots of different things to enhance it or enable it to some degree, but you've really got to have the person behind the wheel using sound judgment [sic]." While only one participant mentioned this issue, there may be many drivers who will not be easily convinced that the ODMS can effectively and accurately determine that they are too drowsy to drive. Truck drivers should be shown how the ODMS works and informed about the likelihood of a false alarm. They will be more likely to believe and trust any warnings they receive if they understand how the technology works and how accurate it is at assessing drowsiness.

7. Provide outreach to trucking companies on the importance of scheduling drivers in such a way that they have time to rest.

Outreach should be done with the companies that choose to implement the ODMS so they understand the importance of allowing their truck drivers to rest after receiving a warning from the monitor that they are drowsy. That is, the ODMS must be a tool within a larger company fatigue management program. During Part 4 (ODMS Barriers), being on time was a barrier to pulling over that was mentioned by 23 percent of participants. Participants described how they are often scheduled so tightly by trucking companies they do not have time to pull over and rest if they are to reach their destinations on time and if they are to stay within their hours on their log books. Implementation of the ODMS will only be successful if the drivers feel that they can and should pull over to rest if they are drowsy. Allowing time within the schedule and encouraging rest when tired are two things that trucking companies must do so that drivers know they can and should pull over and rest if they are too tired to drive.

REFERENCES

- American Academy of Sleep Medicine (2006). *Circadian rhythm sleep disorder due to drug or substance*. Retrieved May 28, 2007 from: <http://sleepeducation.com/Disorder.aspx?id=61>
- American College of Chest Physicians (n.d.). *Updated sleep apnea screening recommended for commercial drivers*. Retrieved May 28, 2007 from: <http://www.chestnet.org/about/press/releases/2006/091206.php>
- Brown, I. D. (1994). Driver fatigue. *Human Factors*, 36(2), 298-314.
- Daft, R. (1995). *Organizational Theory and Design (5th Ed.)*. St. Paul, MN: West Publishing Company.
- Eberhart, R., Hu, X., & Foresman, B. (2000). Dangers of sleepiness and inattention while driving. *Journal of the American Osteopathic Association*, 100(8), S9-S14.
- Federal Motor Carrier Safety Association. (n.d.). *Summary of new Hours-of-Service regulations effective October 1, 2005*. Retrieved May 28, 2007 from: <http://www.fmcsa.dot.gov/rules-regulations/topics/hos/hos-2005.htm>
- Hanowski, R. J. (1998). *Preliminary Examination, Doctor of Philosophy in Industrial Systems Engineering*. Blacksburg, VA: Virginia Tech.
- Hanowski, R. J., Wierwille, W. W., Garness, S. A., & Dingus, T. A. (2000). *Impact of local/short haul operations on driver fatigue, final report*. Report No. DOT-MC-00-203. Washington, DC: U.S. Department of Transportation, Federal Motor Carrier Safety Administration.
- Hendrick, H. & Kleiner, B. (2001). *Macroergonomics: An introduction to work system design*. Santa Monica, CA: Human Factors and Ergonomics Society.
- National Institutes of Health (2006). *Medline plus Online Encyclopedia*. Retrieved May 28, 2007 from: <http://www.nlm.nih.gov/medlineplus/ency/article/003208.htm>
- National Safety Council (2007). *Report on Injuries in America. Table & Chart Statistics Quick Reference: Leading Causes of U-I Deaths, U.S., 1969-2005*. Retrieved May 25, 2007 from: http://www.nsc.org/library/report_table_2.htm.
- National Sleep Foundation (n.d.). *MYTHS—AND FACTS—ABOUT SLEEP*. Retrieved May 28, 2007 from: http://www.sleepfoundation.org/site/c.huIXKjM0Ix/b.2421123/k.2747/Myths_and_Facts_About_Sleep.htm

- National Sleep Foundation (n.d.). *Rules for Hours of Service for commercial drivers*. Retrieved May 28, 2007 from: http://www.sleepfoundation.org/site/c.huIXKjM0Ix/b.2419077/k.C786/NSF_on_Rules_for_Hours_of_Service_for_Commercial_Drivers.htm
- Olson, R. (2006). *Assessment of drowsy-related critical incidents and the 2004 Revised Hours-of-Service Regulations*. Unpublished master's thesis, Virginia Tech.
- Philip, P. (2005). Sleepiness of Occupational Drivers. *Industrial Health*, 43, 30-33.
- Reyner, L.A., Horne, J.A., (1998). Falling asleep whilst driving: are drivers aware of prior sleepiness? *International Journal of Legal Medicine*, 111, 120-123.
- Roth, T., Roehrs, T.A., Carsadon, M.A., & Dement, W.C. (1994). *Daytime sleepiness and alertness*. In Kryger, M.H., Roth, T., & Dement, W.C., *Principles and Practice of Sleep Medicine*, Second Edition. Philadelphia, PA: W.B. Saunders Company.
- Robin, J., & Knipling, R. (2001). *Federal Motor Carrier Safety Administration's Research and Technology Initiatives to Enhance Commercial Driver Training, Licensing and Performance Management*. Retrieved May 28, 2007 from: http://ppc.uiowa.edu/Driving-Assessment/2001/Summaries/Driving%20Assessment%20Papers/75_Robin_Jerry.htm
- Stutts, J.C., Wilkins, J.W. & Vaughn, B.V. (1999). *Why do people have drowsy driving crashes? Input from drivers who just did*. AAA Foundation for Traffic Safety. Washington, DC.
- U.S. Department of Transportation. (2003). *Commercial transportation operator fatigue management reference*. Washington, D.C.
- Williams, D., Allen, J., Lepofsky, M., Murray D., Wahl, K., Vercoe, D., Keppler, S., Moses, T. (August, 2004). *Hazmat Safety & Security Field Operational Test, Final Report*. Report No. FHWA-OP-03-XXXX. Washington, DC: U.S. Department of Transportation, Federal Motor Safety Carriers Safety Administration.

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**APPENDIX A: LITERATURE AND POTENTIAL INTERVIEW GUIDE QUESTIONS
BY STS SUBSYSTEM**

Subsystem/Project-Related Examples:	Literature	Sample Questions
<p>Technology Tools/machines (i.e., cell phone, CB, radio) used to stay alert.</p>	<p>Few strategies, such as listening to the radio or adjusting the air conditioning, work well for anything except mild sleepiness (Eberhart et al., 2000).</p>	<p><i>(1) What standard technologies do you have in your cab (e.g., radio, CB, cell phone)? How often are these used? Do you use any of these to mitigate your drowsiness? If so, how?</i></p> <p><i>(2) What advanced technologies do you have in your cab (e.g., collision warning, adaptive cruise control)? How often are these used? Do you use any of these to mitigate your drowsiness? If so, how?</i></p> <p><i>(3) Are you aware of any technologies that are specifically directed at driver drowsiness?</i></p> <p><i>(4) If you did have a system in your cab that alerted you when you were getting drowsy—what course of action would you take?</i></p> <p><i>(5) What would such a system need to tell you in order to convince you that you were too drowsy to drive?</i></p>
<p>Driver Personal factors: sleep habits and on the job drowsiness</p>	<p>(a) Most adults require 7 to 9 h of sleep a night. When people do not get adequate sleep they accumulate sleep debt which can cause safety problems on the road (National Sleep Foundation, n.d.).</p> <p>(b) Philip (2005) found that long-distance drivers tend to get significantly less sleep the night before they start a new work week than during the work week.</p> <p>(c) The best way to avoid feeling drowsy while driving is to get enough sleep the night before making a trip (National Sleep Foundation, n.d.).</p> <p>(d) Night drivers often shift to daytime schedules on their days off, resulting in weekly disruptions in sleep schedules (U.S. DOT, 2003).</p>	<p><i>(1) How much sleep do you get each night? Does it tend to vary? If so, how much does it vary, when, and why?</i></p> <p><i>(2) Are there certain common times when you get drowsy behind the wheel?</i></p> <p><i>(3) Have you ever fallen asleep while driving? Please describe what caused you to become so drowsy.</i></p> <p><i>(4) How many times each week or month do you drive drowsy?</i></p> <p><i>(5) Do drivers on the road monitor each others' driving performance and inform or report drivers that they suspect are drowsy?</i></p>
<p>Driver Personal factors: exercise</p>	<p>(a) Exercise helps people sleep better and truckers who exercise are more alert when they drive (Robin and Knipling, 2000).</p> <p>(b) Truckers often have a hard time finding an appropriate and safe time or place to exercise (U.S. DOT, 2003)</p>	<p><i>(1) Do you exercise on a regular basis? Please describe.</i></p> <p><i>(2) Do you find it difficult to find places and times to exercise while you are working? Please describe.</i></p>

<p>Driver Personal factors: medications/drugs</p>	<p>A few of the substances that cause sleepiness include: sleeping pills, alcohol, muscle relaxants, pain medications, some antidepressants, blood pressure and heart medications, some allergy/cold/flu products, and antihistamines such as Benadryl (American Academy of Sleep Medicine, 2006).</p>	<p><i>(1) Do you regularly or occasionally take any medications that cause you to feel drowsy? Please describe.</i></p>
<p>Driver Personal factors: medical conditions (sleep apnea).</p>	<p>(a) Patients with sleep apnea have higher automobile accident rates than control subjects (Eberhart et al., 2000; p. S11). (b) Obstructive sleep apnea has been shown to increase the risk of drowsy driving (American College of Chest Physicians, n.d.). (c) Nearly one in three commercial truck drivers suffer from mild to severe sleep apnea (American College of Chest Physicians, n.d.).</p>	<p><i>(1) Do you suffer from sleep apnea (episodes of stopped breathing during sleep)?</i></p>
<p>Driver Techniques used to stay alert (e.g. drinking caffeine, stopping to nap).</p>	<p>Few strategies, such as listening to the radio or adjusting the air conditioning, work well for anything except mild sleepiness (Eberhart et al., 2000).</p>	<p><i>1)) What is the first thing that you do when you start to feel tired while driving? If that does not help, what do you do next? What strategies do you use to stay awake? At what point do you decide that you need to stop—what triggers you to pull over?</i></p>
<p>Driver Training and education on the importance of not driving drowsy and on proper sleep hygiene.</p>	<p>Drivers may benefit from training on the signs of drowsiness so that they are aware of when they need to pull over and sleep (Olson, 2006).</p>	<p><i>(1) Does your company provide drowsiness prevention training? Please describe. (2) Does your company provide training on sleep hygiene? Please describe.</i></p>
<p>Organizational Design Fleet policies and practices: napping policy.</p>	<p>Short-lived naps may be an effective measure to maintain performance in individuals with limited sleep or under conditions of prolonged activity (Eberhart et al., 2000; p. S13).</p>	<p><i>(1) Does your company have a napping policy? If so, please describe how it works.</i></p>
<p>Organizational Design Fleet policies and practices: scheduling.</p>	<p>(a) Drivers must often wait for their truck to be loaded/unloaded before resuming their shift. This time adds to the length of their shift and reduces opportunities to obtain satisfactory sleep (U.S. DOT, 2003). (b) Drivers who are “on call” or have schedules that change frequently may not get adequate rest (U.S. DOT, 2003).</p>	<p><i>(1) Do you find that your work schedule is conducive to getting enough sleep? If not, why not?</i></p>

<p>Environment Government policies and regulations: federal hours-of-service regulations.</p>	<p>Hours of service regulations:</p> <ul style="list-style-type: none"> • May drive a maximum of 11 hours after 10 hours off. • May not work longer than 14 hours in a shift. • May not drive after 60/70 hours on duty in 7/8 days. • May restart a 7/8 consecutive day period after taking 34 hours or more hours off. • Commercial motor vehicle (CMV) drivers using sleeper berth must take at least 8 hours in the sleep berth, plus 2 consecutive hours either in sleeper berth, off duty, or any combination of the two (FMCSA, n.d.). 	<p><i>(1) Do you feel that the federal hours-of-service regulations help or hinder your ability to sleep when you need to? Please describe.</i></p>
<p>Environment Access to safe and quiet places to sleep.</p>	<p>(a) Studies have shown that the number of locations where truckers can stop and sleep without being interrupted is insufficient. This may cause truckers to return to driving without sufficient sleep (National Sleep Foundation, n.d.).</p> <p>(b) A lack of adequate rest stops limits the ability of drivers to rest or nap on many routes (U.S. DOT, 2003).</p> <p>(c) Drivers with sleeper berths often must try to sleep at noisy rest stops, or while their partner is driving, which can make quality sleep difficult (U.S. DOT, 2003).</p>	<p><i>(1) When you are tired and need to sleep, where do you stop? Are there sufficient locations on your routes for you to sleep safely and soundly? Please describe.</i></p>

Screening Questions:

(1) Do you hold a valid Class A Commercial Drivers license?

- If person says no, thank them for their time.
- If person says yes, continue screening.

(2) Are you currently working as a truck driver?

- If person says no, thank them for their time.
- If person says yes, continue screening.

(3) Typically, when delivering a load, how far do you drive one way from your home base?

- If person says under 200 miles, thank them for their time.
- If person says 200-500 miles consider them regional and continue screening. If person says more than 500 consider them long haul and continue screening.

Good you are eligible to participate in our focus group! We are going to be meeting on:

- March 31 from 9:00 a.m. to 11:30 a.m. for long haul (over 500 miles)
- April 12 from 5:00 p.m. to 7:30 p.m. for regional (200-500 miles)

(4) Can you participate at this time?

- If they cannot participate, thank them for their time and ask them when a good time to participate would be in case we organize more groups (e.g., weekends, nights, etc.).
- If participant says yes, continue screening.

Now I have a few personal questions for you. I want to assure you that the information that you share will be used strictly for research purposes and your personal information will remain confidential.

(5) Is this the phone number that you prefer to be reached at or is there another number we should call if we need to contact you?

- *Note number:* _____

(6) May we have your mailing address so that we can send you a confirmation card with directions to the location where your focus group meeting will be held?

- *Note address:* _____

(7) Do you know of anyone with a Class A CDL who drives at least 200 miles in one direction when delivering loads who might be interested in participating?

- If participant says no, finish screening.
- If participant says yes, ask them to have the person call _____ at _____ if they are interested.

Thank you very much for your time, we will be mailing you a confirmation in a few days. Please bring your CDL with you to the meeting. We will provide refreshments.

Thank you again and have a nice evening.

APPENDIX C. FOLLOW-UP LETTER

Date

Dear _____,

Thank you for agreeing to take part in the focus group meeting being held on _____. If you are unable for any reason to take part in this meeting please call or e-mail Stephanie Baker at 540-231-1092 (sbaker@vtti.vt.edu) so that a replacement can be found.

Your focus group meeting will begin at _____. After completing the two and a half hour focus group you will receive \$80 in cash. Refreshments will also be provided.

The focus group meeting will be held at the Virginia Tech Transportation Institute in Blacksburg, Virginia. Directions are listed below:

From I-81, take Exit 118B to Rt. 460W. Follow signs to Virginia Tech/Blacksburg. Take Exit 5AB (Smart Road/Industrial Park Drive). Follow 5A to Industrial Park Drive. Turn right at end of ramp, and then make an immediate right onto Transportation Research Drive. Turn left at end of road come up the hill onto Transportation Research Plaza (you'll see a gated road straight ahead, turn left and come up the hill when you see that gate); turn right at top of hill and then a left into parking lot adjacent to main building, which is the multi-story building. The session will be held in the large conference room to your left as soon as you enter through the glass doors.

OR

From 460E coming from Blacksburg, take Exit 5BA. Veer left onto 5B toward Blacksburg. Turn left at light onto Main Street. Turn right at the next stop light onto Industrial Park Drive. Turn right onto Transportation Research Drive (just past the exist ramp for the 460 bypass). Turn left onto Transportation Research Plaza (you'll see a gated road straight ahead, turn left and come up the hill when you see that gate); turn right at the top of the hill and then a left into parking lot adjacent to main building, which is the multi-story building. The session will be held in the large conference room to your left as soon as you enter through the glass doors.

Thank you again for your involvement.

Sincerely,

Stephanie Baker
Project Manager
Center for Truck and Bus Safety
Virginia Tech Transportation Institute
540-231-1092
sbaker@vtti.vt.edu

APPENDIX D: INFORMED CONSENT FORM

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY *Informed Consent for Participants of Investigative Projects*

Title of Project: Focus Groups in Support of the Development of an Operator Drowsiness Monitoring System

Investigators: Stephanie Baker, Darrell Bowman, Dr. Richard Hanowski

I. THE PURPOSE OF THIS RESEARCH PROJECT

The purpose of this project is to find out what you do when you become drowsy while driving your truck. We also want your opinions about a device that the Virginia Tech Transportation Institute is developing to alert you when you become drowsy while driving your truck.

II. PROCEDURES

You will be taking part in a two and one half hour focus group meeting. During this time you will be asked questions and you will have the opportunity to share your thoughts and opinions. The focus group meeting will be audio recorded.

III. RISKS

There are no more than minimal risks involved with participation in this study.

IV. BENEFITS

No promise or guarantee of benefits will be made to encourage your participation. You may find the focus group discussion to be interesting and your participation may impact the development of a device that will warn drivers if they become drowsy. This device may increase truck driver safety and reduce crashes.

V. EXTENT OF ANONYMITY AND CONFIDENTIALITY

The verbal responses you make during this focus group will be kept strictly confidential. Your name will not be associated with any comments that you make. Audiotapes used during this focus group will be transcribed and then erased. Data collected will be stored at the Virginia Tech Transportation Institute and access to the data will be under the supervision of Dr. Rich Hanowski and Stephanie Baker.

VI. COMPENSATION

You will be paid \$80 for participation in this focus group. Should you leave the focus group session early, you will receive partial compensation (e.g. \$15 for every 30 min completed). This payment will be made, in cash, to you at the end of your voluntary participation in this focus group meeting.

VII. FREEDOM TO WITHDRAW

As a voluntary participant, you may withdraw at any time for any reason without penalty.

VIII. APPROVAL OF RESEARCH

This research project has been approved, as required, by the Institutional Review Board for Research Involving Human Subjects at Virginia Polytechnic Institute and State University.

3-15-2007
IRB Approval Date

3-14-2008
Approval Expiration Date

IX. PARTICIPANT'S RESPONSIBILITIES

I voluntarily agree to participate in this study. I understand that I have the following responsibilities:

1. Listen to all of the focus group leader's instructions.
2. Provide responses, as you are able, to the focus group leader's questions.
3. Respect the opinions of others.

XI. PARTICIPANT'S PERMISSION

I have read and understand the requirements, procedures, and conditions of this focus group. I have had all of my questions answered. I hereby acknowledge the above and give my voluntary consent for participation in this focus group.

If I participate in this study, I understand that I may withdraw at any time without penalty. I agree to abide by the rules of this project.

Participant's name (Print)	Signature	Date
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Researcher's name (Print)	Signature	Date
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Should I have any questions about this research or its conduct, I may contact:

Stephanie Baker (540) 231-1092

Darrell Bowman (540) 231-1068

If I should have any questions about the protection of human research participants regarding this study, I may contact Dr. David Moore, Chair of the Virginia Tech Institutional Review Board for the Protection of Human Subjects, telephone: (540) 231-4991; email: moored@vt.edu; address: Research Compliance Office, 1880 Pratt Drive, Suit 2006 (0497), Blacksburg, VA 24061.

FACILITATOR NOTE: Please note that the participant will sign two copies of this informed consent form. One is to be given to the participant, and the other will be retained by the investigator.

APPENDIX E: INTERVIEW GUIDE

The following questions are primary probes. Secondary probes may be used and will depend upon the issues that arise during the focus group discussion. Secondary probes will not stray from the general line of questioning presented here.

COMMERCIAL VEHICLE INTERVIEW GUIDE (2.5 hours)

I. Greetings and Informed Consent (10 min)

- Participants will be greeted and escorted to the VTTI conference room.
- An investigator will check each participants CDL to verify that it is valid.
- Participants will be given the Informed Consent Form and asked to read the form and voice any concerns or questions that they have to an investigator.
- If subjects wish to participate, they will be asked to sign the back of two informed consent forms. One form will be collected by the experimenter and the second will be given to the participant to keep for their own records.
- Those who choose not to participate may leave.
- Participants will be reminded that they may refuse to answer any questions and may leave at anytime.

II. Facilitator Introduction and Ground Rules (5 min)

Hello, our names are Stephanie Baker and Darrell Bowman. We are researchers at the Virginia Tech Transportation Institute. We want to thank you for taking the time this evening to come and share your thoughts and opinions with us.

PURPOSE OF THE MEETING

- Purpose of this meeting is to discuss issues related to driving while drowsy.
- We are going to ask you a series of questions and need you to respond as openly and honestly as possible. There are no right or wrong answers—we just want your opinions.

CONFIDENTIALITY

- The discussion tonight is strictly for research purposes, we are not selling anything and we will not connect anything you say with your name.
- There is a tape recorder in the room. Please speak loudly and clearly so that we get a good recording of your comments.
- I will make a transcript of our discussion, but I will not match comments with names.
- Tapes will be stored in a secure location and erased after they are transcribed.
- If you feel uncomfortable, you can refuse to answer a question or you may leave.
- Did everyone fill out one of these consent forms? Do you have any questions about it?

LOGISTICS

- This meeting will run until _____ (time), we are very appreciative of the time that you are spending and will honor it by not running over.
- Bathrooms are located around the corner to your left. Refreshments are at the back. If you would like something to eat or drink please help yourself now before we get started. We will also have a break later.
- Please turn off any phones/beepers unless you need them on for emergency reasons. This will help us to avoid distractions and finish on time.

GROUND RULES

- Please let me know if you are uncomfortable with any of these rules. If you are ok with these rules, then lets agree to abide by them for the remainder of the meeting.
 - Listen to each other
 - Everyone participate fully
 - No side conversations
 - Spelling does not count
 - Don't criticize others
 - Finish on time
 - Return from break in a timely manner

III. Group Introductions and Warm-up (15 min)

Facilitator Question:

- I'd like to start by going around the room. Please tell me your first name and describe a typical 24 hour work day? Let me know, among other things:
 - When do you sleep?
 - How long do you sleep?
 - What hours do you work?
 - How long do you drive before you stop for a break?
 - How long a break do you take?
 - What do you do during your breaks?
 - Is there a time of day that you tend to get drowsy or sleepy while driving?
 - Is there a point in your driving shift that you tend to get drowsy or sleepy?

Activity: Show list of areas to cover on flip chart. Go around the room and as each person speaks, write down responses on flip chart. Each person will be given a code: A1, A2 (meaning focus group A, participant 1). Note responses by code, not name.

IV. Countermeasures (20 min)

Facilitator Question/Directions:

- Now I'd like to discuss the strategies you use to stay alert when you are drowsy.
- Please take a moment and think about what you do to stay awake when you become drowsy while driving your truck.
- Now take a few sheets of paper and write each strategy you use on a separate sheet.
- Use as many sheets as you need. It is o.k. if you only use 1 or if you use 20.
- Take your time and remember there are no right or wrong answers.
- Now take your sheets and put them in the order in which you do them. For instance, if the first thing you do when you feel drowsy is drink a coke then put that sheet first.
- Please sort all of the sheets, putting them in the order in which you do them.
- Once you are done sorting, take a pen and write 1, 2, 3, 4, etc. on the sheets.
- Now I am going to go around the room and have each of you give me your first idea.
- It is ok if we have duplicates. Duplicates show me that it is a common technique or strategy for staying awake.
- Continue to ask for ideas until all of the sheets have been collected.
- Are there any more ideas?

Activity: Hand out pens and paper. After everyone has written and sorted their ideas, collect them in a round robin fashion and place them on the wall. Put all the 1s, 2s, 3s, 4s, etc., together. As you collect each new idea have the person describe it. For instance, if they have written 'listen to the radio' ask them what type of radio station they listen to. Do they listen to loud music or talk radio to help them stay awake. After everyone is done, ask them if anything is missing from the list or if they want to add any that they forgot.

*Note if illegal drug use comes up as a response, collect the idea but do not pursue it further. IF a conversation starts amongst participants about illegal drug use, ask that the conversation move onto another subject and Do Not let it continue.

V. ODMS Warning (15 min)

Facilitator Question:

- For this next set of questions I want to give you some background about a project that the Virginia Tech Transportation Institute is conducting. Researchers at VTTI are creating a device that will be placed in truck cabs to alert commercial vehicle drivers if they become drowsy while driving. The device will monitor truckers while they drive. If the driver show signs of sleepiness an alarm will warn them that they are drowsy.
- Now I'd like you to imagine that you have a drowsiness monitoring system in your cab.
- Take a moment and think about what this drowsiness monitoring system will need to "do" and/or "say" in order for you to pull over when it warns you that you are drowsy?
- Please write down anything that comes to mind. Use as many sheets as you need.
- There are no right or wrong answers.

Activity: Hand out paper and let them brainstorm individually.

Facilitator Question:

- Now I'd like us to break into two groups. Each group will have a facilitator.
- As a group, discuss what you think this drowsiness monitoring system needs to "do" or "say" in order for you to pull over. Use sheets that you prepared as a starting point for your discussions.
- Please work for about 10 minutes.

Activity: Break into two groups. Give each group a flip chart, paper, and pens. Let them discuss/write/draw their ideas for what the ODMS should do/say. Place a recorder with each group. Be sure to collect individual sheets.

Facilitator Question:

- Now that we have discussed all of these ideas, I'd like each of you to write down the #1 thing this monitoring system needs to do or say in order for you to pull over. This can be an idea discussed here or a totally new one that you have to share.

Activity: Hand out sheets of paper and have them write their response. Collect.

BREAK (5-10 min)

VI. ODMS Reaction (35 min)

Facilitator Question:

- Again, I'd like you to imagine that you have a drowsiness monitoring system in your cab.
- Imagine you are driving down the road at the end of a long day and the alarm (give an example from activity above) goes off alerting you that you are drowsy. What, if anything, would prevent you from pulling over and seeking the rest that you need?
- Please write down anything that comes to mind. Use as many sheets as you need.
- There are no right or wrong answers.

Activity: Hand out paper and let them brainstorm individually.

Facilitator Question:

- Now I'd like to go around the room and collect your ideas.
- Can you tell me a bit about this idea? I want to make sure I understand.

Activity: Take each idea and put it on the wall. As you take each sheet, have the participant explain what their idea means. Once all of the ideas are up, ask the group if anything is missing.

Facilitator Question:

- Now I'd like you to help me cluster these into common ideas.
- Lets do this activity silently.
- If one idea doesn't fit into a group, that is ok, just put it out to the side.
- Don't argue—just keep sorting until you are happy with the groupings.

Activity: Have group come up and silent sort.

Facilitator Question:

- Lets give these ideas/clusters a title.
- What is common about these ideas? Is anything out of place? Is anything missing?

Activity: Have group give each cluster a title. Try to open discussion.

Facilitator Question:

- Now that we have discussed all of these ideas, I'd like each of you to write down the #1 thing that would keep you from pulling over. This can be an idea discussed or a totally new one you have to share.

Activity: Hand out sheets of paper and have them write their response. Collect.

BREAK (5-10 min)**VI. ODMS Demonstration (15 min)****Facilitator Question:**

- Now I would like you all to take a look at this prototype drowsiness monitoring system.
- What concerns, if any, would you have about this technology being in your cab?
- For instance, how, if at all, would the position of the monitor affect how you drive—meaning where you place your maps, drinks, etc.

Activity: Show participants the prototype (either actual technology or pictures). Answer any questions they have about the system and encourage open discussion.

Closing (10 min)**Facilitator:**

- Thank you very much for your time and input.
- If you don't mind, please take a moment and fill out one of these brief questionnaires.
- When you are done, please come forward and I will have you sign for your payment.

Activity: Hand out questionnaires. Bring out lock box. Take questionnaires, have each person sign the payment forms, and hand them the cash.

APPENDIX F. COMMERCIAL VEHICLE DRIVER QUESTIONNAIRE

For the following questions, please write a brief response in the blanks provided.

- (1) During what part of a typical work day are you most drowsy (e.g., when you first start your shift, after a meal break, at the end of your shift)?

- (2) Over the course of a typical work week, how many days would you say that you feel drowsy while driving your truck? _____

- (3) Have you ever fallen asleep while driving your truck? _____

- (4) Are there any ideas or thoughts that you would like to share with the researchers regarding the drowsiness monitoring system that was discussed tonight?

Thank you for sharing your thoughts and opinions with us!

APPENDIX G: FOCUS GROUP INTRODUCTIONS

Introductions

- When do you sleep?
- How long do you sleep?
- What hours do you work?
- How long do you drive before you stop for a break?
- How long a break do you take?
- Is there a time of day that you tend to get drowsy or sleepy while driving?

Long-Haul Participant #1

- **Sleep Time:** When sun is down.
- **Length of Sleep:** 5-6 hours.
- **Work Hours:** During daylight. Avoid rush hour.
- **Time Before Break:** Varies. Depends on the load and point of pickup/delivery.
- **Break Length:** 1 hour-1 hour and fifteen minutes.
- **Drowsy Time:** 1-3 in afternoon.

Long Haul Participant #2

- **Sleep Time:** When partner driving.
- **Length of Sleep:** 3-5 hours.
- **Work Hours:** 24 hours a day.
- **Time Before Break:** Break only for fuel, bathroom, and a meal on a thousand mile trip.
- **Break Length:** 30-45 minutes for meal break.
- **Drowsy Time:** 2-4:30 in a.m.

Long Haul Participant #3

- **Sleep Time:** Never, try to get good night sleep before go out.
- **Length of Sleep:** No more than 6 hours.
- **Work Hours:** 2:00 p.m. to midnight.
- **Time Before Break:** Try not to break, only if must for fuel, food, or coffee.
- **Break Length:** 15-30 minutes for fuel or food
- **Drowsy Time:** When sun comes up (4-6 a.m.).

Long Haul Participant #4

- **Sleep Time:** When get to where delivering load or back home from trip.
- **Length of Sleep:** 5-7 hours.
- **Work Hours:** Drive 8 hours to deliver load and return next day once re-loaded.
- **Time Before Break:** Five hours.
- **Break Length:** One hour for meal.
- **Drowsy Time:** 3-4 hours into trip home, usually around 10:00 at night.

Long Haul Participant #5

- **Sleep Time:** 10 or 11:00 at night to 4 or 5:00 in the morning
- **Length of Sleep:** 5-6 hours
- **Work Hours:** Daytime.
- **Time Before Break:** Don't like to stop, only do if have to go to bathroom.
- **Break Length:** Don't like to stop so keep it short if must.
- **Drowsy Time:** 2 hours after big meal so avoid big meals.

Long Haul Participant #6

- **Sleep Time:** Depends on run.
- **Length of Sleep:** Usually catnap (45 minutes sleep) for 2-3 days and then sleep 8-9 hours get up and start the cycle again.
- **Work Hours:** Whenever they need me.
- **Time Before Break:** Usually 5-6 hours but depends on run.
- **Break Length:** Depends on if getting a cup of coffee or waiting to avoid rush hour.
- **Drowsy Time:** After I eat a big meal, so avoid big meals.

Regional Participant #1

- **Sleep Time:** Depends on job.
- **Length of Sleep:** 5-6 hours.
- **Work Hours:** Drive mostly weekends (as needed) because have a full-time day job.
- **Time Before Break:** Don't usually take a break.
- **Break Length:** Don't break.
- **Drowsy Time:** 2:00 a.m.

Regional Participant #2

- **Sleep Time:** Usually go to bed around 10 or 11:00 p.m.
- **Length of Sleep:** 6-7 hours
- **Work Hours:** Work part-time and depends on trip.
- **Time Before Break:** Stop every 2.5 hours.
- **Break Length:** 30 minutes. Walk around truck, check load, check tires, and go.
- **Drowsy Time:** When sun starts coming up (5-6 in morning).

Regional Participant #3

- **Sleep Time:** Go to bed around 8:30/9:00 at night.
- **Length of Sleep:** 5-6 hours
- **Work Hours:** When working start at 4:30 a.m. and run 11-15 hours. Work part-time, on 2 days one week and 1 day the next week.
- **Time Before Break:** Do not break between destinations. Run for example from Roanoke, VA to Charlotte, NC without break.
- **Break Length:** Time at destination.
- **Drowsy Time:** Wee hours just before the sun comes up in the morning.

Regional Participant #4

- **Sleep Time:** When get to destination.
- **Length of Sleep:** No answer.
- **Work Hours:** 6:00 p.m. until 2/3:00 a.m.
- **Time Before Break:** Don't stop unless need bathroom.
- **Break Length:** 10-15 minutes.
- **Drowsy Time:** 25-45 minutes after the sun starts to come up if still running in the morning.

Regional Participant #5

- **Sleep Time:** At home every night.
- **Length of Sleep:** 6-8 hours
- **Work Hours:** Usually start around 6:00 a.m. and run for 10-12 hours.
- **Time Before Break:** Depends on if delivering locally or out of state. If delivering locally don't stop till reach job site. If out of state will stop at least 2x to check load, check straps, and stretch legs.
- **Break Length:** No answer.
- **Drowsy Time:** Sometime after 12, around lunch/mid-day, especially if eat something.

Regional Participant #6

- **Sleep Time:** When reach destination, usually around midnight.
- **Length of Sleep:** 4-6 hours
- **Work Hours:** Depends on when get loaded, usually 4:00 p.m.-midnight/2a.m.
- **Time Before Break:** Usually don't stop until reach point B, unless need to fuel.
- **Break Length:** 10-15 minutes
- **Drowsy Time:** Wee hours of morning 2a.m.-sun comes up.

Regional Participant #7

- **Sleep Time:** during day from 10 or 11:00 a.m. until 5:00 p.m.
- **Length of Sleep:** 6-7 hours
- **Work Hours:** 9:45 p.m. to 9:45/10:45 a.m.
- **Time Before Break:** Get mini breaks when switch out and hook back up. Also take one 10 minute break and one hour break during shift.
- **Break Length:** 10 minute break to check tires around one o'clock, sleep one hour from 4-5 in the morning.
- **Drowsy Time:** One o'clock every night and again from 4-5 in the morning.

APPENDIX H. ODMS BARRIERS GROUPED BY STS SUBSYSTEM

Long Haul Responses by STS Subsystem

STS Subsystem	Cluster	Brainstorming Idea
ENVIRONMENT	No Parking	Where do you park?
		No where to pull off
		Two lane road can't stop
		Charge money for parking
		No parking available in truck stops
		Lack of truck parking
	Hours of Service	Hours of Service
		Hours on duty screwed up
	Prostitutes	Prostitutes
		Lot Lizards beating on door
	Placarded Load	Placarded load unable to park (hazmat)
Parking Tickets	Fear of retaliation from local law enforcement	
	State police \$80 ticket parking on/off ramp	
ORGANIZATIONAL DESIGN	Being on Time	Load has to be there
		Shippers hold us up
		Load needs to be delivered
		Is load going to be delivered on time?
Company Monitors	Company Monitors	
DRIVER	Family Emergency	Family Emergency

Regional responses by STS Category

STS Subsystem	Cluster	Brainstorming Idea
ENVIRONMENT	No place to stop	No place to stop
		Would have to be a safe and legal place
		No safe place
		No room in rest area or truck stop
		No parking in a big city
		Lack of places to stop
		No place to stop
		Legal parking area
	Parking tickets	Getting a ticket
	Weather	Weather—don't want to get stuck in bad weather
Hours of Service	Up against your hours	
Traffic	Traffic—can get sleepy in heavy traffic	
ORGANIZATIONAL DESIGN	Being on Time	Service—need to get package to next person for delivery
		Truck waiting for you
		Time of delivery
TECHNOLOGY	False Alarm	Not being sleepy and get a false alarm

APPENDIX I: RESPONSES TO COMMERCIAL VEHICLE DRIVER QUESTIONNAIRE

For the following questions, please write a brief response in the blanks provided.

1. During what part of a typical work day are you most drowsy (e.g., when you first start your shift, after a meal break, at the end of your shift)?

- a. End of shift
- b. End of shift
- c. After a large meal
- d. 2 hours after a meal afternoon
- e. Between the hours of 3-6 am
- f. Early afternoon and close to midnight when running hard
- g. After meal break
- h. End of shift
- i. After meal break
- j. End of shift. Also any night (dark hours)
- k. Sleepy at 1:00-1:30 a.m.
- l. 1 a.m. to sun-up
- m. Midday to 3-4 p.m.

2. Over the course of a typical work week, how many days would you say that you feel drowsy while driving your truck?

- a. 2-3 (end of week)
- b. 5
- c. 5
- d. 2
- e. 2-3
- f. 8-10
- g. 2 days
- h. 2 of 7
- i. First day after break
- j. All at some time
- k. Three
- l. 2 days (Thursday, Friday)
- m. 3-4

3. Have you ever fallen asleep while driving your truck?

- a. Yes
- b. No
- c. No
- d. Yes
- e. No
- f. Yes
- g. Yes
- h. Yes

- i. Yes
- j. Yes
- k. No
- l. No
- m. No

4. Are there any ideas or thoughts that you would like to share with the researchers regarding the drowsiness monitoring system that was discussed today?

- a. Great idea. Need to incorporate an override that would allow driver to continue in any situation that would be unsafe to stop. Keep it simple. Allow for early warning to not wait till driver is completely fatigued before alerting.
- b. When installed needs to be in a location that will not be drawing your attention to it.
- c. Would this system, if installed, limit a person to make a living for his/her family? Will this be another restriction added to the burden that a driver already has. Well intended or not, I see another restriction.
- d. To be able to control the sensitivity of monitor. To be able to set different sounds of system. Set monitor to control truck functions such as speeds and power of truck. Maybe alert company of actions of driver.
- e. It all comes back to economics. If a company and driver can make a reasonable living by stopping regularly and following all of the laws drowsiness would not be a problem or issue.
- f. It is a good idea that has to get the human factor to accept and go along with.
- g. Good Idea. Need a place to stop.
- h. Good system.
- i. I very much approve, it's a good idea. Anything that will help safety to me is very good.
- j. Good ideas!!
- k. I would like to know when this monitoring system is going to be tested. I would like to see everyone in these classes get to test the monitoring system on the road.
- l. No
- m. The alert system would be perfect if you had a safe and roomy place to pull over.