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Safety of Railroad Employees' Use of Personal Electronic Devices

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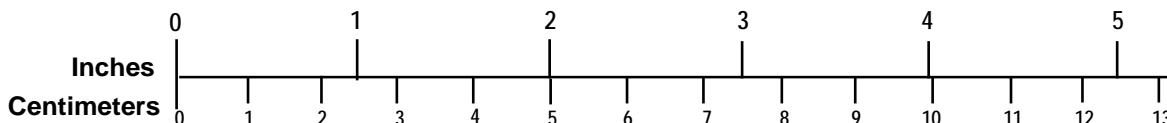
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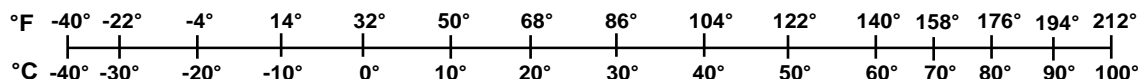
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PREFACE

This research report describes two studies aimed at understanding employee workplace distraction resulting from the use of personal and company-issued electronic devices. Study I, which began in 2010, included individual listening sessions with railroad employees, along with analyses of railroad efficiency testing results and accident databases to provide the Federal Railroad Administration (FRA) with information regarding the use of personal electronic devices (PEDs) among maintenance of way and signal maintenance railroad employees. If warranted, FRA could consider expanding existing regulations prohibiting and or restricting the use of PEDs beyond those employees who operate trains to include other safety-related railroad occupations or crafts.

Study II, which began in 2012, employed structured focus group procedures and supplemental individual listening sessions to increase the number of safety-related railroad crafts considered and build upon the findings of Study I, to provide a qualitative baseline of PED usage among safety-critical employees on the job. Study II included locomotive engineers, conductors, dispatchers, and car inspectors. The focus groups and supplemental listening sessions provided information and data regarding employees' use of personal and company-issued electronic devices, as well as attitudes toward their safety impact. The baseline of usage and attitudes will be considered in an evaluation of an education and outreach program coordinated by a Railroad Safety Advisory Committee (RSAC) working group on electronic device distraction.

The results from these studies provide a baseline qualitative assessment of personal and company-issued electronic device use among safety-related railroad crafts. Employees described the circumstances in which they use them, their attitudes toward the use of these devices, and their understanding of and views on employee compliance with federal regulations and company rules designed to prevent their use from causing distraction-related safety hazards.

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Finally, the authors acknowledge the contribution of the maintenance of way employees, signalmen, locomotive engineers, conductors, car inspectors, dispatchers, and the railroad safety facilitator who contributed to the study's information meetings. Their shared insights, experiences, first-hand accounts, and opinions about electronic device distraction were instrumental in the successful completion of this project. This project was sponsored by the FRA Office of Research and Development in collaboration with the Office of Railroad Safety. The authors would like to thank Tom Raslear, FRA Office of Research and Development, the sponsor of Study I, as well as Andrew Martin, Michael Fitzpatrick, and Miriam Kloeppel of the FRA Office of Railroad Safety, the sponsor of Study II, for their comments on earlier drafts of the report.

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EXECUTIVE SUMMARY

As part of its response to the Rail Safety Improvement Act of 2008, the Federal Railroad Administration (FRA), Office of Research and Development and Office of Railroad Safety, sponsored two studies to understand the use of company-issued and personal electronic devices (PEDs) by safety-related railroad employees while on the job. These studies focus on the potentially distracting effects of electronic device usage among railroad employees and are intended to provide formative information about the prevalence of and circumstances surrounding PED usage among railroad employees. PEDs include cell phones, smart phones, video games, mp3s, personal tablets, e-readers, and other mobile communication, information, and entertainment devices. Company-issued electronic devices refer to any mobile electronic device supplied by the railroad for business purposes.

Study I results are intended to provide information about expanding the current Restrictions on Railroad Operating Employees' Use of Cell Telephones and Other Electronic Devices (49 CFR Part 220, 2009) to include categories of non-operating safety-related railroad personnel. In contrast, Study II results are intended to provide a qualitative baseline for a survey evaluation of an education and outreach program that is being developed and coordinated by a Railroad Safety Advisory Committee (RSAC) working group on electronic device distraction.

Studies I and II collected perspectives, opinions, and work experiences from selected employees when they were off duty. Study I included one-on-one information meetings (conducted over the phone) with maintenance of way (MOW) employees and signalmen, two union leaders, and a railroad safety officer. Study II included two focus groups with locomotive engineers, conductors, car inspectors, and dispatchers, as well as two individual listening sessions conducted over the phone. Table 6 and Table 7 summarize the most common observations, insights, and comments expressed by those participating in these discussions.

Study I also included research into FRA's safety databases to identify reportable incidents and accidents involving MOW employees and signalmen that occurred since 2000. If these employees were involved in events related to their use of PEDs, then researchers propose that FRA consider expanding existing Federal rules regarding their use. The team examined the 2009 efficiency test results from three railroads. To complement these analyses, the team also gathered information about railroad policies and procedures on electronic device usage. The team also conducted a Web-based search for Federal or State rules and regulations that restrict employees' use of PEDs in other transportation modes. They also examined information about the aviation, maritime, and road transportation modes, as well as an executive order affecting all modes. In most cases, the policies or rules followed serious accidents where vehicle operator distraction attributed to PED use was identified as a probable cause. Only two reports were found in FRA's accident/incident database that described an event attributed to distraction, and those records did not describe what caused the distraction.

Current railroad operating rules and FRA policies and regulations were also reviewed to identify specificity, degree of restriction, and PED definitions. Some policies indicated specific devices as well as

situations or circumstances in which PED usage was allowed or prohibited. Other rules stated general restrictions (e.g., blanket prohibitions), or limited PED usage to when “it is safe to use.”

Finally, Study I also used information obtained from three railroads, including efficiency test materials and results, rulebooks, policies, company newsletter articles and bulletins, 2009 employee efficiency exam results, and supplementary instructions for PED usage rules. Efficiency exams are written tests and operational performance observations of railroad employees conducted periodically to ensure that employees fully understand and comply with Federal safety regulations and company work rules and procedures. Caution is required to draw inferences from this limited sample of exam results, but the efficiency test results suggest that employee compliance with limitations on PED usage may vary across railroads. For example, one railroad reported 10 percent noncompliance with a rule that prohibited using PEDs within 4 feet of a track, but efficiency tests at another railroad rarely found noncompliance.

Information meetings from Studies I and II provided researchers with the opportunity to collect firsthand perspectives from employees who may use electronic devices in the field or who may see others using electronic devices. Study I found that most of the “rank and file” MOW and signalman participants carried only their company-issued cellphone during the work day and did not support expansion of the operating employee prohibition on cell phones.

- Four thought that the railroad’s current rules were sufficient.
- Seven suggested that employees follow the local foreman’s best practices.
- Four suggested expanding the federal regulation; two of those four thought that it should be adjusted for the specific crafts.

The Study II participants consisted of both operating (engineers and conductors) and non-operating (car inspectors and dispatchers) safety-critical personnel.

- They did not want to risk using an electronic device improperly because it could jeopardize their employment status.
- They would approach colleagues and remind them about the rule if they were in violation.
- Car inspectors and passenger conductors described scenarios in which using their personal cell phone made their work more efficient.

There were a small number of participants in each of the two studies; therefore, results should be interpreted cautiously. However, the results of the information meetings suggest that if the federal rule is expanded, it should be tailored to particular crafts. Neither study found substantial evidence of inappropriate use. At this time, assessing the prevalence of unauthorized or prohibited PED use on the job will require additional data collection and study. Nevertheless, railroad employees should not feel complacent about their safety regarding the use of PEDs. Recent accidents at Chatsworth, CA, (<http://www.fra.dot.gov/eLib/details/L01917>) and Santiago de Compostela, Spain (<http://www.cnn.com/2013/07/30/world/europe/spain-train-crash>) illustrate the potential disastrous consequences of inappropriate, unauthorized, or prohibited use of PEDs in the railroad operating environment.

1. INTRODUCTION

1.1 BACKGROUND

On September 30, 2009, Secretary of Transportation Ray LaHood launched an initiative to increase awareness and understanding of the dangers inherent in the distracted operation of a vehicle in different transportation modes and convened the first of two National Distracted Driving Summits (September 30, 2009, and September 21, 2010) to emphasize the dangers of distracted driving. The following month, the Secretary testified before the Senate Committee on Commerce, Science, and Transportation that, in 2008, the Department “began enforcing limitations on texting and cell phone use throughout the rail industry.” He also described the initiation of rulemaking “to codify restrictions on the use of cell phones and other electronic devices in rail operations” (LaHood, 2009).

The Federal Railroad Administration (FRA) issued Emergency Order Number 26, (EO 26) on Oct 7, 2008, less than a month after a September 12 collision in Chatsworth, CA, that resulted in 25 fatalities. An investigation by the National Transportation Safety Board (NTSB) found that just prior to this collision the engineer had been frequently using a cell phone. NTSB determined that the Chatsworth collision was probably caused by “the failure of the Metrolink engineer to observe and appropriately respond to the red signal aspect at Control Point Topanga because he was engaged in prohibited use of a wireless device, specifically text messaging that distracted him from his duties” (NTSB, 2010a, vii). EO 26 restricted “on-duty railroad operating employees from improperly using cell telephones and other distracting electronic and electrical devices,” because “company rules and procedures have not been effective....” EO 26 was replaced by a final rule, Federal Regulations Concerning the Use of Electronic Devices (49 Code of Federal Regulations or CFR Part 220 Subpart C), effective in March 2011. This rule placed restrictions on “electronic devices such as mobile telephones (cell phones or cellular phones) and laptop computers.” Other electronic devices, such as tablets and smart phones, were not specifically described or included in the regulation.

1.2 PURPOSE AND SCOPE

Section 405 (Locomotive Cab Studies) of the Rail Safety Improvement Act of 2008 (RSIA, 2008) called for research on the prevalence and safety impact of the use of personal electronic devices (PEDs), including cell phones, video games, personal digital assistants (PDAs), and other distracting devices, by “safety-related railroad employees” while on duty. “Safety-related employees,” as defined in section 20102(4) of title 49, United States Code, include employees who inspect, repair, or maintain locomotives, passenger cars, or freight trains, and any other employee of a railroad carrier who affects railroad safety. The RSIA amended this definition to explicitly include signal employees and employees who maintain the right-of-way of a railroad, as well as certain other employees.

FRA is responding to this call. In addition to the studies discussed here, FRA is also supporting a railroad study that uses the Cab Technology Integration Laboratory, a railroad locomotive simulator at the Volpe National Transportation Systems Center, to examine how locomotive engineer distraction contributes to rule infractions (Parasuraman, Isaac, & Fisher, 2012). Additionally, a RSAC working group comprised of railroad, union, and government representatives formed an Electronic Device Distraction working group

to address this issue through employee education. FRA has begun to evaluate the progress of this educational program.

This report describes two studies; the first started in 2010 and the second in 2012. Study I, limited to MOW employees and signalmen, sought to understand the safety impact associated with distraction from employee use of PEDs during the performance of their duties. The intent of this study was to provide FRA with information related to the possible expansion of the Restrictions on Railroad Operating Employees' Use of Cellular Telephones and Other Electronic Devices (49 CFR 220) to include these non-operating safety critical crafts. The authors listened to employees as they discussed their use of personal and company-issued electronic devices while on the job, their attitudes toward the use of such devices, and whether there are situations in which the use of PEDs is common. This information was supplemented with analyses of company training on their rules regarding distraction from PED usage and with analyses of rules and their comprehension and application (efficiency testing), as these factors comprise the context for PED usage.

Study II employed a similar methodology to address PED and company-issued electronic device use among locomotive engineers, conductors, car inspectors (car men), and dispatchers. In this effort, researchers asked about employee use of personal and company-issued electronic devices among locomotive engineers, conductors, car inspectors, and dispatchers. Additionally, the researchers sought to understand the circumstances in which these electronic devices might be used while on the job and employee opinions regarding their potential for distraction. An important objective of this data collection effort was to provide a qualitative baseline of PED and company-issued electronic device use to assist FRA in evaluating efforts directed toward eliminating PED distraction through education about safe and rule-compliant use.

1.3 SAFETY-RELATED RAILROAD CRAFTS

The scope of this research was limited to safety-critical railroad employees because their work has consequences for their own safety or the safety of other employees, passengers, and people living or working near the railroad. These crafts include: MOW employees, signalmen, locomotive engineers, conductors, dispatchers, and car inspectors. The initial scope of this work also included machinists; however, the researchers were unable to recruit members of this craft for the study.

1.3.1 Study I: Maintenance of Way and Signalmen

Both MOW employees and signal-maintenance personnel work, either singly or in groups, outside throughout the year and in all types of weather. The approximately 30,950 MOW employees¹ build and maintain tracks, bridges, buildings, and other structures on the railroad. As part of their duties, they

¹ Numbers of employees estimated as of May, 2012 were obtained from http://www.bls.gov/oes/current/naics4_482100.htm.

conduct inspections and repairs of railroad infrastructure. The 6,550 signal-maintenance personnel are responsible for constructing, installing, repairing, upgrading, and maintaining communication equipment and automatic signal, electronic switch notification systems, warning systems used in the movement and coordination of trains for the railroad, and equipment for the protection of grade crossings. Signal-maintenance personnel conduct inspections and maintain signal systems.

To protect MOW employees and signal maintainers, the dispatcher creates work zones that trains and moving equipment cannot enter. In some cases, trains and moving equipment can enter the protected work zone with permission from the employee in charge of the work zone. The dispatcher uses a variety of mechanisms to protect employees working on the track. These methods include foul time, train approach warning, track and time, individual track protection, and Form D train orders.

- Foul time, according to a Northeast Operating Rules Advisory Committee (NORAC) rule, is “a method of providing working limits through exclusive track occupancy in which notification is given and recorded by the train dispatcher or control operator to a roadway worker that no trains will operate within a specific segment of controlled track during a specific time period, and that the required blocking devices have been placed on the control point to protect the track to be fouled” (United Signal Employee Handbook On-Track Safety Program, p. 3–4).
- Train Approach Warning provided by watchmen/lookouts is used when the work consists of inspection by track walking, minor repairs performed using hand-carried tools, or is conducted outside the working limits of the track. One or more watchmen are assigned to positions from which they can see and warn other maintenance workers of oncoming trains so that they can reach a predetermined place of safety at least 15 seconds before trains (moving at the maximum authorized speed) reach the work area. At the approach of a train, watchmen sound a whistle or an air horn to warn workers within the foul area (within 4 feet of all rails) to vacate immediately. Under current labor agreements and Federal workplace safety regulations, workers have the right to such protection when working within foul limits.
- Track and time allows for a dispatcher, at the request of a railroad employee, to block off a section of track for a specific amount of time. This allows that employee to move about that section of track to conduct repairs or inspections. The dispatcher logs the requested “track and time” and prevents any trains from using that section of track during the specified time period.
- For tasks that take place mostly or entirely outside of the foul limits (e.g., some signal maintenance tasks), for work on tracks with low train speeds and low train frequency, and if other specified safety conditions apply, workers may elect to work without a watchman using individual track protection, meaning that he or she is responsible for his or her own safety.
- Form D train orders or track warrants are permissions given by dispatchers to trains in their territory which gives them authority to operate or travel on certain tracks without risk of coming in contact with another train in the same territory.

The type of protection depends on the work being performed. When not protected by one of the methods described earlier, the watchmen or solo workers must remain alert for the sight and/or sounds of an approaching train. In most situations, train approaches are noticeable well in advance of the 15-second

action limit. Due to the expectation that they will always be noticed in time by the train crew, employees may become complacent and fail to maintain vigilance, especially because they are performing other tasks besides watching for approaching trains. These considerations underscore the importance of watchmen remaining vigilant and communicating effectively with the dispatchers. This study examines how PEDs may add to the burden of maintaining vigilance for approaching trains.

1.3.2 Study II: Locomotive Engineers, Conductors, Dispatchers, and Car Inspectors

Both freight and passenger locomotive engineers work primarily in the locomotive cab where they operate the locomotive. The 37,540 locomotive engineers are responsible for monitoring displays inside locomotive cab and monitoring the outside environment. The locomotive engineer's workload can vary during a trip from low to high depending upon conditions. Even during periods of low workload, however, it is important to monitor the outside surroundings for signals that may unexpectedly change, grade crossings that may have cars on the tracks, and for trespassers along the right-of-way.

Freight railroad conductors work inside and outside of the locomotive cab, supporting the engineer, dropping off and picking up cars at industry yards, and switching and moving cars en route and in the yards. The railroad company may issue onboard work order devices, similar to tablet computers, to many freight conductors who use them to report deliveries and pick-ups to their railroad. Passenger railroad conductor work is different from that of freight conductors. They primarily work inside the train (outside of the locomotive cab) and are responsible for assisting passengers with ticketing and communicating with the engineer using onboard radio regarding signals and station stops. Passenger conductors may use an electronic device such as a company-issued and restricted smart phone like the Apple iPhone for ticketing purposes while onboard the train as part of their duties. There are approximately 39,840 conductors, including yardmasters, in this country.

The 2,710 railroad dispatchers in the United States manage, coordinate, and monitor the safe and efficient movement of trains, roadway workers, and equipment on a given company's rail network. Dispatchers work in an office environment and use computers and radio communications to carry out their tasks. Dispatchers are responsible for safely and efficiently moving trains and protecting roadway workers on the tracks, which includes knowing where all trains and workers are within their territory.

Car inspectors work in the shop or on the track to build, inspect, and repair rail cars. There are 12,140 rail car repairers in the United States. They must remain vigilant while on the job to prevent collisions with moving cars on the right-of-way and when working with heavy equipment in the shop to avoid injuries.

2. SAFETY ISSUES RELATED TO DISTRACTION FROM PED USE

The following section provides an overview of the scientific literature regarding safety issues related to electronic device usage. Most of the empirical evidence about the distraction caused by PED use comes from automobile drivers and concerns the effects of using cell phones, either handheld or hands free, on driver distraction.

Recent large scale surveys indicate that cell phone use is widespread among motor vehicle drivers. The National Occupant Protection Use Survey (NHTSA, 2011), is an annual, nationally representative observational survey conducted by the National Center for Statistics and Analysis that collects driver behavior data including information regarding restraint (child and seat belt) practices by drivers and passengers, motorcycle helmet use, and cell phone use, among other areas of interest. This study observed drivers for 40 minutes at each of 2,500 randomly selected intersections with traffic control devices (signals, stop signs). In 2010, 5 percent of drivers were observed holding a handheld phone to their ear while stopped at randomly selected intersections during daylight hours. These data provided an estimate of approximately 660,000 drivers who use cell phones while driving in the United States. This was about the same as in the 2008 survey (NHTSA, 2009) when approximately 6 percent of drivers were observed using handheld cell phones while driving during daytime hours (an estimated 812,000 drivers nationally). In the 2010 survey, cell phone use in the youngest demographic category (ages 21 to 24) was 2 percent higher than in the older driver category (ages 25 to 69), a trend consistently found in this survey since its inception in 2004. These findings suggest that cell phone use and potential distraction are inversely related to age.

The National Survey on Distracted Driving Attitudes and Behaviors (Schroeder, Meyers, & Kostyniuk, 2013), is a telephone survey last conducted in 2012. It asks participants to rate how often they perform a specific task while driving. The survey reported that, overall, the incidence of cell phone use remained stable between 2010 and 2012, similar to the reported incidence between 2008 and 2009. The 2012 survey found that

- 48% of drivers reported that they at least sometimes answer a cell phone while driving;
- 24% reported that they at least sometimes place a call; and
- 10% said that they at least sometimes send a text message or email.

The survey classified drivers as “distraction-prone” and “distraction-averse.” Distraction-prone drivers (15.2%) were likelier than distraction-averse drivers to receive or make phone calls while driving (1.4%). Almost two-thirds (64.8%) of drivers in the 21 to 24 year age group were classified as distraction-prone, a higher percentage than any other age group.

What are the consequences of cell phone distraction among drivers? The 100-Car Naturalistic Driving Study monitored 109 drivers who commuted to and from the Washington, DC, area for 1 year (Klauer, Dingus, Neale, Sudweeks & Ramsey, 2006). Researchers documented driver behavior, the vehicle environment, and other potential factors in critical incidents, near crashes, and crashes. These 109 participants drove more than 2 million miles and accumulated more than 43,000 hours of driving. They

had 69 crashes, 761 near crashes, and 8,295 incidents. The study identified the causal factors for crashes through video data analysis and police accident reports. One causal factor was “inattention,” which included “secondary task involvement,” defined as “driver behavior that diverts the driver’s attention away from the driving task” (p. 21). Examples of secondary tasks at the time of the study included eating and talking on a cell phone or to a passenger. Engaging in a secondary task contributed to 22 percent of the crashes and near-crashes. When drivers took their eyes off the road for more than 2 seconds during a 6-second interval, their odds of involvement in a crash or a near-crash increased significantly. Dialing a cell phone took their eyes off the road for more than 3 seconds, as did lighting a cigarette, reading, applying makeup, and attending to objects and events inside or outside the vehicle. However, talking to a passenger in the adjacent seat (a simple secondary task) significantly decreased risk by 50 percent relative to crash or near-crash risk when the driver performed no secondary task. A driving simulation and on road study similarly found that simple secondary tasks such as listening to the radio or to books on tape placed a low level of cognitive demand on the driver (Strayer, Cooper, Turrill, Coleman, Madeiros-Ward & Biondi, 2013). Using a handheld device did not significantly increase the odds of a crash or near-crash in the 2006 analysis. However, a re-analysis of the 2006 data found that moderate and complex secondary tasks, including using a handheld device, significantly increased the risk of driver involvement in a crash or near-crash (Klauer, S., Guo, F., Sudweeks, J., & Dingus, T., 2010). Young (2011) confirmed that talking on a cell phone does not in itself increase crash risk in “naturalistic” studies of actual driving, but secondary tasks such as dialing a handheld device significantly increase the risk of experiencing at least a near-crash.

The hazards of driving while using a PED, typically a cell phone, are well documented in laboratory research. For example, experimental evidence from a driving simulation study (Burns, Parkes, Burton, Smith, & Burch, 2002) showed that drivers respond more slowly to road signs while using a cell phone (handheld or hands free) than while alcohol-impaired. Strayer, Drews & Crouch (2006) also compared alcohol-impaired driving to driving while using a cell phone in a simulation study. They showed that the effects of using a handheld or hands-free cell phone while driving could be as “profound” as the effects of driving while impaired at illegal alcohol levels in terms of delayed braking reactions and more rear end collisions. These studies demonstrate that cell phone use can have negative consequences for the performance of the tasks necessary for the safe operation of both trains and automobiles.

It is worth noting that both of these studies found worse driving with both handheld and hands-free cell phones, compared to drivers without any distraction from speaking on a phone. Although even “hands-free” phones require some manual inputs to place the headset or ear buds adjacent to the driver’s ears, and possibly to disentangle wires, these findings suggest that the distraction that they cause is not entirely due to interference with hands and eyes. Strayer, Drews, & Johnson (2003) provided clear evidence of this by showing that after driving, drivers using a hands-free cellphone recognized half as many road signs that they had encountered as drivers who were not using a cellphone even though the researchers used an eye tracker to show that the drivers who were using a cell phone looked at the signs as much as the drivers who were not using a cell phone. This finding was reinforced in a meta-analysis (Horrey & Wickens, 2006), a type of study that statistically combines the results of many prior experimental results (23 were compared in this meta-analysis). The authors concluded that “the costs in driving performance are

equivalent across hands-free and handheld phones, suggesting that the larger part of these costs is attributable to the cognitive aspects of conversation and not to the manual aspects of holding the phone” (p. 203). This evidence suggests that when drivers use cellphones they are affected by “cognitive distraction,” which “includes any thoughts that absorb the driver’s attention to the point that they are no longer able to navigate through the road environment safely” (Young & Regan, 2007, p. 381).

Recently, Holland & Rathod (2013) extended our understanding of the negative effects of cell phone use in a driving simulator experiment where young drivers placed their own cell phones where they normally would while driving. The researchers instructed the drivers not to answer the phone if it rang. The driving scenario provided various hazards, including a pedestrian crossing the road when the cell phone rang; the researchers compared this situation to one in which the pedestrian crossed without the driver’s cell phone ringing. They found that 41 percent of the drivers collided with the pedestrian when the cell phone rang, but none collided with pedestrians when it did not. This study implies that a cell phone does not need to interfere with a driver’s vision or hearing for it to reduce the driver’s vigilance and that it may be necessary for a driver to turn off a PED that can ring if the driver needs to maintain unimpaired vigilance.

What about PEDs that require the use of hands and eyes to operate? A simulation study of text messaging among novice drivers with texting experience showed how these drivers responded to the following four situations: a red light, car following, lane change situations, and pedestrian and vehicle hazards (Hosking, Young, & Regan, 2007). When sending and receiving text messages using a Nokia™ cell phone with auto-completion, the drivers spent up to 400 percent more time with their eyes directed away from the road and failed to respond to lane change signs more often than when they did not receive and send text messages. Furthermore, the amount of effort that the texting task requires is important. On drives during which drivers alphabetized five-letter strings on an iPhone 4, they responded 0.7 seconds slower and failed more often to respond to driving hazards than on drives during which they copied the same five-letter strings; however, copying them led to no more failures to respond or slower responses than when the drivers did not enter any text (Burge and Chapparo, 2012).

There is also evidence that cell phone use could lead employees to pay less attention to safety rules. Beede & Kass (2006) found that hands-free cell phone use resulted in more traffic violations (speeding, lane violations, and running stop signs and traffic signals) in a driving simulation than driving without the cell phone.

Laboratory studies of how PED use affects driving have not been limited to cell phones. Young, Mitsopoulos-Rubens, Rudin-Brown, & Lenné (2012) reported a driving simulator experiment that required drivers to search for a particular song title using a finger motion to scroll through an alphabetized list displayed by the iPod Touch, a portable music player. The study found that the drivers looked away from the road, on average, more than four times as much when they were searching for a song as when they were not searching for a song. An earlier driving simulator study by Chisolm, Caird, & Lockhart (2008) employed scenarios with hazardous events, including the car ahead braking and pedestrians and

other cars appearing in the path of the driver. Performing a similar song title search task (from a much longer alphabetized list of song titles) resulted in 53 collisions, significantly more than the 28 that occurred when the drivers were not searching for a song title. Most of the drivers in these studies had prior experience using digital music players.

Chiang, Brooks, & Weir (2004) recorded address and city entry in a production vehicle navigation system on city streets and on an urban motorway. After viewing destination information on a cue card, the drivers made entries on the system touchscreen that provided a list of potential addresses or cities after the driver correctly touched several letters or numbers. The drivers took approximately 34 seconds to complete the task and while completing it, looked at the display more than twice as long, on average, as they looked at the road. However, this amount of inattention did not result in more lane departures.

To what extent are these findings related to PED distraction among railroad employees? Luke, Heavisides, & Basacik (2013) consider this question in an assessment of ways to manage cell phone use in the United Kingdom's rail industry. Noting that the lack of lateral control and longer timeframe for decisions in rail operation distinguishes it from motor vehicle operation, the authors conclude that the most relevant effect of PED distraction for rail is an increased failure to detect signals. According to a recent article, in the United Kingdom, ScotRail claims that "at least 37 SPADS [signals passed at danger] have been attributed to mobile phone use in recent years" (May/June, 2013, Mobile Technology, CIRAS, p. 2). Other potential effects of PED distraction include increased reaction time that would slow an engineer's sounding of the train horn to warn a trespasser and detection of other unexpected hazards.

Pedestrian Use

Although many crafts ride and operate a variety of vehicles and equipment, they also perform work on foot near railroad tracks that may be active; so, they share attention requirements with pedestrians as well as drivers. They are vulnerable to hazards that are similar to those faced by pedestrians who use a PED while walking. In fact, fatalities have occurred when rail employees and contractors walked across the tracks while using a cell phone and were struck by a train².

Research has shown that cell phone use has an effect on pedestrian walking behavior. Hatfield & Murphy (2007) found that while talking on a cell phone, pedestrians were less likely to look at traffic before or while crossing the street at an unsignalized intersection and also less likely to wait for traffic to stop before entering the road at a signalized intersection. Although this effect was only found among female pedestrians in the study, Nasar, Hecht & Wener (2008) also observed in a field study that cell phone users crossed unsafely into oncoming traffic more often than those crossing while not using cell phones. In a third field study, pedestrians using cell phones weaved while crossing a public square, compared to those not using a phone or those using music players, and did not report seeing an unexpected and otherwise

² FRA Incident 0608HO008; Safety Database – 4.06 – *Casualty Detail Report*

memorable event: a clown on a unicycle riding along their route (Hyman, Boss, Wise, McKensie & Caggiano, 2010). These studies also found that cell phone users walk more slowly, which Neider, McCarley, Crowell, Kaczmariski, & Kramer (2010, p. 593) interpret as “evidence of a diminished ability to process visual stimuli while conversing on a cell phone.”

Cell phone use is also linked to pedestrians’ cognitive awareness. Stavrinou, Byington, & Schwebel (2011, p. 105) found that using a cell phone to perform “more cognitively demanding tasks may have an effect on the visual attention of pedestrians,” including attention to traffic. The cognitively demanding tasks included conversation, mental arithmetic, and describing the participant’s living quarters. In addition, laboratory evidence suggests that PED use could distract an employee from performing his or her duties, resulting in interruptions and delays and errors when redirecting attention to the task at hand. (Monk, Boehm-Davis & Trafton, 2004; Bailey & Konstan, 2006).

In summary, the literature on driving and pedestrian PED usage suggests that distraction from PEDs can result in errors in performing work tasks. Distraction from PEDs can also alter railroad employees’ situational awareness while they walk near tracks to a work site or in a rail yard, or operate a locomotive or other mobile equipment. It may also affect their adherence to safety rules while engaged in safety critical work. Finally, research conducted on drivers’ and pedestrians’ use of PEDs indicates that railroad employees who use PEDs while operating trains or on-track vehicles, or who work in the vicinity of railroad tracks, may expose themselves and others to increased safety risks.

This research emphasizes the need for effective countermeasures to unsafe PED usage by railroad employees. In response to earlier findings that suggest statutory requirements for the use of hands-free devices have not had a long term effect on road safety, the Swedish National Road and Transport Research Institute (VTI) created a “toolbox” of countermeasures that could be employed as alternatives to banning the use of PEDs while driving (Kircher, et al. 2012). The authors describe 18 countermeasures within three broad overlapping areas: Education/Information, Technology, and Society. Technological countermeasures that could transfer by analogy to the railroad industry include “rail mode” applications (a term used by a participant in the present study) and systems that provide a PED interface embedded in the locomotive cab. Societal countermeasures take an economic perspective to address “why the behavior of individuals is or needs to be regulated in the first place” (p. 62) and proposes possible financial interventions based on the finding that individuals do not assess their distraction risks well or decide to “consume” excessive risk. The educational countermeasures aim to “influence the motive behind the action (such as attitudes and norms)...and require help in drawing the correct conclusions” (p. 46). For example, the prohibition on handheld phones is erroneously interpreted by some drivers to mean that it is safe to use hands-free devices.

3. METHODOLOGY

3.1 OVERVIEW

The methods used in Study I and Study II differed in that Study I used a wider variety of methods to understand distraction from PED usage and the context in which it occurs. Study I included an examination of the policies regarding PED usage across transportation modes, an analysis of FRA reported incidents and accidents that were attributed to PED usage, a description of current railroad rules, an analysis of recent results from efficiency testing that railroads conduct to ensure rule compliance, and informational meetings. Study II included only informational meetings.

Study I and II consisted of listening sessions, information meetings, and focus groups. Listening sessions were used primarily with union representatives to gain insight into and understanding of the different crafts and to get their perspective and input on fictional scenarios. The information meetings and focus groups followed a general topic agenda. Participants were asked to comment on different topics and scenarios. In Study I, one-on-one information meetings were conducted with the participant and researcher. In Study II, focus groups were held with 3–5 participants.

Study I collected information relating to PED usage from six sources:

- 1) Current policies of different transportation modes, state laws, and federal agency directives;
- 2) Reports of railroad incidents and accidents that occurred within the past 11 years involving MOW employees or signalmen and PED usage;
- 3) Current railroad industry rules;
- 4) Efficiency test materials and results regarding PED usage;
- 5) Efficiency test results;
- 6) Listening sessions with union leaders and railroad management representatives; and
- 7) Individual listening sessions with MOW employees and signalmen.

Study II expanded upon Study I and collected information about company-issued and PED usage through:

- 1) Focus groups conducted in person with locomotive engineers, conductors, dispatchers, and car inspectors and
- 2) Supplemental individual listening sessions conducted by telephone with safety critical employees under the age of 30.

3.2 POLICIES OF TRANSPORTATION MODES AND OTHER GOVERNMENT AGENCIES

Study I examined policies for PED use that have been implemented in other transportation modes. FRA policies are summarized in Section 1.1. Federal and state policies for the aviation, maritime, transit, highway, and motor carrier modes were obtained using Web-based searches including the following databases and Web sites:

- Federal Transit Administration's National Transit Database
- Federal Aviation Administration's (FAA's) Advisory Circular and Information for Operators (InFO) databases
- Federal Aviation Regulations (FARs)
- U.S. Government Printing Office
- United States Coast Guard (USCG) Navigation Center Web site
- NTSB Accident Reports and Safety Recommendations databases
- Federal Motor Carriers Safety Administration's (FMCSA's) Rules and Regulations database
- Presidential Executive Orders Web site
- Governors Highway Safety Association Cell Phone and Texting Laws Web site

These sources were accessed and searched using the following keyword search terms: electronic, cell, personal, device, phone, telephone, portable, company, distraction, and PED.

3.3 FRA REPORTED INCIDENTS AND ACCIDENTS

Study I included a search of the 2009 database entries in the FRA Office of Safety Analysis railroad incident and accident databases. Forms that were considered for this task contained information related to job classification³. There were two forms that met this criterion:

1. FRA Factual Railroad Accident Report (Form 6180.54)
2. Railroad Injury and Illness Summary Continuation Sheet (6181.55a)

The FRA Factual Railroad Accident Report (6180.54) is used for reporting collisions, derailments, fires, explosions, and other accidents involving the operation of standing or moving railroad on-track equipment that result in damages in excess of \$6,700⁴. This form provides information about the type of equipment involved in the incident, but not the job classification of personnel involved. Therefore, this form was not used. Similar limitations led to the exclusion of the Highway-Rail Grade Crossing Accident/Incidents report (6180.57). The Railroad Injury and Illness Summary report (6180.55) summarizes a railroad's accident/incident data for a given month, including operational data, such as the total mileage traveled by that company in a given period of time across all personnel and equipment, number of personnel and type of casualties, and any other reports that are associated with the accident/incident. This form is used for all railroad accidents and incidents, but does not contain enough information about the causes and circumstances of casualties to be useful for this study, so it was not included.

³ Highway-Rail Grade Crossing Accident/Incidents (Form 6180.57) & Railroad Injury and Illness Summary (6180.55)

⁴ At the time of this analysis, the threshold was \$6700; the current threshold is \$9900.

The Railroad Injury and Illness Summary Continuation Sheet (6180.55a) records information about each accident or incident such as the job code of the employee, the physical act that the employee was performing at the time, the event (or injury) that occurred, its cause, and a narrative description of the event. The type and specificity of the information on this form would support analysis. The narrative provided a way to identify whether a PED was involved in the incident or accident. Therefore, researchers conducted an analysis that focused on the past 11 years of railroad accidents and incidents (2000 through 2010) reported using this form. The analysis described the frequency of incidents/accidents that involved MOW employees or signalmen by year, the physical location of the event, the equipment involved, the location of the person involved in the incident, the cause of the event, and whether distraction due to PED usage was cited in the narrative as its cause.

3.4 RAILROAD RULES

Researchers conducted a Web-based search of railroad operating rules to identify railroad company policies for PED usage. Policies were obtained from railroad Web sites supplemented by the Metrolink rules cited in the NTSB report of its investigation of the Chatsworth, CA collision. Part of the NTSB report, Exhibit 3-T, Docket No. DCA-08-MR009 (NTSB, 2009 February), includes “instructions, policies and/or rules that place restrictions on cell telephones” that different railroads provided to NTSB. For this analysis, researchers also examined the current rules regarding PED usage within the Canadian Rail Operating Rules (Rail Association of Canada, 2008), General Code of Operating Rules (GCOR, 2010), and the Northeast Operating Rules Advisory Committee (NORAC, 2008).

3.5 EFFICIENCY TESTING

An efficiency exam is a proficiency test (written exam) given once a year or observation of railroad employees made periodically throughout the year (a manager’s observations) that assesses the employee’s understanding, knowledge, and adherence to rail operating and safety rules. Each railroad conducts its own efficiency tests based on its policies.

In Study I, researchers collected copies of efficiency exams, rulebooks, policies, company newsletter articles and instructions about PED usage, bulletin orders, and 2009 efficiency exam results for four railroads. Three of the four railroads’ efficiency exam results included job codes permitting the selection of results specifically for MOW employees and signalmen. The fourth railroad’s exam results lacked this information and were omitted.

3.6 INFORMATION MEETINGS

Study I and II both consisted of information meetings (individual listening sessions with employees and focus groups) to understand the prevalence of electronic device usage in the industry and identify employee attitudes regarding electronic devices. Additionally, the information meetings sought to understand when, and under what circumstances, employees perceived the use of electronic devices to be a distraction that could result in unsafe conditions on the job; researchers also collected other information that could be useful in countering the unsafe use of PEDs. The term “listening session” is used here to

refer to largely unstructured and open-ended opportunities that the researchers provide to employees for the purpose of discussing the issue, how the employees learned about it, and how best to address it.

3.6.1 Participants

Study I included information meetings with a total of 13 participants: ten rank-and-file employees, two union leaders, and one railroad manager. These sessions occurred in July and August of 2011.

Participants included:

- 6 freight railroad signalmen
- 1 passenger railroad signalman
- 2 freight railroad MOW employees
- 1 passenger railroad MOW employee
- 2 union leaders (BMWED & BRS)
- 1 freight railroad safety manager

All ten rank-and-file employees received a \$100 gift card as incentive to participate (all signalmen and MOW employees who offered to participate were included in the study). Rank-and-file participants' position titles included Foreman, Signal Inspector, Electronics Technician, Signal Maintainer, Truck Driver, Safety Facilitator, and Bridge and Building Mechanic. Five supervised gangs of more than five other railroad employees. All worked a 5-day, 8-hour work schedule. All but one owned a personal cell phone, and all ten used a company cell phone. All participants were male.

Study II included two focus groups and two listening sessions with a total of nine employees. The railroad crafts and the freight and passenger railroad breakdown of Study II participants are listed below:

- 1 freight railroad engineer
- 1 passenger railroad engineer
- 2 freight railroad conductors
- 1 passenger railroad conductor
- 2 passenger railroad dispatchers
- 2 passenger railroad car inspectors

The rank and file participants' years of experience is shown in Table 1. The focus groups took place at the Volpe Center during February and March of 2013. Each lasted approximately 2 hours. Four employees participated in the first focus group and three participated in the second. In addition to the focus groups, researchers conducted two telephone listening sessions with individual employees, each lasting approximately 1 hour. The employees participated during their off-duty hours and, as in Study I, each received a \$100 gift card as an incentive.

Table 1. *Years of Railroad Work Experience for Rank and File Participants*

	Study I	Study II
10 years or less	1	1
11–20 years	4	5
More than 20 years	5	3

Five of the participants worked 5-day shifts and four were on-call employees. All owned a personal cell phone and four possessed at least one company-issued electronic device. Participants owned GPS navigation devices, e-readers, tablets, laptop and desktop computers, and MP3 players. All participants were male.

3.6.2 Materials

The materials for both studies consisted of an agenda with lists of potential topics, questions to prompt the participants, if necessary, and a set of scenarios involving the use of PEDs by employees in various crafts.

The topics on the agenda for both studies included the following:

- Prevalence of PED usage
- Frequency of PED usage
- Circumstances of PED usage, safe and unsafe situations
- Need for PEDs for work purposes
- Rules governing PED usage, how employees learn about them, application to non-operating employees, attitudes toward these rules, and consequences for noncompliance

See Appendix B for a complete list of items and prompts.

The scenarios used in Study I covered the following fictional characters and situations involving signalmen and MOW employees:

- Employee use of cell phone to contact dispatcher when radio service is intermittent
- Using personal phone while handling switching equipment
- Wearing a Bluetooth earpiece while operating equipment on track, cell phone in “on” position, in holster; not currently using phone
- Possible effects of using mobile phone applications (“apps”) to obtain track information, access “repair databases,” track warrants/authorities
- Using cell phone while off-duty, riding in nonleading locomotive, and not in the company of on-duty personnel
- Using phone in moving, operating cab of locomotive, in presence of engineer

- Using cell phone while walking around hi-rail⁵ vehicle
- Employee working in track gang when phone rings in employee's grip; employee removes it from clip, mutes phone, places back in clip, and returns to duties

See Appendix C for a complete list of the scenarios used in Study I.

Scenarios in Study II addressed fictional situations surrounding locomotive engineer, conductor, car inspector, and dispatcher use of a PED:

- Using a company-issued phone while another employee is returning to the train
- Using a PED while repairing a locomotive engine on track
- Wearing a Bluetooth earpiece while conducting switching operations
- Deadheading off-duty employee in nonleading locomotive receives and sends text messages
- Employee uses cell phone next to main track while inspecting car in repair facility
- Employee uses phone while waiting for train to depart as another employee drives back to release handbrakes on rear of train
- Employees call and text while holding for an hour at an interlocking
- Employees use phones while train in dark territory on single track is proceeding at 20 mph
- Dispatcher uses cell phone, when radio reception is intermittent and choppy, to call road foreman about broken-down train to keep desk phone line open

See Appendix D for a complete list of the scenarios used in Study II.

3.6.3 Procedure

Study I consisted of 10 one-on-one information meetings with rank-and-file employees. Information meetings took place during the participants' off-duty hours and lasted 1–2 hours each. Information meetings were held over the phone. Listening sessions with union leaders and management also occurred on the phone.

Study II consisted of two focus groups and two one-on-one information meetings. The focus groups were held at the Volpe Center with off-duty employees and lasted approximately 2 hours each. One-on-one information meetings were supplementary and resulted from feedback received during the focus groups. These information meetings were held over the phone with off-duty freight conductors under the age of 30 and lasted approximately 1 hour each.

The format for information meetings and focus groups with rank-and-file employees was the same for Study I and Study II. The remaining three Study I information meetings followed a similar open format and addressed many of the same issues, but did not use the topical agenda or scenarios. At the beginning of each meeting, the facilitator outlined what the participant(s) should expect during the session,

⁵ A hi-rail vehicle is a modified automobile, generally a sport utility vehicle, designed to operate on highways and railways.

identified the researchers who were present, and explained that notes were being taken, but that any personally identifiable information from the participant(s) would not be kept. Before the conversation began, the facilitator ensured that the participant(s) understood the purpose of the session and answered any questions they had about the study. The sessions were loosely structured around a set of topics and scenarios (see above). The facilitator selected from among these topics and scenarios to ensure they were all considered during individual listening sessions in Study I and across the focus group listening sessions in Study II. The topics and prompts were tailored to the specific crafts present in the information meeting and to the individual or group's flow of ideas, perceptions, and opinions. The selection of scenarios (below) also followed this relatively unstructured procedure in both studies. Four or five scenarios were typically presented depending on the remaining time. The facilitator clarified what was said, asked different members of the focus groups what they thought, and turned to a new topic or scenario when the participant(s) finished discussing the current one. The particular issues discussed differed with each information meeting.

Study I & II: Data Analysis

The method of analysis of the information meeting data was the same for both Study I and Study II. Following each information meeting, the research team compared notes taken by each team member to ensure that the information was correct and consistent. Final notes for each information meeting were typed into separate documents. For information meetings that were conducted as focus groups, comments were separated by participant so that each participant's comments were co-located in one document. The team members coded the final documents to identify common themes across participants using ATLAS TI® Version 5, a software application designed for qualitative data analysis. Appendix E contains the coding scheme. Results from the data analysis are provided in the following section.

4. RESULTS

Study I analyzed the PED policies of U. S. government transportation agencies. Study I also analyzed FRA incident, accident, and injury reports, railroad rules regarding the use of PED, results of railroad efficiency testing of PED rule compliance, and notes from information meetings with MOW employees and signalmen. Study II analyzed notes from information meetings with locomotive engineers, conductors, dispatchers, and car inspectors. The following section describes the results of these analyses.

4.1 POLICIES OF TRANSPORTATION MODES AND OTHER GOVERNMENT AGENCIES (STUDY I)

PED use by an operator can present safety hazards in all modes of transportation, not just rail. NTSB, an independent federal agency focused on ensuring transportation safety, has recommendations and policies to reduce unsafe use of PEDs. Additionally, states have recognized that PED use can present a safety hazard and, as result, some have limited or outlawed texting and speaking on handheld cell phones while operating a motor vehicle. This section of the report provides a summary of regulations that other U.S. Department of Transportation modal administrations have issued to limit PED use and increase transportation safety.

Aviation

FAA issued Federal Aviation Regulation (FAR) 14 CFR Part 121.542 in 1981 which states that:

“...no flight crew member may engage in...any activity during critical phases of flight (takeoff, taxiing landing, and flight operations under 10,000 ft.) which could distract any flight crewmember from the performance of his or her duties... activities such as eating meals, engaging in nonessential conversations within the cockpit or between cabin and cockpit crews, reading publications not related to proper conduct of the flight...” (Flight Crewmember Duties, 1981).

This regulation limited the actions and behaviors of cockpit members’ activities to only those necessary during critical phases of flight. The regulation does not specifically impose any limitations on PED usage, but does imply that using a PED for nonessential purposes would be prohibited.

In April 2010, FAA released an Information for Operators (InFo) (Cockpit Distractions, 2010) that specifically included flight deck use of PEDs as a safety risk. The guidance document did not mandate, but strongly suggested that crewmembers focus only on tasks directly related to flight activities. PEDs were defined as “laptops and mobile telephones.” This InFo was created after an October 21, 2009, incident in which two aircraft pilots lost situational awareness while using laptop computers in the cockpit for non-flight related activities and overflowed their destination by 150 miles. The InFo also called for the creation of a safety culture that establishes guidance, expectations, and requirements controlling cockpit distraction and for a review of flight crew training related to PED usage.

On January 15, 2013, FAA issued a Notice of Proposed Rulemaking titled Prohibition on Personal Use of Electronic Devices on the Flight Deck. The proposed rule would prohibit flight crew members in air carrier operations from using a wireless communications device or laptop computer for personal use while at their duty station on the flight deck during aircraft operation. Its purpose is to “to ensure that certain nonessential activities do not contribute to the challenge of task management on the flight deck or a loss of situational awareness due to attention to nonessential tasks” (Federal Register, p. 2912). This rule would respond to the FAA Modernization and Reform Act of 2012, which also states that “this prohibition does not apply to the use of a personal wireless communications device or laptop computer for a purpose directly related to operation of the aircraft, or for emergency, safety-related, or employment-related communications.” The rule would prohibit the pilot in command from permitting any flight crewmember from using a laptop or PED. The Act and proposed Rule followed incidents in which pilots overflew their destination by 150 miles while using personal laptop computers and a pilot sent a text message from her cell phone while taxiing. The latter event violated the Sterile Cockpit Rule, which prohibits nonsafety related and potentially distracting activities on the flight deck during critical phases of flight.

Motor Vehicles and Trucking

In recent years, a number of states have passed laws prohibiting the use of texting on cell devices and only permitting use of a cell phone for conversation while driving in hands-free mode (GHSA, 2011). In addition, the U.S. DOT and a number of the modal administrations passed regulations regarding the use of PEDs. Executive Order 13513 (2009), “Federal Leadership on Reducing Text Messaging While Driving,” was issued in 2009. This Executive Order prohibits any federal employee from text messaging while driving in government owned, leased, or rented vehicles and driving privately owned vehicles while conducting official government business. It also prohibits the use while driving of a PED supplied by the government.

In 2010, the Federal Motor Carrier Safety Administration (FMCSA) prohibited texting by commercial motor vehicle (CMV) drivers while operating in interstate commerce. In addition, motor carriers were prohibited from requiring or allowing drivers to text message while driving (FMCSA, 2010). If a commercially licensed driver is convicted of texting while operating a CMV, his or her commercial driver’s license (CDL) may be suspended. The International Brotherhood of Teamsters issued a memorandum to all U.S. Local Unions on February 11, 2010, from their Safety and Health Department in response to FMCSA’s 49 CFR Part 390.17 that prohibited “commercial drivers from using electronic devices to prepare or review text messages while operating a commercial motor vehicle in interstate commerce” (Byrd, February 11, 2010). The purpose of this memo was to provide additional information, such as the definition of electronic devices and what constitutes “commercial motor vehicles” that fall under this regulation.

The Pipeline and Hazardous Material Safety Administration (PHMSA) issued a safety advisory (PHMSA, 2010) similar to the FAA’s.

This advisory urged motor carriers that transport hazardous material to institute policies and create awareness to discourage the use of PEDs by drivers. PHMSA issued this advisory in response to the NTSB accident report of a March 26, 2010, incident in which a semi-tractor trailer crossed a multilane highway and collided with a passenger van. Eleven people, including the tractor trailer driver and van driver, were killed. NTSB found that the tractor trailer driver was distracted by using his cell phone for calls and text messaging (NTSB, 2011).

Marine

NTSB investigated two incidents that occurred within 3 weeks of each other during the winter of 2009 and found that crewmember usage of a PED played a role in both incidents. On December 5, 2009, a U.S. Coast Guard vessel collided with a passenger vessel carrying 25 passengers; 6 were injured. On December 20, 2009, a Coast Guard vessel carrying 5 crew members collided with a recreational vessel carrying 13 passengers; 5 were injured, 1 fatally (Hersman, 2010 Summer). In response, on August 11, 2010, NTSB issued recommendation M-10-2 (NTSB, 2010b), which requested that the USCG “develop and implement...policies that address the use of cell telephones and other wireless devices aboard C.G. [USCG] vessels.” NTSB also issued M-10-3 (NTSB, 2010c) recommending that the maritime industry issue a safety advisory to create an awareness of the “risk posed by the use of cell telephones and other wireless devices.”

In response to these incidents and NTSB recommendations, the USCG issued a policy on September 1, 2010, that prohibited the use of electronic devices while onboard, unless it was approved by the person in charge (the coxswain) of the vessel and prohibited the person responsible for operating the boat from using a device at all while on duty (Boat Force Policy, 2010; Conley, 2011 March). NTSB subsequently closed its safety recommendation M-10-3 on December 14, 2010 indicating that the Board was satisfied with the USCG response. This policy pertains to a class of employees who, similar to MOW employees, signalmen, and employees who work as watchmen or foul tracks, do not operate vehicles, but should remain vigilant in the vicinity of moving vehicles. In summary, several modal administrations of the U.S. DOT responded to accidents and hazards caused by PED use by enacting policies governing their use.

4.2 ANALYSIS OF FRA INCIDENT, ACCIDENT, AND INJURY REPORTS (STUDY I)

The Railroad Injury and Illness Summary Continuation Sheet, Form 6180.55a, provided a database of 114,762 railroad accidents, incidents, and injuries that occurred between 2000 and 2010. These data are available from the FRA Office of Safety (see <http://safetydata.fra.dot.gov/OfficeofSafety/default.aspx>). Using the FRA Guide for Preparing Accident/Incident Reports (2011), in Study I the research team identified records involving a MOW employee or a signalman using the employee job codes.⁶ In total,

⁶ Job codes were based on the FRA Guide for Preparing Accident and Incident Reports (2011). The specific codes were: 300 to 315 for maintenance of way employees and 316 to 320 for signalmen. They included the following type of person codes: A (Worker on Duty - Railroad Employee); B (Railroad Employee Not on Duty); F (Worker on Duty – Contractor); G (Contractor –Other); and H (Worker on Duty –Volunteer).

12,918 MOW employees and 3,100 signalmen were involved in an accident or incident according to data accessed on February 11, 2011. The incidents involving MOW employees or signalmen were parsed to find incidents that involved distraction, specifically distraction caused by PED usage. The researchers examined contextual information such as the location, equipment involved, position of the person, and cause of the incident/accident to gain a more complete understanding of the type of incidents that most affected MOW and signalmen.

Figure 1 and Figure 2 depict the number of MOW employees and signalmen involved in an incident or accident from 2000 through 2010. There are more MOW personnel than signalmen in the United States. Possibly as a result of higher exposure, a higher number of MOW personnel than signalmen were involved in an incident/accident. The largest percentage of casualties occurred with section laborers and machine operators among the MOW employees, and with signalmen and signal maintainers among the signalmen. Section laborers usually work as members of a gang performing track and roadbed maintenance and repair. Machine operators operate several types of heavy machinery such as excavating equipment, tractors, graders, cranes, forklifts, and loaders. Signalmen and signal maintainers build, install, repair, upgrade, and inspect communication equipment and automatic signal, switch and warning systems used in the coordination and movement of rails for the railroad and protection of grade crossings.

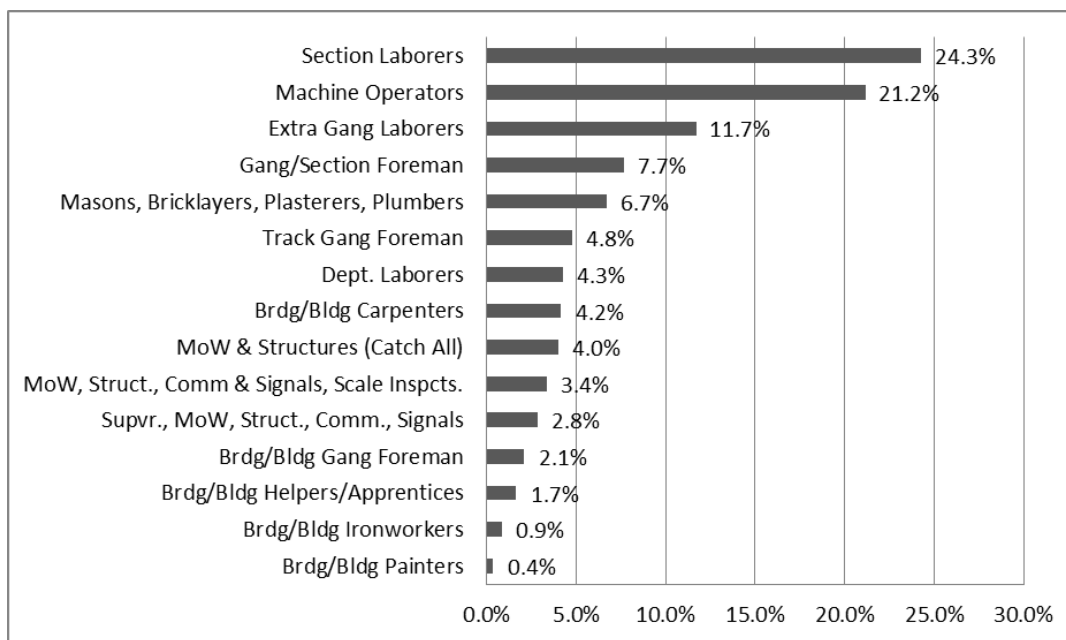


Figure 1. MOW employees involved in a casualty between 2000 and 2010

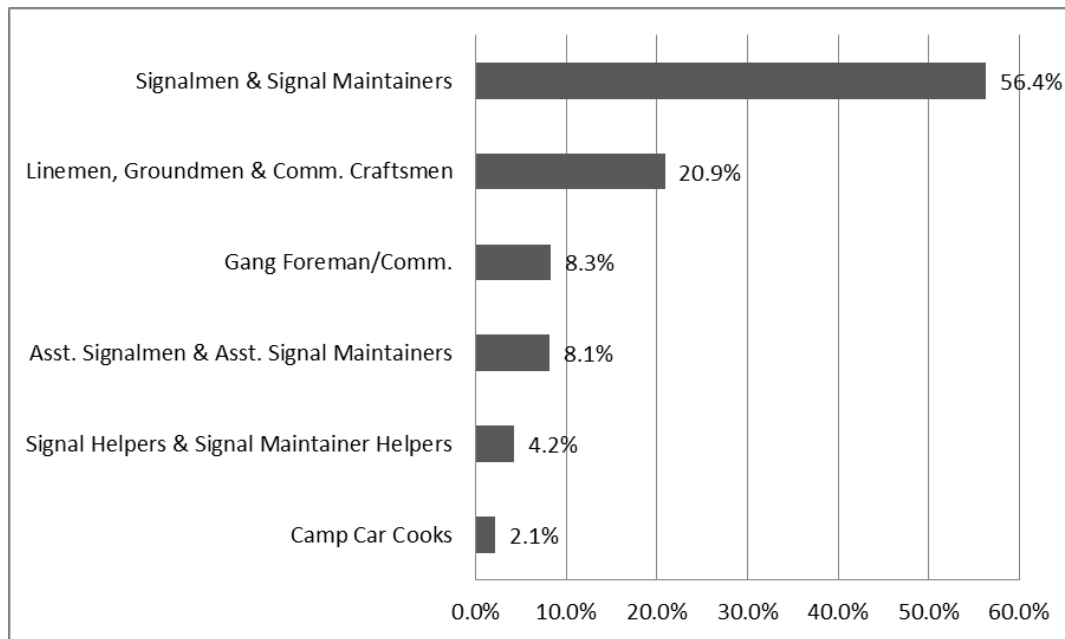


Figure 2. Signalmen involved in a casualty between 2000 and 2010

The percentages of employees in particular job categories who were involved in a casualty should be considered in relation to their percentages in the workforce. A higher percentage of casualties may suggest a higher level of vulnerability. Estimates of MOW workforce participation for the job categories with the highest percentages of casualty were obtained from Mr. Rick Inclima, Director of Safety for BMWED (personal communication, July 10, 2013). Comparing the casualty percentages in Figure 1 with his estimates, one finds that while the highest casualty percentages are from laborers (40.3%), laborers/trackmen account for an estimated 20 percent of the MOW workforce. In contrast, while track foremen and track inspectors make up an estimated 15 percent of the workforce, foremen comprise 4.8 percent of the casualties. Machine operators represent 21.2 percent of casualties and constitute an estimated 35 percent of employees. So, although it is important to treat the estimates with caution, it appears that laborers suffer more casualties than their numbers would predict, while the opposite applies to foremen and machine operators. The largest percentage of incidents/accidents occurred on or near the right-of-way main branch of track or yard for both MOW personnel (Figure 3) and signalmen (Figure 4). We observed similar trends in the percentage of incidents/accidents in specific locations. Incidents/accidents that involved MOW employees and signalmen occurred more often near right-of-way main branch tracks and yards, not near right-of-way at highway/roadway locations, passenger terminals, or repair facilities.

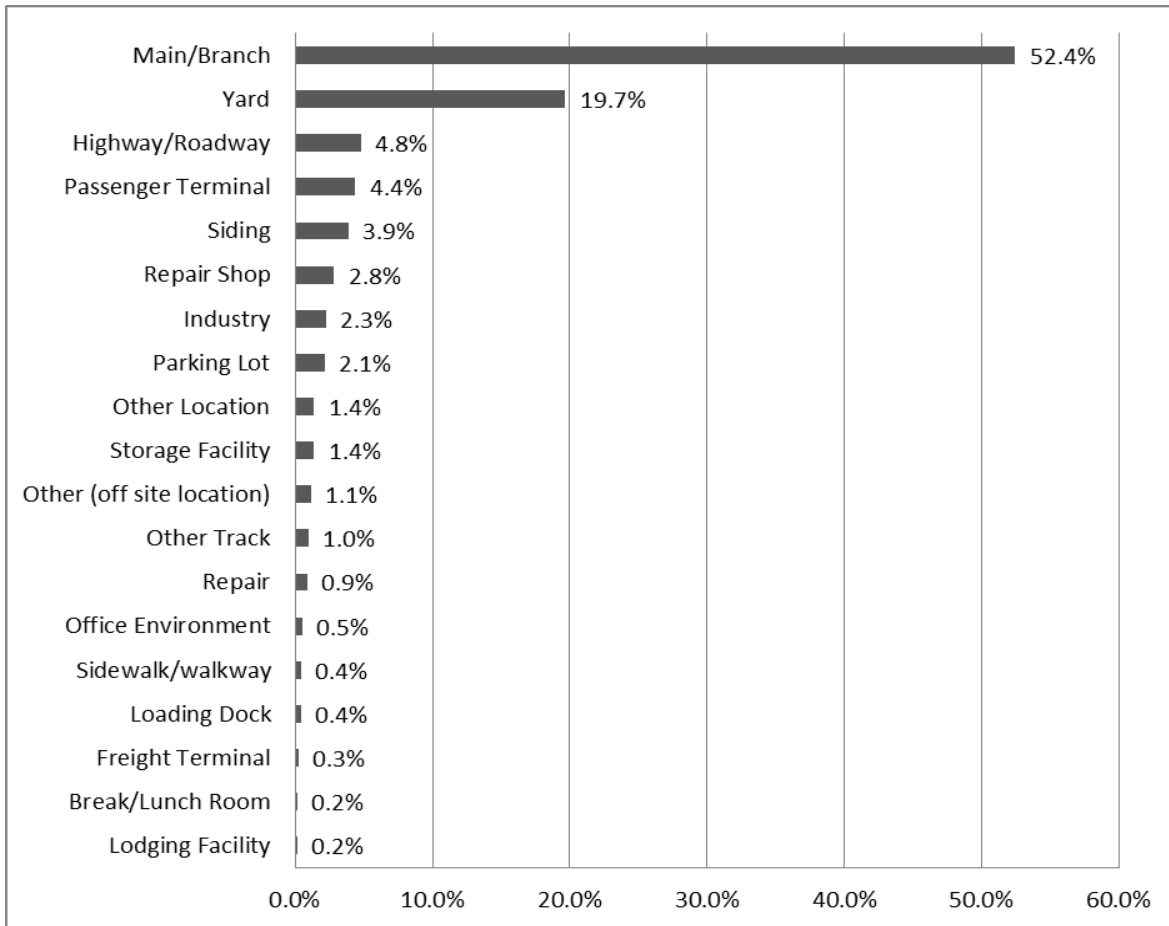


Figure 3. Locations of incidents/accidents involving MOW employees between 2000 and 2010

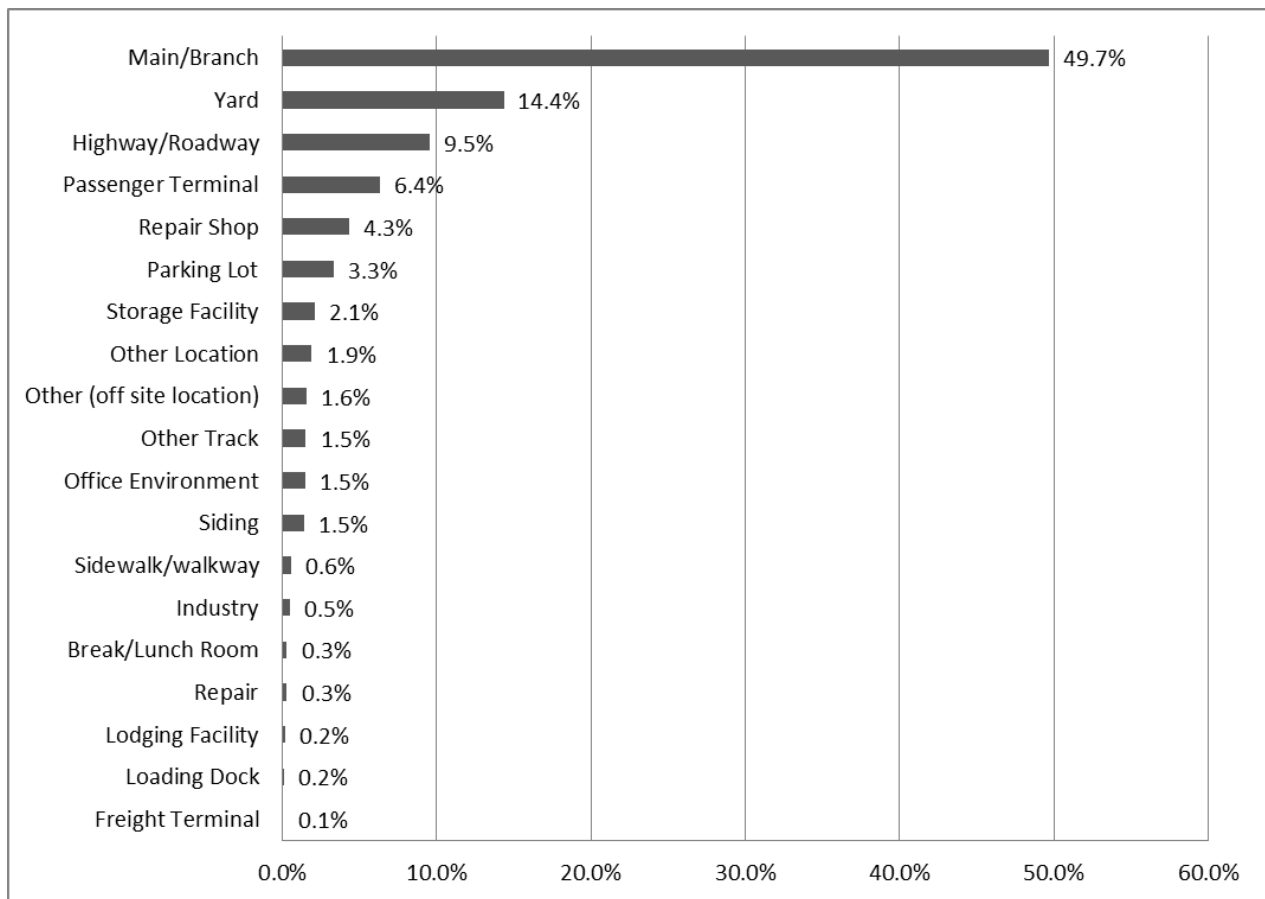


Figure 4. Locations of incidents/accidents involving signalmen between 2000 and 2010

Figure 5 and Figure 6 show the type of rail equipment, if any, involved in each incident/accident. Figure 7 and Figure 8 show the type of nonrail equipment, if any, involved. The percentages from these two figures do not total 100 percent because they exclude incidents and accidents that did not involve equipment. The most common types of equipment were MOW equipment and hi-rail vehicles for both MOW employees and signalmen. MOW equipment includes ballast cleaners, spikers, rail grinders, flangers (clears the space between sets of rails of ice and snow), and snowplows. Nonrail equipment includes trucks, cranes, loaders, and passenger vehicles. A majority of incidents/accidents for both MOW employees and signalmen involved rail equipment.

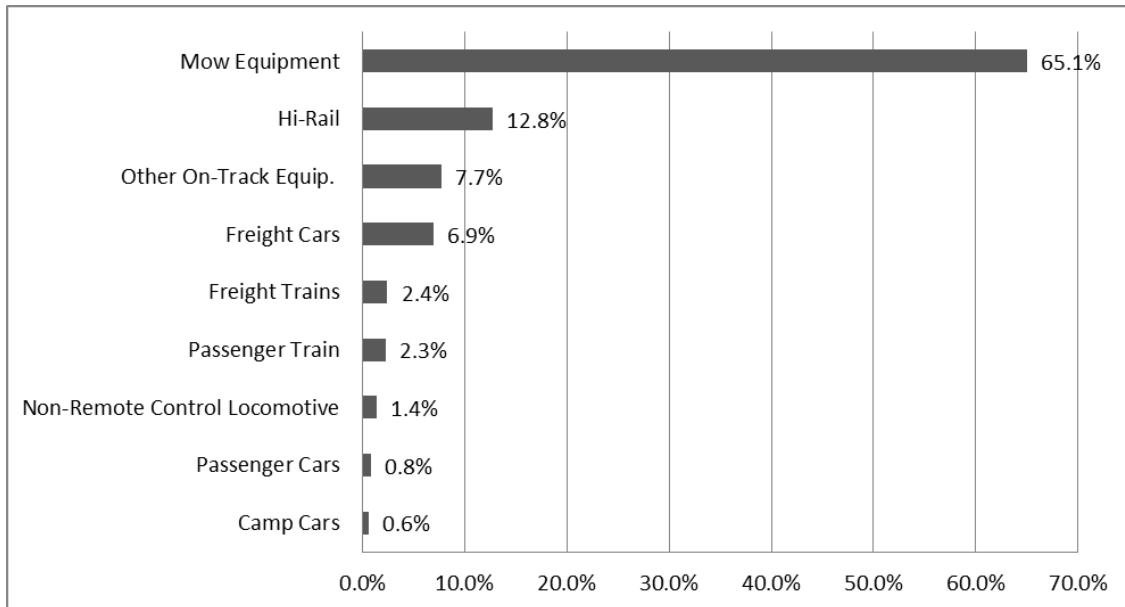


Figure 5. Type of rail equipment involved in incidents/accidents with MOW employees between 2000 and 2010

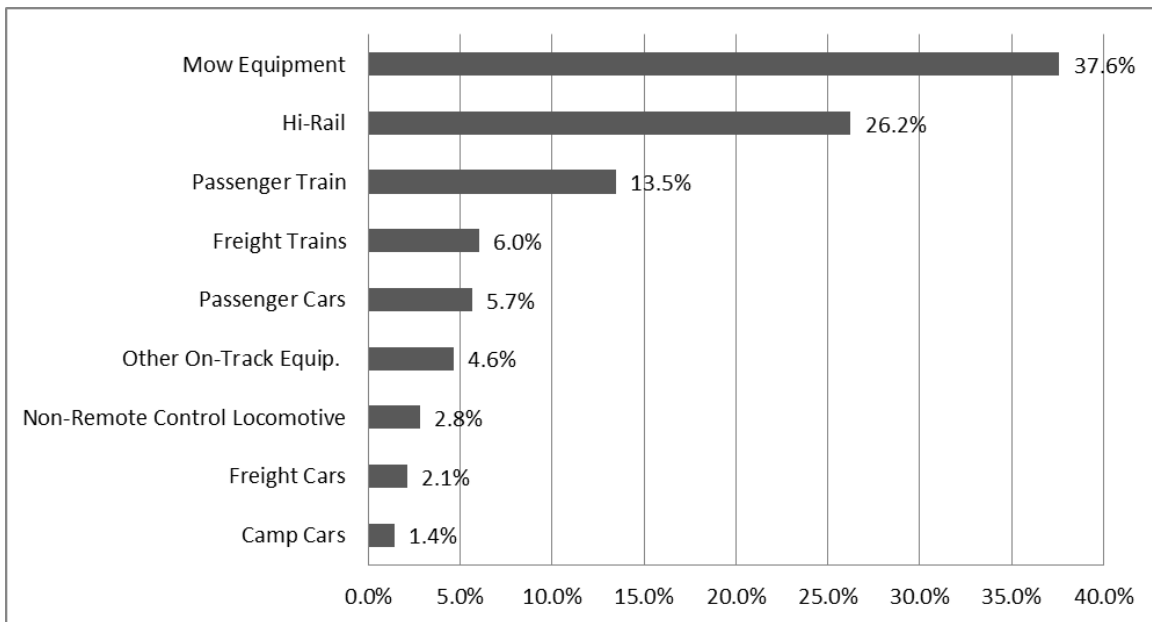


Figure 6. Type of rail equipment involved in incidents/accidents with signalmen between 2000 and 2010

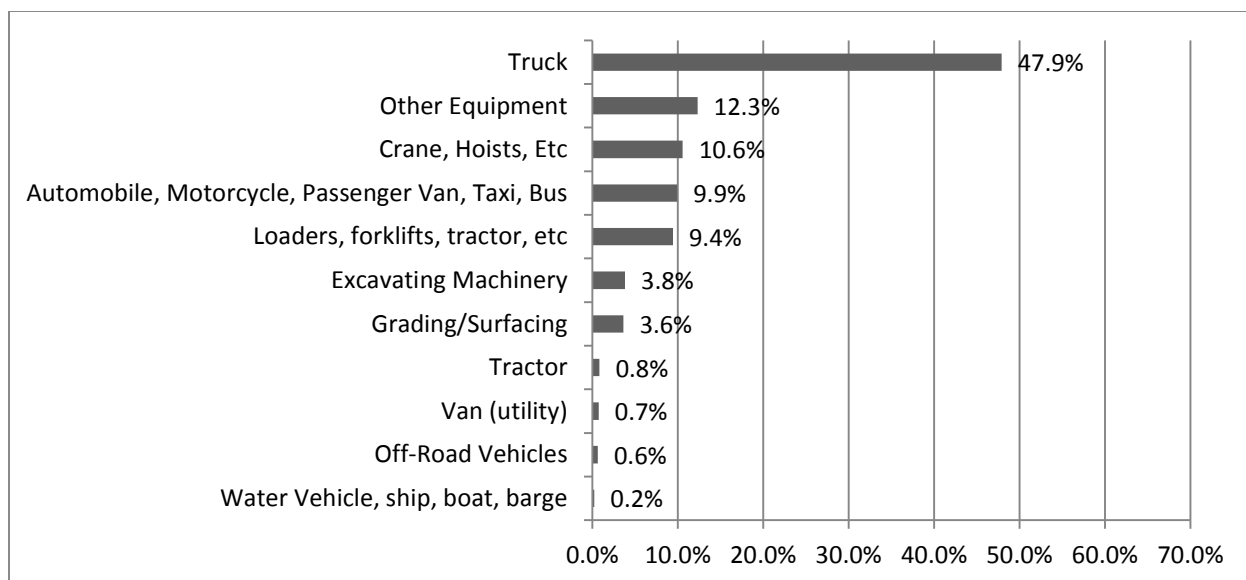


Figure 7. Types of nonrail equipment involved in incidents/accidents with MOW employees between 2000 and 2010

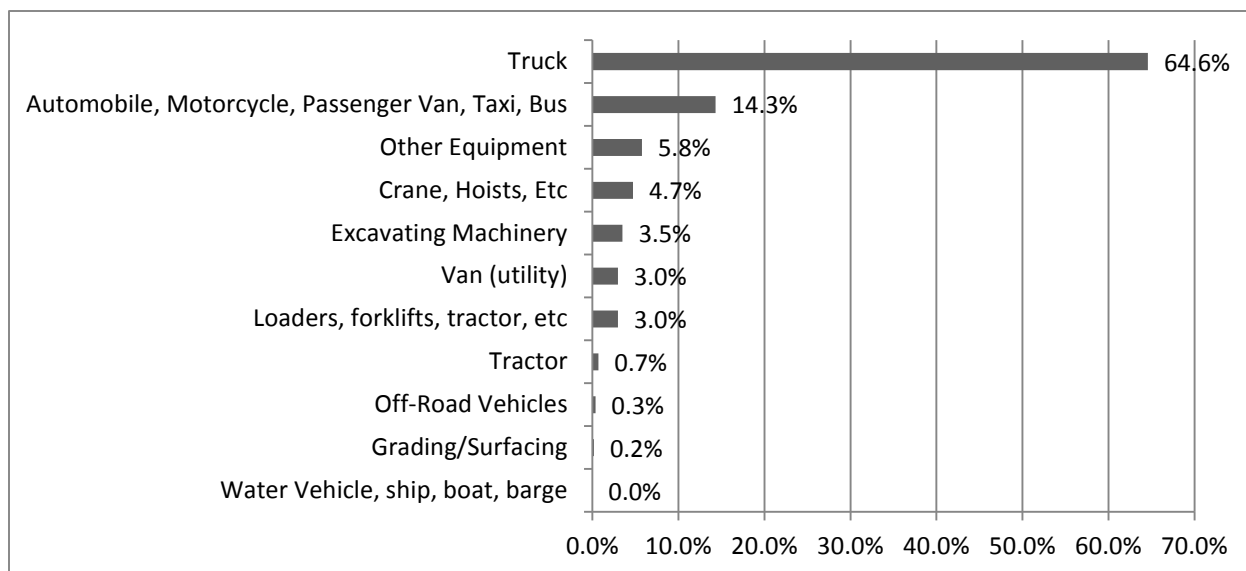


Figure 8. Types of nonrail equipment/vehicles involved in incidents/accidents with signalmen between 2000 and 2010

Form 6180.55a is also used by the railroads to report employee injuries. Figure 9 and Figure 10 show the locations where MOW employees and signalmen were injured. The most hazardous location for MOW workers was beside the track. Following injuries beside the tracks, MOW personnel were more likely to be involved in incidents/accidents on the track, at their work station, alongside ontrack equipment, between tracks, and in or operating vehicle, in that order. Injuries involving signalmen occurred beside

the track, at their work station, inside a vehicle, and between tracks. These findings indicate that a majority of the injuries involved personnel located within proximity of the tracks and highlight the need for employees to maintain constant safety awareness, especially in this location.

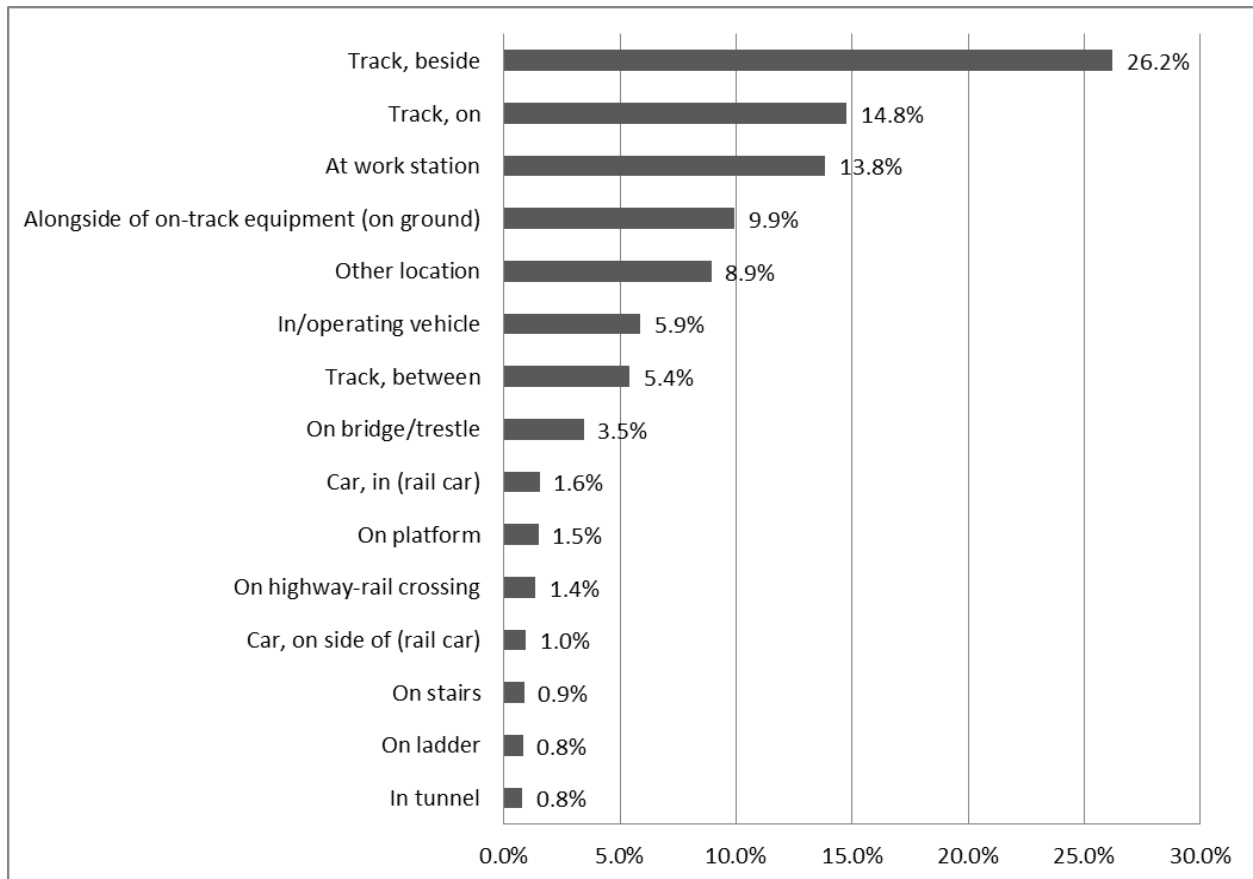


Figure 9. Top 15 locations of MOW employees when injured between 2000 and 2010

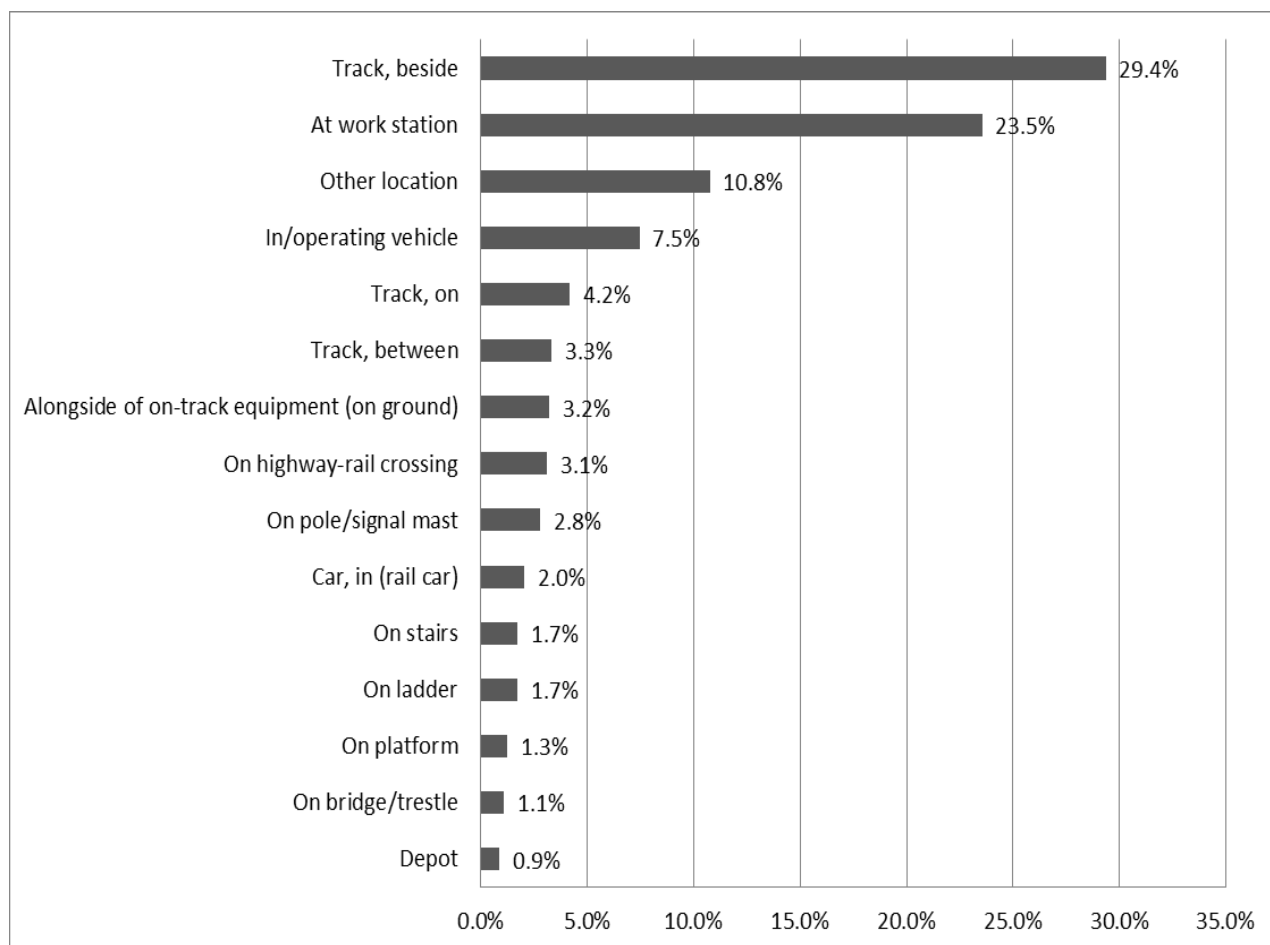


Figure 10. Top 15 locations of signalmen when injured between 2000 and 2010

The Railroad Injury and Illness Summary Continuation Sheet, Form 6180.55a, has two areas in which the probable reason for the injury-related incident/accident may be documented, the coded “Cause” field and the narrative description. Figure 11 and Figure 12 list the probable causes of the incidents/accidents that involved MOW employees and signalmen. “Human Factor” was the most prevalent probable cause code for both employee categories. Specific information about the human factor cause can be described in the narrative. Other probable cause codes, for example, “Procedures for Operating and Using Equipment Not Followed,” “Impairment, Physical Condition,” and “Insufficient Training,” are also types of human factors errors. If we include these as human factor probable causes, we have an even greater percentage of accidents/incidents resulting from human factor errors, which is well above the industry average of 35–40 percent (see safetydata.fra.dot.gov). Further research may be warranted to understand why these occupations have a higher human factor error cause than others.

Other frequently used probable cause codes for incidents/accidents involving MOW personnel and signalmen were Environmental (weather), Procedures for Operating and Using Equipment Not Followed, and Equipment. No cause was provided for approximately 16 percent of the incidents/accidents involving

a MOW employee and approximately 14 percent of incidents/accidents involving signalmen. Form 6180.55a does not require further explanation for an event that was caused by a human factor issue. But such clarification of the circumstances surrounding the human factor issue, for example, the impact of distraction on the event causation or the effect of disregarding any company rules, would enable in-depth analysis of the link between human factor errors and accidents/incidents and thus facilitate improved rules, training, and safer working conditions.

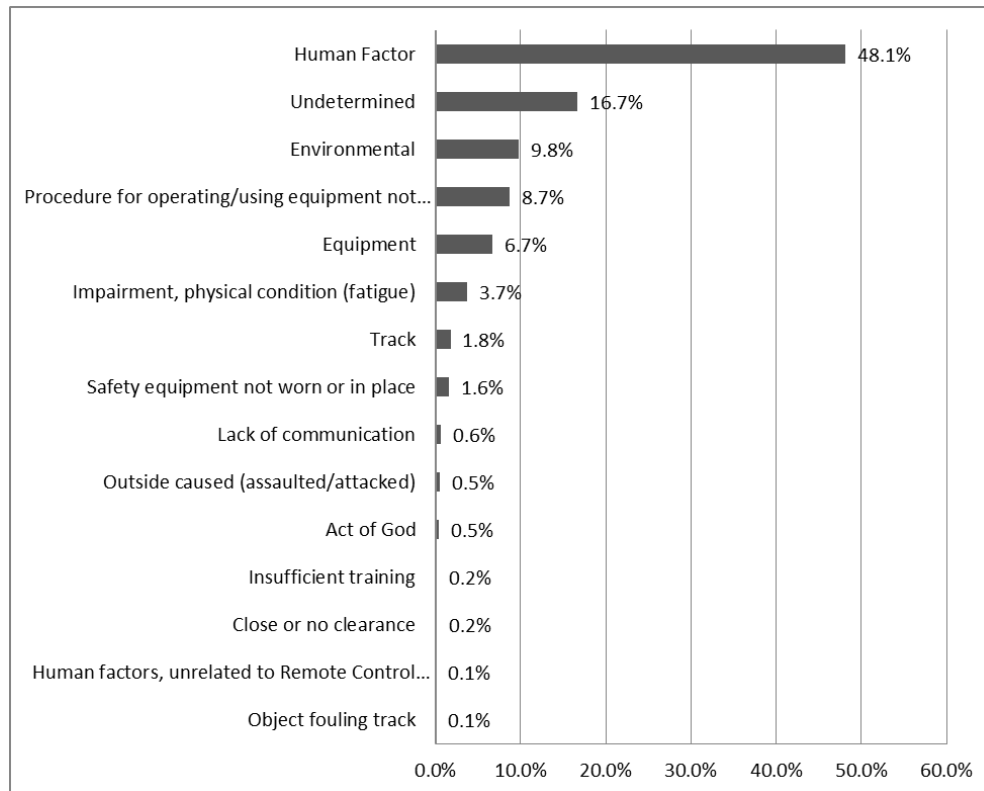


Figure 11. Top 15 probable causes of incidents/accidents involving MOW employees between 2000 and 2010

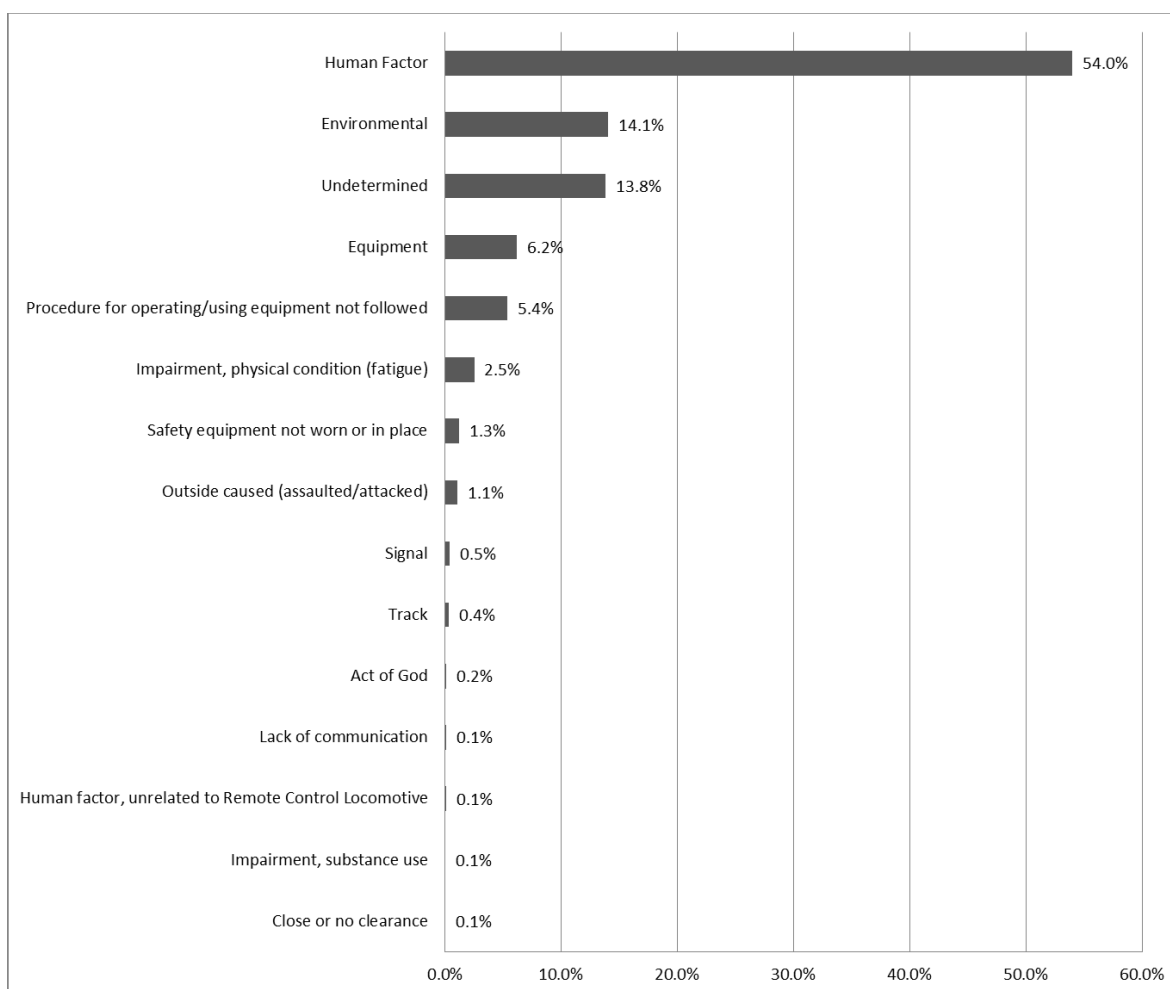


Figure 12. Top 15 probable causes of incidents/accidents involving signalmen between 2000 and 2010

An analysis of Form 6180.55a examined its narrative entries for information about distraction and PED usage. The examination employed forms of the following key search terms: Attention, Cell, Cell Company, Device, Distract, Distraction, Electronic, Phone, Personal Portable, and PED. The team read narratives with continuation sheets containing at least one of the key search terms to determine whether the incident/accident involved distraction and/or the use of a PED. The team identified four relevant narratives; three involved MOW employees and one involved a signalman. Appendix A provides a breakdown of the incidents/accidents, including the physical action and location of the person at the time of the event, its location, any equipment involved, its cause, and a narrative providing further details and explanation. Two of the four incidents described an incident/accident involving distraction. None of the events established an association between PED use and distraction. Although these results suggest that PED-related distraction was not associated with any incidents or accidents, it is possible that this finding simply reflects a limitation in the FRA reporting process. Information about the part that PEDs may have played in incidents and accidents is not specifically requested on the form.

4.3 ANALYSIS OF RAILROAD RULES (STUDY I)

This Study I analysis identified and compiled railroad industry rules restricting PED usage to understand what the rules allow, what they restrict, and their specificity. Our analysis found that Class 1 Railroads, local passenger railroads, and governing bodies instituted a total of 13 rules that apply to PED usage for these railroads. Table 2 provides a synopsis of many of the policies that various entities⁷ have instituted; it presents a readily available subset of the railroads and governing bodies that have instituted a rule, policy, best practice, or bulletin regarding PED usage. It shows examples from the railroad industry of the definitions, implementations, and interpretation of what is considered a PED and the circumstances under which their use is permitted. Some railroads use GCOR or NORAC PED definitions and procedures (APPENDIX A. NORAC (10th Edition) AND GCOR (6th Edition) ELECTRONIC DEVICE USAGE RULES), while others have implemented their own definitions and procedures. These rules apply to all employees, as specified (not limited to MOW and signalmen).

There is inconsistency among the different railroads and governing bodies on the guidance and the specificity of the rules. Some rules specified role responsibilities and job duties during which an employee could not use any electronic device that would divert attention and jeopardize safety; others treated their rule as a “blanket rule” that covers all rail employees at all times. Some did not indicate the distance from the track at which an employee could use a PED safely, nor did they all describe the appropriate practices for answering a call. For example, while some prohibit PED usage in foul of track, others prohibit their use within 25 feet of tracks. This variability can create particular difficulty for contract employees who work for multiple railroads. Their companies need to be aware of all applicable rules and instruct their employees to comply with a single rule that satisfies all customer requirements (e.g., if one railroad’s rule prohibits PED use within 4 feet of tracks and another within 10 feet, then the company should instruct the employees not to use PEDs within 10 feet).

⁷ “Entity” is used to refer to railroads and governing bodies.

Table 2. *Sample of Current Rules and Policies Regarding PED (Study I)*

Entity/rule	PED definition	Specific job roles	Situations safe to use	Situations not safe to use	Other authorized uses	Other unauthorized uses
Entity 1 <i>Class 1 (a)</i> System General Order No. 16, 10/27/2008	GCOR	General, all employees	Train is stopped and no member of the crew is engaged in activities.	Cell phones must be turned off and ear pieces removed when:	Access electronically stored rule-related files, but only after the train is stopped (text messaging, emailing, or use of other device features is prohibited)	GCOR
			For business purposes if user is not in the controlling unit or the cab room of the controlling car	Employees on moving trains		
			After safety briefing with all assigned crew members (all must agree on how communication can safely take place), to make mechanical or technical evaluations	Crew members are on the ground performing duties related to train movement, switching, performing air tests riding equipment, inspection of passing trains, assisting in preparation of train or fouling track	Will not interfere with any safety related duties, such as calling or acknowledging signals	
			During emergencies, while deadheading or on freight train, due to radio failure	Other employees performing safety related duties		

Entity/rule	PED definition	Specific job roles	Situations safe to use	Situations not safe to use	Other authorized uses	Other unauthorized uses
Entity 2 <i>Class 1 (b)</i> 2009 Incident Review, Study Guide, Rules Review	GCOR	General, all employees	Train is stopped after all required duties have been completed to report work activities.	Employee is standing in foul of track.	Cell phone may be used during emergencies.	GCOR
Entity 3 <i>Class 1(c)</i> Timetable No. 3, 4/1/2002	NORAC	General, all employees	NORAC	On a moving train	NORAC	For other than company business
				At controls of moving or on-track equipment		
				When using a cell phone will compromise rules compliance		Another employee is assisting in the preparation or repair of a train or OTE.
				Engaged in switching operations		
		Train and engine service employees		Riding on the lead engine or controlling end of train		
				Not in a place of safety within 25 feet of nearest rail		
Entity 4 <i>Class 1 (d)</i> Operating Rules, General Regulations: GR-27: Attention to Duty – Cellular	<ul style="list-style-type: none">• laptop,• PDA/palm pilot,• blackberry,• DVD/cd player,• audio player,• electronic work order reporting device,• wireless	Crew members and on-track equipment operators	GCOR	On moving train, engine, or on-track is moving... PEDs must be turned off.	Train, engine, or on-track equipment is stopped.	Activities that would: <ul style="list-style-type: none">• jeopardize their personal safety or the safety of others• interfere with or distract their attention from

Entity/rule	PED definition	Specific job roles	Situations safe to use	Situations not safe to use	Other authorized uses	Other unauthorized uses
Telephones/ Wireless Electronic Devices, 5/1/2008, pp. 25-26	headset/earpiece for cell telephone, • video camera, • television and non-railroad radio, • handheld game					their work • circumvent the requirements of the rules
				Operating the controls of a moving train, engine or on-track equipment... except in an emergency	Does not interfere with or distract from safety or the performance of their duties for business purposes, including reporting work and checking company communications	Using a company issued PED while on duty, unless related to duties
					Minimal, incidental personal use only when its usage does not interfere with required duties or railroad operations	Using personal PEDs on a moving train or engine
Entity 5 Passenger RR (a) Special Instructions GO- 81; Rule E-2, 1/10/2004	NORAC	General, all employees	In case of an emergency	When required to perform service	Company issued cell phones only used for company business while on duty	NORAC
			When necessary in conjunction with the safe operation of the train or a track car			

Entity 6 Passenger RR (b) Bulletin Order No 8-70; GO 804; (f), 2/23/2004	Cell phones, pager or personal digital assistants (PDA's)	"On-duty employees"	Passenger train conductors may use to conduct railroad business while the train is moving provided they are not in the controlling cab, or controlling the movement from the leading end.	In the foul of the track or roadway unless track or roadway is out of service	Remain stationary, preferably seated...when using a cell phone whether in an inside or outside environment	NORAC
				Operating a locomotive, crane, or other motorized railroad equipment, except in an emergency or when the equipment is stationary		
				Riding in the controlling cab of a moving train, unless the business is associated with the movement of the train.		
				In areas where inattention could result in being struck by tools or equipment		
Entity 7 Passenger RR (c) 7/8/2008 Crew Resource Management: Operations: - Electronic Devices, pg.9	GCOR	General, all employees	Layover facility	On the ground – lining switches, meeting trains, standing next to main tracks, performing activities that "require undivided attention to safety and rules compliance"	Communicating railroad business on stopped train	GCOR

			In crew transportation van	In control of moving train	Conductors reporting to dispatchers (not in control compartment of moving train)	
				Conducting non-railroad business on or near trains		
Entity 8 Passenger Railroad (d) Corporate Policy and Procedures; Safe-011, Cell Phones & Other Portable Electronic Devices	“Any device...of remote use [that] has the potential to divert user’s attention...or inhibit their ability to...monitor and...respond to the work environment” “...including the use of hands-free devices/blue tooth)..	General, all employees	No specific situation described that is safe to use an electronic device	On/about the tracks near yards, shops, and crossings	No specific situation described that is safe to use an electronic device	Moving vehicles, machinery and trains (cars, trucks, buses, train sets, locomotives, car movers, cranes, etc.)
				Working in/near active shop operations (work presses, grinders, welders, conveyors, etc.)		Stationary vehicles, machinery and trains (booms, outriggers, tampers, grinders, sweepers)
				Boarding, aligning trains, moving within moving trains, traversing stairs, escalators)		Personal vehicles (used for company business or on company time; including the use of hands-free devices/blue tooth).
				Working on trains, tracks, right-of-way, in towers, in control centers, etc.		

<p>Entity 9 Passenger Railroad(e) Bulletin order: 4-243, 4-157, 4-326, 4-54; 1/10/2010; Operates Rules, Prohibited Behavior, Rule D, Item 6.</p>	<p>“An electronic or electrical device that was not provided by railroad” (not including hearing aids, or devices intended to accommodate a disability).</p> <p>Defined “use of an electronic or electrical device”</p> <ul style="list-style-type: none"> • conduct a verbal communication; • place or receive a telephone call; • send or read an electronic mail message or text message; • play a game; • navigate the Internet play, • view or listen to video; • play view or listen to a television broadcast; • play or listen to a radio broadcast other than a radio broadcast by a railroad; • play or listen to music; • execute a computational function, or • perform any other 	<p>All employees, including rail traffic controllers, power directors and yardmaster</p>	<p>No specific situation described that is safe to use an electronic device</p>	<p>Operating on-track equipment</p>	<p>No specific situation described that is safe to use an electronic device</p>	<p>No specific situation described that is not safe to use an electronic device</p>
				<p>Providing roadway worker protection</p>		
				<p>Fouling a track</p>		
				<p>In the controlling cab of train</p>		
				<p>Engaged in/connected with the movement of train/equipment or switching operations</p>		

	function that is not necessary for the health or safety of the person and that entails the risk of distracting the employee from a safety-critical task.”					
Entity 10 NORAC 9th Edition; General Rules, Prohibited Behavior, p. 10	An electronic or electrical device used to conduct oral, written, or visual communication; place or receive a telephone call; send or read an electronic mail message or text message; take or look at pictures; read a book or other written material; play a game; navigate the Internet; navigate the physical world; play, view, or listen to a video; play, view, or listen to a television broadcast; play or listen to a radio broadcast other than a radio broadcast by a railroad; play or listen to music; execute a computational function; or, perform any other function that is not necessary	General, all employees	No specific situation described that is safe to use an electronic device	Using a cell telephone while operating the controls of a moving train or engine	No specific situation described that is safe to use an electronic device	Unless reporting or responding to an emergency condition
				Using a cell telephone when occupying the controlling cab of a moving train or engine and not operating the controls, unless the communication directly relates to duties		

	for the health or safety of the person and entails the risk of distracting the employee or another employee from a safety-related task.					
Entity 11 GCOR 6th Edition, 4/7/2010 1.10: Games, Reading or Electronic Devices	Defines a PED as: <ul style="list-style-type: none">• cell phones,• electronic games,• TVs,• computers,• media players,• associated earpieces	General, all employees	In the body of business car/passenger train	Operating controls of moving locomotive	May be used “in the event of railroad-supplied radio failure...”	Using PED or have them turned on while on duty
				In the foul (4ft) of the nearest rail of any track	Access stored electronic rule book files	
				On the ground and engaged in switching operations	“Push-to-talk” or “direct connect” features (when authorized by railroad)	
				Any crew member riding on a piece of moving equipment outside cab of the locomotive	Personal cell phone may be used during break time, meal period, or after job briefing	
				Assisting in the preparation of the train or railroad equipment or brakes		
				Inside the controlling bad of a locomotive or train (unless job briefing has	During an emergency	

				occurred and all members agree)		
Entity 12 American Public Transportation Association American Public Transportation association (APTA) Standards development program: rail standard, rt-s-op-017-11, February 2011: electronic device distraction policy	Electronic devices include but are not limited to: •mobile phones •music and/or photo download devices •electronic ear devices of any kind (except prescribed hearing aids) •headphones, ear buds or any device that projects sound •portable computing devices •ancillary devices associated with an electronic device. Authorized electronic devices: two-way radio	Mainline operation	May allow operators of rail vehicles to use mobile phones/electronic devices in a situation only when the rail vehicle is stopped Allow the use by operators while the operator is on a layover or break as long as it is from a safe use location	When it “would interfere with the safe operation of revenue or nonrevenue vehicles”	No specific situation described that is safe to use an electronic device for mainline operation personnel	No specific situation described that is not safe to use an electronic device for mainline operation personnel
		Operations control center, yard control tower, interlocking control tower	No specific situation described that is safe to use an electronic device for control center, yard, tower personnel	No specific situation described that is not safe to use an electronic device for control center, yard, tower personnel	No specific situation described that is safe to use an electronic device for control center, yard, tower personnel	Earpieces of any kind shall not be worn inside the occur, yard control tower, or interlocking control tower
						Unauthorized devices must be stowed out of sight, off the person, and must be powered off

		Roadway worker activity	Necessary electronic device (such as, but not limited to, survey equipment, gage measuring equipment, etc.) [can be] used only by properly trained personnel and only with safety precautions (established in accordance with roadway worker protection policies in place.	Use ...that would interfere with the safe performance of right-of-way maintenance and inspection activities	No specific situation described that is safe to use an electronic device for roadway worker personnel	No specific situation described that is not safe to use an electronic device for roadway worker personnel
		Maintenance and storage facilities (shop and yard)	Necessary electronic device (such as, but not limited to, meters, laptops, etc.). Shall be used only by properly trained personnel and only with safety precautions established in accordance with equipment inspection/maintenance policies in place.	When not in an established safe use location	No specific situation described that is safe to use an electronic device for maintenance and storage facility personnel	No specific situation described that is not safe to use an electronic device for maintenance and storage facility personnel

Entity 13 Canadian Railroad Operating Rules 2/26/2008 (TC O-0-93) Editorial changes on March 19, 2008, General Rules, p. 18	Cellular telephone	“Any employee conducting actions related with the movements, handling of main track switches and protection of track work and track units...”	No specific situation described that is safe to use an electronic device	“...not engage in non-railway activities which may in any way distract their attention from the full performance of their duties.”	When cell telephones are used in lieu of radio all applicable radio rules must be complied with.	Use of personal entertainment devices is prohibited.
						Use of communication devices restricted to matters pertaining to railway operations. Cell phones must not be used when normal railway radio communications are available.

4.4 ANALYSIS OF EFFICIENCY TESTING (STUDY 1)

Railroads conduct efficiency exams, which include written tests and operational performance evaluations, to ensure that employees understand and follow company and federal regulations and company operating rules and procedures. Employees are expected to pass a written exam after annual training on operating and safety rules and federal regulations. They must answer questions related to information covered during their training and their company operating rules handbook. Railroad company supervisors and FRA inspectors conduct observations and report them periodically throughout the year. The researchers collected efficiency exam results for MOW employees and signalmen from FRA sources for four of the railroads participating in the railroad rule analysis. These results (see Appendix G) only provide examples and may not typify or include the complete reporting or findings of the particular railroads. Representative results would require a nationwide efficiency test survey. Of those that were collected, one railroad was excluded because it was not possible to identify results that pertain specifically to these crafts. The other three railroads' results contained this information and were included in the analysis. The three railroads' results are presented below. Railroads are identified by numbers in brackets to provide anonymity.

Materials collected from a passenger railroad [9] include:

- PED usage information/rules (operating rules, general safety instructions, and bulletin orders)
- Roadway Worker Efficiency Testing form used to conduct performance observations
- Flyer regarding PED usage restrictions
- List of observational efficiency tests conducted in 2009 by department (Communications, Power, Signals, Structures, and Track departments)
- Efficiency test template for cell phone usage

The test template for cell phone usage provided the criteria used to evaluate employees' knowledge and practices. The test numbers in Table 3 correspond to the rules set forth in the operating rules, general safety instructions, and bulletin order issued by the company with regard to PED usage among employees. That is, the company has four specific numbered rules, each of which is tested.

Table 3. *Efficiency Test Template of a Passenger Railroad (Study I)*

Rule/Test Number	Rule Description
1	Cell phone not being used by an employee at the controls of a moving train, track car, or machinery.
2	Cell phone or other electronic device not being used in the controlling cab, or by a(n) employee operating a track car.
3	Cell phone located in the controlling cab of a train is powered off.
4	Electronic device not being used by an employee while performing service except for company business.

Efficiency results were only provided for Test Number 4, and completion dates were not provided. Results identified the department, the number of efficiency observations conducted, and the number of observations that resulted in noncompliance with the Test Number 4 rule.

There were 1,507 observations across the different departments for Test Number 4. Three employees were observed to be using an electronic device while “performing services that [were] not for company business.” The persons observed to be noncompliant were operating employees (conductors and assistant conductors). This is a 0.19 percent deficiency rate for this compliance observation. No non-operating employees (MOW and signalmen) were found to be in noncompliance although tests were infrequent (12 Signal Department tests, 1 Track Department test).

Materials collected from a second passenger railroad [6] included:

- PDF copy of “Roadway Worker Protection Manual, NORAC North East Corridor,” revised 1/1/2001
- PDF copy of “Maintenance of Way Employees Safety Rules and Instructions...” booklet, revised 7/1/1992
- Excel[®] document of efficiency testing results from February 1, 2009, to February 10, 2010

This passenger railroad’s materials utilized a coding scheme that related its rules to its efficiency test elements. The rules in the rule book and questions on the efficiency tests were coded so that during scoring and review of an employee’s test results, the questions on the efficiency test could be mapped to the specific rule that gives the correct answer. However, the rules in the rulebooks provided did not correspond to the current efficiency test elements possibly because the rulebooks were 10 years old. There was no mention of or reference to any type of PED usage in the rulebooks. The Excel[®] document referred to “Rule XYZ123,”⁸ which may correspond to a policy regarding PED usage among employees, but it was not referenced in the manual or rulebook. Researchers used the most current version of the rule book (at the time of the study). Table 8 in APPENDIX G. EXAMPLES OF EFFICIENCY TESTS AND RESULTS shows the efficiency test data for this rule from railroad [6]. There were 2,247 efficiency test observations involving MOW personnel or signalmen. Nearly all observations indicated that the employee passed or complied with Rule XYZ123. Three of the seven who failed received mentoring, and four received a verbal warning. See Table 9 in APPENDIX G. EXAMPLES OF EFFICIENCY TESTS AND RESULTS, which provides narrative information for each failure. The narratives provide context about what Rule XYZ123 applies to and the reason personnel failed the observation, but they do not describe the circumstances of the incident.

⁸ Actual titles for each rule were changed to ensure confidentiality.

Materials collected from a passenger railroad [5] include:

- Test Qualification System TRO-10 (2008)
- Rail Employee Safety Rules and On-Track Safety Procedures Manual (2009)
- Individual Train Detection (ITD), Statement of On-Track Safety (ND)
- Regulations Governing On-Track Safety (Revised, 1/24/2009)
- On-Track Protection Job Briefing form, Engineering Department Daily Job Briefing form, Contractor Safety Briefing form
- Description of responsibilities and methods: “Providing On-Track Protection” (ND)
- Bulletin Order 4-H-S1219- Safety Rule and Special Instruction Week , Special Instruction E-6 – Cell Phones – Engineering Department (2/27/2009)
- Efficiency testing results for employees by supervisor reporting, by craft, test question, and department summary during the period of 01/01/2009 to 12/31/2009

This railroad provided information about the book the exam was based on, the test number, date and time the test was taken, whether the employee complied with the rule and, if not, the action taken to rectify failed compliance. The results applied to maintainers and trackmen, and it was not possible to differentiate between their results as the employee’s name was only provided for each set of efficiency exam results.

The “Rail Employee Safety Rules and On-Track Safety Procedures Manual” and “Test Qualification System 2008” booklets identified the test numbers that pertain to PED usage among employees. Table 10 in APPENDIX G. EXAMPLES OF EFFICIENCY TESTS AND RESULTS lists the five rules that pertain to the PED usage, the number of compliances, failures and type of action taken. Fifteen (5.3%) of the 281 efficiency observations of the trackmen and maintainers showed a failure, indicating that they were observed using a PED in violation of the rules. All fifteen employees received verbal counseling.

4.5 ANALYSIS OF INFORMATION MEETINGS

During Study 1 the researchers held telephone meetings with individual MOW employees and signalmen to gather information about a list of topics. Focus groups with similar agenda were held with other railroad crafts during Study II, supplemented with individual telephone meetings. The following tables summarize the results of these information meetings (see Table 4 and Table 5). Details of the qualitative analysis are presented below.

Table 4. *Most Common Statements from Study I Information Meetings*

Topic	Most Common Statement	Second Most Common Statement
Type(s) of PED in possession and location of stowage	Carries only company-issued cell phone on their person	Leaves personal phone in vehicle, locker, or work vehicle
Prevalence of use ⁹	Uses cell phones between 6 and 10 times a day	Uses cell phones >10 times per day
Percentage of calls made for business ¹⁰	Between 76% and 99% business calls	100% business calls, no personal calls
Location of cell phone use	Cell phone used away from tracks (not near hi-rail truck), greater than foul of track*	Cell phone used for emergencies
Primary radio issues	Radio is too “busy” with chatter*	Radio use is intermittent/unreliable (signal is weak)
Business conducted using PEDs	Calls to or from supervisor regarding work plans	Call coworkers about equipment/software issues*
Company-issued rule	Sets limitations on PED usage while operating vehicle	Sets distance limits of PED usage near tracks
Company-issued rule awareness	Learned of rule through company Web site, email, etc.	Learned of rule through daily briefing
Federal rule awareness	Given a definition of the regulation	Learned of rule through word-of-mouth
Safety issues	Overcoming cultural norms/socially acceptable practices*	Situational awareness
Training practices	Yearly rules review	Daily safety briefing conducted
Thoughts on current regulation/policy	Use of best practices are sufficient (not put in place by company or FRA)	Company policy in place is not sufficient

⁹ Less than 5 times per day, 5-10 times per day, or more than 10 times per day

¹⁰ Less than 50%, 51-75%, 76-99%, or 100%

* Two or more comments occurred an equal number of times.

Table 5: *Most Common Statements from Study II Information Meetings*

Topic	Most Common Statement	Second Most Common Statement
Type(s) of PED in possession	Carries only personal cell phone	Carries no cell phone
Location of stowage	Leaves personal phone off and stowed away*	Personal cell phone carried on person as back up communication device
Prevalence of use ¹¹	Sometimes	Often
Type of calls made ¹²	Mostly business calls	Only business calls
Location/circumstance of cell phone use	Cell phone used on stopped locomotive with special permission (no radio, after briefing)	Cell phone used with blue-flag*
Primary radio issues	Radio use is intermittent/unreliable (signal is weak).	Using the radio is sufficient
Business conducted using PEDs	Coordinating pick-up, repair schedule using a tablet	Communication with supervisor or dispatcher using a cell phone
Company-issued rule	Sets parameters for emergency use of PED on the locomotive	Specific roles named that cannot have PED on their person*
Company-issued rule awareness	Learned of rule through yearly meeting/training	Learned of rule through daily briefing
Federal rule awareness	Learned of rule through company Web site, e-mail, etc.	Learned of rule through yearly meeting/training
Safety issues	Generational divide (older versus younger)	Overcoming cultural norms/socially acceptable practices*
Training practices	Yearly classroom, rules review*	Peer-to-Peer observations
Thoughts on current regulation/policy	Regulation/policy not clear*	Regulation/policy enforced with exceptions allowed

¹¹ Rarely, sometimes, or often

¹² Only business, mostly business, 50/50 business and personal, mostly personal, or only personal

* Two or more comments occurred an equal number of times.

4.5.1 PED Use among Employees

Study I: MOW Employees and Signalmen

Of the 10 rank-and-file participants, 8 said that they carried only their company-issued cell-phone during the work day. Four mentioned that they leave their personal cell phone in a place such as their grip, truck or locker, away from the work site. Six participants said that there was a generational divide at work. The younger, less experienced workers were more apt carry and use their phone throughout the day without much thought to the safety implications. Three of those six also said that their fellow workers did not always follow the rules. Regarding the frequency of calls made during the workday, seven rank-and-file participants indicated that they use their personal cell phones six to ten times per day and that 76 to 100 percent of those calls are business-related. The location of PED use varied among the participants (e.g., within the foul of the tracks, outside the foul, by their truck, in their truck as a passenger).

Participants noted some limitations of the company-issued two-way radio. The radio frequency can become congested and the signal can become weak, making this form of communication unreliable. Only 2 of the 10 railroad employees said that the radio was sufficient for communication while working.

Participants said they used company-issued cell phones for business matters throughout the work day, including contacting the dispatcher to obtain and release track authority. The more frequently mentioned reasons for making calls were to contact a supervisor about work plans (seven participants), to coordinate with an outside facility for the pick-up or repair of equipment (six participants), and to call coworkers about equipment or software questions (six participants).

All 10 participants reported using the voice call feature of their cell phones. One mentioned using text messaging, Internet, and Direct Connect (a file sharing system that includes Nextel and AOL Instant Messaging). One participant saw value in using texting *and* picture messaging on the job. He said he carried his personal phone in addition to the company-issued one so he could use it to explain technical issues during equipment repair. The picture message feature reduced error in communication and provided a clearer understanding of the situation for all parties because he was able to better describe the problem.

Study II: Transportation Crafts

Of the nine participants, seven said they carried their personal cell phones or stowed them away in their bag for use in emergencies or at appropriate times. All participants noted that they only used cell phones under appropriate circumstances (e.g., when the train was stopped and after having discussed it with the other crew members)—seven participants cited their fear of losing their jobs or losing pay as the primary reason for complying with the cell phone rule. For example, one participant noted that “it’s less about safety, it’s about saving our jobs.” However, all of the participants also noted the importance of rule adherence to ensure their own safety and the safety of those around them.

With regard to frequency of use, all of the participants noted that they rarely use PEDs for personal reasons. The most commonly cited reason for using a PED was to make a phone call. Some examples participants gave of why they might use a PED included calling family members if they would be late

coming home, or receiving emergency phone calls. One participant gave an example of a time when his son was doing a tour of duty in Iraq. This participant stated that he kept his cell phone nearby and if his son called, he told his manager he would pick it up. The manager said that this reason for using a cell phone was alright because it happened so infrequently.

Participants discussed their use of PEDs for company-related business. Three participants (passenger conductor, freight conductor, and high-speed rail car inspector) stated that they use their personal cell phones *daily* for work-related tasks such as calling the dispatcher for help with disabled passengers, communicating with customers, and sending and receiving picture messages. The participant who discussed sending picture messages said that this function was invaluable because it allowed him to send and receive pictures of equipment and blueprints while in the yard (rather than having to send them from the office by computer), and that the picture message feature reduced errors in communication and provided a clearer understanding of the situation because crews on trains were able to send a clear image of the issue, rather than only describing it over the radio.

Two of the participants (freight engineer, freight conductor) stated that they use their personal cell phones *sometimes* for work related tasks, most often in order to communicate with the dispatcher when radio is intermittent or to communicate with the yard master when working in the terminal (and therefore not on moving equipment). One participant said, “There are situations where you just don’t have good radio communications and so you have to use your cell phone for business purposes.” In one instance, a participant noted that in addition to his personal cell phone, he also used his personal tablet computer to check schedules and rosters, although he only used it while he was off equipment (e.g., in the yard).

Four participants (passenger engineer, two passenger dispatchers, and car inspector) noted that they rarely use their PEDs for work matters. One noted that he would only use his personal cell phone “... if radio communications wasn’t working or if the problem requires an intense conversation with the supervisor or mechanical department (an emergency situation).”

In addition to using their own PEDs for company-related business, five participants noted that they also use company-issued electronic devices, including onboard work order devices (freight conductors), electronic scanners (passenger conductor), cell phone (car inspector), and tablet computer (car inspector).

4.5.2 Rule Awareness

Participants in Studies I and II described how they learned of their employers’ rules and federal regulations regarding electronic device usage and their understanding of how the rules pertain to them.

Study I

Seven participants stated that they learned about their company rules primarily through electronic correspondence such as company and union e-mail or Web sites. Eight participants learned of the company rules through word-of-mouth from coworkers or supervisors, through daily safety briefings, monthly safety meetings, and yearly rulebook recertification training.

Participants were also asked to describe their understanding of their employers' rules and how they applied to them and to their job responsibilities. Eleven participants acknowledged that there was a company-issued rule in place regarding electronic device usage. They identified four parts of the rule that applied to MOW employees and signalmen. The most common element was the safe distance away from the tracks or work areas needed for one to use an electronic device. Seven of the eleven participants whose narratives contained this theme stated that the rules set specific distance limits for electronic device usage near tracks. For a larger group, five or more, usually 4 feet to 15 feet away from the general work area [is required].

A second theme identified by eight of the eleven employees restricted the use of an electronic device while operating a vehicle. Participants stated that employers do not permit use of a phone while driving or operating equipment and that a "...Bluetooth needs to be used while driving in a company car." A closely related, third theme concerned the fact that the company rule upholds state laws regarding cell phone use. Some states, as mentioned earlier in this report, restrict phone usage to only "hands-free devices" documented in six of the eleven participants' narratives).

A fourth theme was that company rules put restrictions on specific roles in a gang which prohibited them from having an electronic device on their person while working (four of eleven participants' narratives). Their comments identified those personnel as individuals whose responsibilities were "safety-related" (for example, look-outs and watchmen).

The participants reported learning about the federal mandate, Restrictions on Railroad Operating Employees' Use of Cellular Telephones and Other Electronic Devices (49 CFR Part 220, 2009), formerly Emergency Order (EO) 26, through word-of-mouth (three participants), company Web site or e-mail (one participant), and daily safety briefings or union e-mail or Web site (one participant). No one reported learning about the federal restriction through monthly or yearly training meetings.

All thirteen participants responded in terms of the federal regulation awareness theme. Seven expressed their understanding of the mandate:

"[We are] not permitted to use PEDs while on duty; no cell phone, BB [BlackBerrys], computers, iPads, etc."

"[I] was aware of the rule, but not as EO 26. [It is] only for operating employees; [they] cannot have a phone even on while the train is moving. [I think that] if the train is powered down they can use them."

"[The] policy came out right after this incident [referring to Chatsworth, CA] mandating that any operating employee on a locomotive could not have a phone on /on them on a train at all; [it] was later changed to a moving locomotive."

"MOW [personnel] were initially told the same thing, but the rule was changed after a month when phones were seen to be necessary for their work. [There was] no written rule at that time.... It was never specified who [the] rule applied to."

“No cell phone while on the track or on duty.”

“Train crews cannot have PEDs on them at all during their tour of duty.”

“Phones cannot be used in a moving locomotive; [they] have to be stopped to use a phone.”

The responses illustrate that there is variability in how MOW employees and signalmen understand the restrictions in the federal mandate. Of course, MOW employees and signalmen are not the focus of the mandate so they have less reason to know about it. Participants differed in their understanding of whom the rule applies to and the locations where the mandate prohibits use of a PED. Two suggested (incorrectly) that it applies only when workers are on the track, but they may have been thinking of the company rule.

Study II

Seven participants learned of the company rule regarding PED usage during their yearly training and safety briefings. Four stated that they learned of it from company and union Web sites and emails, and through “onboard” (on-the-job) training. A freight conductor, with 2 years in the industry stated that “[the] rule was presented as a federal regulation and a company rule...it was covered on the first day or two when we first started [new-hire training].”

As in Study I, the focus groups and individual listening sessions often included general questions about how the rule applied to the participants and how they understood it. All of the participants said that the electronic device rule applied to them. A passenger conductor and a freight conductor both described their interpretation of their respective company’s cell phone rules as being synonymous with the FRA regulation:

“[A passenger railroad] has a specific cell phone rule that says no use of personal cell phones. It’s clearly stated-while on duty on a moving train. Black and White, clear as can be” - passenger conductor

“Phone must be off and out of reach, stored in bag or car. It cannot be turned on. If you do have to use it on the train, you have to be stopped and have had a discussion with another crewmember. Has to be an emergency” - freight conductor

Another freight conductor described how he understood the rule and also described how it changed from a comprehensive ban on any type of usage to one that allowed limited use:

“When the train is moving or a crew member is on the ground involved in switching, phones must be off and stowed away. The rules changed recently: when the train is moving or crew is on the ground [phones] must be off and stowed in your grip. You can use them for work when the train is stopped and you are 25 feet away from the tracks for brief ‘basic’ things (quick call or text). What is ‘basic’ is subject to interpretation.”

4.5.3 Training

Study I

Participants described their training experiences related to PED usage. Ten participants received training during a classroom-based, yearly rulebook recertification and monthly safety meetings. The yearly training is conducted by a company safety administrator, and it incorporates company rulebook and Federal regulatory materials related to safety.

The monthly classroom training is conducted either by a railroad safety manager or a Safety Captain. One participant said that he is currently a Safety Captain who is a rank-and-file employee selected for a 2 year term. Safety Captains maintain awareness of any changes to current rules and identify the topics to review; for example, policy, standard operating procedures, and relevant changes in responsibilities.

Seven of the ten employee participants also said that they consider their daily briefing as safety training. Daily briefing topics include logistical information (the work schedule, role assignments for the day, how to communicate with each other and others outside of the department) and other issues that may not be specific to the day's work, but may include new safety rules or regulations and such advice as "maintaining concentration during the job and not letting other things influence you while at work."

The rank and file participants described their experience with computer-based training (CBT). Five of the ten said that they have access to CBT either at computer stations at the railroad or from their personally owned computers. One participant said that "[we] have computer based training every other year [which] covers rules [and is] craft specific." Other participants said that railroads are gradually adopting CBT: "[we] have some computer-based training available...more and more employees are getting PCs [personal computers] so internal and external CBT is becoming more common." Two participants said that they prefer classroom training "because the rules are always changing and it can create a forum for questions and discussion."

Study II

Yearly classroom training was the most common type of training mentioned by the Study II participants. Five indicated participating in these sessions during which PED usage has been a topic of discussion. One participant indicated that he receives CBT less frequently, stating it is provided "every few years." Other training methods for rule awareness that were mentioned include: at home review via a rule book, onboard training, and safety briefings that review the rules and provide employees with any updates.

Peer-to-peer safety programs, both formal and informal, were a common topic of discussion. Four participants mentioned that their organizations have an established safety observation program—three of those participants indicated that their safety program was a peer-to-peer program in which employees look out for and coach one another. These programs hold no threat of punitive action and the participants seemed to view them very favorably. In the spirit of peer-to-peer safety, five participants indicated that they feel comfortable with and would approach a peer to remind him of a rule if they saw him doing something potentially hazardous.

4.5.4 Rule Expansion

Study I

Participants offered their opinions about expanding the federal PED mandate to non-operating employees, the sufficiency of the rules and policies already implemented by the railroad companies, and the best practices that they use or consider worthwhile. Six participants did not think that the federal rule should be expanded and gave the following reasons:

“[I] feel they [non-operating employees] can handle this with an internal operating rule without it becoming a regulation.”

“[I] feel the company’s rule is sufficient; if there is compliance to the rule. So if compliance isn’t there, maybe there should be an FRA rule.”

“[It] should not be expanded. They [MOW employees and signalmen] need their work phone to complete their work. As long as it is used responsibly with protection and using common sense and for work only, they can be used and need to be used.”

“One big blanket rule is not going to work. Each craft is different, so the rule should adjust for different job functions.”

“If it were expanded to signalmen, it would tie their hands. They would have to come up with another way to communicate/notify them. The radio isn’t reliable enough.”

“I don’t think it should apply to everyone in the railroad. There are many times when I am working on a project a few miles apart from my co-workers. In these cases the phone is the best way to communicate on the job. There are situations where it is an invaluable tool; no one talking over you, no miscommunication, it’s private (unlike radio). If used properly the PED is a valuable tool.”

Two participants wanted to see the rule expanded:

“[I] think everyone should follow the same rule. [It] organizes things more easily, and if a position changes the rule is cut and dry and no re-learning needs to take place.”

“An FRA rule would help with eliminating rule breaking, and, if they are going to make an FRA rule, it needs to be cut and dry on the consequences.”

Two other participants suggested that the rule could be expanded to non-operating employees, but with some exceptions:

“It could be expanded, but different sets of rules should apply to different jobs. Limit excessive use, but allow those who can benefit from having them to use them in safe situations. No use in foul, operating machinery, dangerous jobs.”

“[I] think the rule should be implemented for any railroad employee that is on

or near the tracks. Anyone on the track should be completely alert to their job and surroundings. However, they need to have access to a phone. It is important for their work, but it should be used safely.”

Four participants said that their railroads’ current rules and policies are sufficient:

“[I] feel the (company) rule is sufficient and shouldn’t be changed. I’ve seen what happened when people don’t follow the rules. I agree with the rule because I have heard of specific incidents of people getting hurt.”

“I agree completely with the need for the rule.”

“I agree with the company’s policy to put the responsibility on the employee to follow the rules.”

“[I] feel the company’s rule is sufficient if there is compliance to the rule.”

Seven of the ten participants’ narratives suggested that employees follow the local foreman’s best practices, not only rules that are formally put in place by the railroad or by federal regulations. For example:

“Some local groups [track gangs] have their own restrictions. No phone in foul of the track, have radios for communication during work.”

“Local groups would mention rules and set the rules themselves. No policy statement for track workers, no written instructions.”

“Everyone has their own practices.”

“[It’s] easier for foreman to suggest policies and best practices, but if company imposes policy that makes things difficult - the workers resist.”

“It is up to the different divisions or gangs to decide how strictly they enforce/monitor/reprimand the rules (not officially, but it seems that this is the culture within this company).”

Ten participants offered examples of possible future policies, practices, rules and regulations, or changes that could be implemented. They range from defining the distance from live track to proper handling of phones when in a vehicle, specific gang roles that should not have access to a PED, precautions to put in place, and the use of hands-free devices to help avoid distraction:

“There should be no cell phone use in the foul of the track at all, ever... should be 4 plus feet from any rail.”

“No use of any electronic device while operating any equipment or working in the foul of potentially live track...Roles change throughout the day, so no one should be barred from having them at all.”

“Foreman needs to put the phone rule out during morning briefing... to answer a call worker should excuse themselves at least 25 feet away from site, so [it] doesn’t distract everyone else.... No phones [in hi-rail or passenger vehicles] even the passengers.”

“A lookout should never have a phone or PED...Outcomes of violations should be made public. Rather than hear it through the grapevine. It would sway others to not violate; don't publish their [the violator's] name, but publish the data: setting, circumstances, rule broken, repercussions...Put information out over a conference call.”

“They [MOW employees and signalmen] should be provided with a smart phone (or at least a phone that is compatible with hands free) and a hands free device... no PEDs anywhere near the tracks unless you have clearance for protection...use for work purposes only.... Should be a common rule for MOW employees and signalmen....Different rules for operating and non-operating.”

“Laptops, when the vehicle is in motion, should be stowed away and turned off ... blue tooth should be used [while using a cell phone], and when you go to work just leave the phone in the truck and address your calls and messages on a break...should be 25 feet away from track to use phone... people who should never have a PED on them are the operators on a locomotive...or machine operators...”

“I don't think 4 feet is a reasonable distance. People walk around when they talk and could re-enter the foul unknowingly. They should go next to or near the truck, which is usually about 20 feet away.”

“There isn't a rule about laptop being on, but I think there should be because the screen makes it impossible to see the side view mirror and it is distracting to have it open and readable in a car while driving...an instructor ...[could] come out to each site and show and explain the dangers of cell phone use.”

“Look into a cell phone app/program like “train mode” for cell phones (similar to airplane mode)... Include reminders about cell phone usage in briefings and debriefings... Create back up plans that family members can use in case they need to reach a member of the work gang that is out in the field, without their cell phone on and on their person.”

Two participants said that the federal regulation of PED use should be expanded to MOW employees and signalmen, and two other participants also thought that it should be expanded to MOW employees and signalmen, but adjusted for the specific crafts. The comments suggest that there is a need for longer distances away from tracks, specific personnel who should not have access to a PED other than a two-way radio, other devices that could be made available to create a hands-free (and largely eyes-free) environment and that foremen may be key individuals for implementing best practices.

Study II

Three participants suggested that policy makers consider job function when it comes to restricting PED usage. Some jobs take place in environments where PEDs can be used safely and effectively.

“There are situations that come up where phones could be helpful, especially when it's a business call to the dispatcher and the radio is out. If there is engine trouble he should be permitted to use it to talk to Mechanical. Engineers may need it to talk to a yardmaster or dispatch. The phone in that case is not any more distracting than the radio”

“Handheld devices, whether you like it or not, are here to stay. It is inevitable. [They are a] part of effectiveness. Moving forward there is an advocacy to incorporate them into the job, but there needs to be responsibility, common sense and safety culture applied. “

“We’re different than operations. If you use them correctly and safely it’s okay.”

Three participants believed the current policy in place for PED usage is sufficient as it is.

“I think everyone is on board with the cell phone rules, and understands what they are.”

“The rules for cell phone use, even when they change slightly are pretty obvious-don’t use it ever and always err on the side of caution.

“Rule is pretty spot on. It helps with safety. Nothing I would change”

Two participants commented that the current policy in place for PED usage is not sufficient, either because it leaves no room for employee judgment and common sense or because the policy is not well thought-out.

“I think the rules now were made as a kneejerk reaction, not well thought out.”

“I may need to call my wife if I’m late for pick up. There must be a place to meet in the middle. I should be able to call the engineer with a cellphone and tell him to call the Mechanic Help Desk. Ninety eight percent of employees have enough common sense to make safe choices. Trust the employees. They want to go home with all of their toes and fingers.”

Four participants indicated that the current policy is ambiguous.

“They receive training every 3 years so there is a need for more refresher training to keep it at the forefront of their mind and keep people updated on any new information that may have come about since the last training session.”

“Our rules are written in ways that can lead to misinterpretation. There is a lot of grey area. There is not a common understanding among everyone. I do not know why you cannot talk on a moving train. Is there a distinction between use for work and personal use, or is the rule the same? I understand that work and personal calls fall under the same rules. Phone use is phone use.”

“You won’t see the written policy until you get in trouble; it’s not explicit to everyone.”

Two other participants indicated that having a blanket policy in place would help because the current policy is confusing; it has many layers, making it “muddled.”

“Having so many layers of rules is confusing. I always stick to the most restrictive rule when there is confusion.”

“The only thing I would change is to make the rules less muddled; the wording can be unclear for some job functions. Provide an explanation. For me as an engineer it is clear, just don’t use it.”

Five participants commented that enforcement of the current PED policy is a problem. Exceptions to the rules are allowed, usually when the company benefits from the use of a PED (e.g., in the name of cost saving and efficiency).

“Your phone rings, and the foreman asks why you don’t answer. When money (efficiency) and safety contradict each other money is going to win sometimes.”

“We don’t know who is in charge, FRA or company? If the company needs something and your boss says to do something, you listen to them. Either have the rule or don’t, there are too many exceptions, in business and personal realms.”

“Unfortunately, the companies approach is “don’t use your phone... unless it’s convenient for us.”

“The tablet used to be restricted like the phone, but now I’m under the impression that you can use the tablet when the train is moving once you clear it with the engineer.”

“I think the companies are realizing the cell phones are a good tool.”

Another enforcement issue focused on favoritism. Three participants indicated that not all employees are sanctioned equally for the same offence. It was their feeling that supervisors and “long-time employees” get away with breaking the rules, while others face harsh penalties.

“Supervisors are the worst offenders; they’re always outside on 2 phones with a cigarette, etc. They should lead by example. Also, the management is hypocritical, they’ll tell you to get off the phone while they themselves are on the phone.”

“I would like to see a uniform rule applied if a person is caught, where everyone is reprimanded equally. People with more experience and more friends get leniency.”

“If that person was someone else they may not have been sanctioned.”

One participant held the opinion that the current policy is too strict.

“It’s a great tool when used properly. There has to be some common ground, blanket rules don’t work. If you tell people to not use them, people will rebel and look for reasons to use them. Companies need to do a better job of giving the younger generations a good reason to not use them constantly.”

4.5.5 Scenarios

The participants’ responses to the scenarios were coded in terms of whether they regarded the fictitious character’s actions as safe or unsafe. Note that only two or three participants responded to some scenarios, while nearly all responded to others. Not all participants had something to say about all of the scenarios presented in the Study II focus groups. Also, the participants did not present a clear safe or unsafe response to some scenarios, but instead provided additional details or comments. (For the Study I scenario responses, see Table 6 and Table 7 for the Study II scenario responses.)

Study I

The following discussion summarizes the five participants' comments on the scenarios presented to them (Appendix C). Note that the information meetings included different numbers of scenarios.

Table 6: *Coded Scenario Responses (Study I)*

Scenario	Scenario Descriptions	Safety Issue	No Safety Issue	Additional Details or Comments
1	Employee use of cell phone to contact dispatcher when radio service is intermittent	1	3	3
2	Using personal phone while handling switching equipment	1	0	0
3	Wearing a Bluetooth earpiece while operating equipment on track, cell phone in "on" position, in holster; not currently using phone	3	0	2
4	Possible effects of using mobile phone applications ("apps") to obtain track information, access "repair databases," track warrants/authorities	5	0	1
5	Using cell phone while off duty, riding in nonleading locomotive, and not in the company of on-duty personnel	2	2	4
6	Using phone in moving, operating cab of locomotive, in presence of engineer	6	1	0
7	Using cell phone while walking around hi-rail ¹³ vehicle	8	0	1
8	Employee working in track gang when phone rings in employee's grip. Employee removes it from clip, mutes phone, places back in clip, and returns to duties	1	5	3

¹³ A hi-rail vehicle is a modified automobile, generally a sport utility vehicle that is designed to operate on highways and railways.

Scenario 1 describes an employee borrowing another employee's cell phone to contact the dispatcher because of static on the two-way radio. The five participants asked to comment on this scenario agreed that it does not present a safety issue, provided certain measures are taken. Four stated that the call needed to be made away from the tracks. The fifth participant indicated that the employee could make the call from the tracks provided he or she had "track and time." Two of the participants added that the scenario describes a frequent occurrence and that "sometimes you have to do whatever is necessary to contact the dispatcher." One also suggested that any new information from the cell phone call to the dispatcher needs to be relayed over the radio for everyone's awareness.

Scenario 2 describes an employee talking on a personal phone call while handling switching equipment. The two participants who responded said that there is a serious safety issue with the situation because the call is a distraction. One commented that if he were in this situation, he would have told the person on the line that he would return the call later, or, had he been on the track, he would not have answered the phone at all. This participant added that when he receives calls at work from family it is usually important, and the employee should have excused himself from what he was working on to take the call safely.

Scenario 3 described a situation where an FRA representative observes an employee who has a Bluetooth device in his ear and cell phone powered on while operating equipment on the track. Of the five participants responding, four said that the employee's use of a Bluetooth device was not safe. Two of those participants commented that others may perceive him to be distracted or he may be more tempted to answer because of the Bluetooth device. Two of them also agreed that the FRA representative would have said something to the employee. A fifth participant stated that there was "no safety issue present if he wasn't using the phone. The Bluetooth doesn't make a difference safety wise." Additionally, two participants (one of whom was the individual who said that this was not a safety issue) suggested that the employee could turn the phone off or stop what he was doing and excuse him or herself if a call came. Scenario 4 described the possibility that future apps may be developed that may assist signalmen and MOW employees when they are out in the field. Five participants responded that this smart phone technology could present safety issues. Four of the five said that company-issued laptops are sufficient for their rail work. They favor laptops over smart phones because they are easy to use properly and safely. The portability of smart phones makes improper use easier, while laptops promote safer use because they are generally used away from the tracks (generally in a truck). Other concerns by three of those who favored the laptop were that the screen size of a smartphone would be too small, that rail information is not public, and smart phones are easier to hack.

Scenario 5 described an off-duty signal maintainer using his cell phone while riding in a nonleading locomotive and not in the company of any on-duty personnel. No participants said that the employee was in violation of the rules or causing a safety issue. Three commented that this situation would have been a violation had the employee been on-duty, but since he was off-duty and away from any on-duty personnel, he should be permitted to use his phone.

Scenario 6 described a signal supervisor having a cell phone conversation in the cab of a moving locomotive in the presence of the operating engineer. Six participants said that this was a safety issue. The signal supervisor's cell phone conversation would be an unsafe distraction for the engineer operating the locomotive. Three suggested that a rule that applies to cell phone use by the engineer should also apply to the signal supervisor, and the signal supervisor's phone should be off. Other comments were that the signal supervisor should not have taken the call, or should have left the cab, and that the engineer should have intervened. The one participant who found no safety issue said that a signal supervisor is not a regular presence in the cab of a locomotive and the call was probably important enough to take.

Scenario 7 described a track employee using a cell phone while walking around his hi-rail vehicle to check wheel engagement. Eight said that the track employee's action in this scenario presented a safety issue due to his cell phone use on the track. One participant thought the most egregious part of the scenario was that the employee then backed the vehicle near a grade crossing. Two said the crossing location only added to an already unsafe situation. Two participants mentioned safety issues arising from multitasking. Four mentioned a lack of situational awareness while in the foul of the track outside of the hi-rail vehicle and then at a grade crossing. There was a comment that the employee's inattentiveness to the job could have resulted in him being struck by a train or car. One suggested not answering the phone, or, if it were an important call from a supervisor, stopping to explain the situation and return the call later.

Scenario 8 described an employee in foul of the tracks who muted a cell phone when it rang while clipped to her belt. Five participants did not rate this scenario as a safety issue and thought that the employee acted correctly by muting the phone. The two participants who found a safety issue thought that no one should touch his or her phone unless clear of the track.

Table 7: Coded Scenario Responses (Study II)

Scenario	Scenario Descriptions	Safety Issue	No Safety Issue	Additional Details or Comments
1	Using a company-issued phone while another employee is returning to the train	1	0	2
2	Using a PED while repairing a locomotive engine on track	4	0	0
3	Wearing a Bluetooth earpiece while conducting switching operations	5	0	3
4	Deadheading off-duty employee in nonleading locomotive receives and sends text messages	0	2	2
5	Employee uses cell phone next to main track while inspecting car in repair facility	2	0	1
6	Employee uses phone while waiting for train to depart as another employee drives back to release handbrakes on rear of train	0	2	1
7	Employees call and text while holding for an hour at an interlocking	4	1	0
8	Employees use phones while train in dark territory on single track is proceeding at 20 mph	1	1	0
9	Dispatcher uses cell phone, when radio reception is intermittent and choppy, to call road foreman about broken-down train to keep desk phone line open	3	1	3

Study II

Scenario 1 described a conductor who answers a Nextel Direct Connect call from a trainmaster while preparing to shove back from the main track and while an assistant conductor alights onto the right-of-way to unlock and line the main switch. Two participants commented on this scenario, one of whom indicated that answering the call would be unsafe. The participants also commented that this scenario raises questions about the safety of using a company-issued device and that in most cases the call would be made over the radio because of the benefits of a party-line.

Scenario 2 described a mechanic on a personal call with his wife while repairing the engine of a locomotive on the track. Four participants offered their opinion on this scenario, and all of them claimed that the mechanic's actions posed a potential safety threat.

Scenario 3 described a conductor wearing a Bluetooth earpiece that is turned off, with his phone locked in a truck far away. Seven participants were presented with this scenario. Five indicated that a safety issue would be present. The other two participants commented that Bluetooth earpieces are uncommon in the railroad industry.

Scenario 4 described an off-duty, deadheading crewmember checking his phone messages away from any on-duty employees. Two participants found no safety issue with this scenario, indicating that it was their belief that cell phone use while deadheading is a common, allowable practice. A third participant noted that this scenario is irrelevant for freight because there is no place other than the lead locomotive to ride, and this is not allowed.

Scenario 5 described a car man who ensured protection and was observed using a cell phone while performing a maintenance inspection on a locomotive that was parked at a repair facility next to a main track. The two participants who responded found this cell phone use to be unsafe. They noted that when the engineer has to power everything down, another crew member has to get between two cars, so one cannot be preoccupied.

Scenario 6 described an engineer who calls his wife while waiting in the cab of a locomotive that is parked, set, and centered with the generator field off after briefing with his conductor. Two participants found no safety issue with this scenario. One provided additional comments, stating that he was completely comfortable with this scenario provided there is a briefing so that everyone is "on the same page."

Scenario 7 described an engineer and a conductor who begin to use their smartphones while they are stopped at an interlocking. Four participants said that this is unsafe. One of those participants commented that this scenario used to happen before the PED policies were put in place. A fifth participant dissented, saying that there is no safety issue, provided that the crew members all agree that they will stay stopped and nothing else is going on.

Scenario 8 described a young engineer and young conductor who are on their smartphones while at the head of a freight train travelling at 20 mph on a single track in dark territory. One participant indicated there is a safety issue with this scenario. Another participant found no safety issue present, commenting

that this scenario offers the most acceptable time to use a PED while moving because “you own the track. [In] open territory [there is] nothing to watch for unless there is another car on the track. As long as you aren’t like watching a movie on your phone and continuously looking down, and paying a decent amount of attention, it’s not too bad.”

Scenario 9 described a freight dispatcher who set a reminder on his cell phone to check on a powerful thunderstorm approaching his territory. He uses his cell phone again later after receiving word of a broken-down train in the storm’s path to keep the office telephone line open and avoid using the radio, which had choppy reception. Three participants said that his use of a cell phone in this scenario is a safety issue. One participant disagreed, stating that there is no safety issue provided that the dispatcher receives permission first. This scenario sparked additional conversation around the idea of using common sense; one of the participants who regarded this scenario as a safety issue qualified his statement by saying that common sense tells you that this situation is OK, even though the dispatcher is technically breaking the rules.

4.5.6 Non PED Distractions

Study I

Six participants discussed non-PED-related distractions that they regularly encounter. They mentioned chatter or noise on company-issued radios, side conversations within a work group, members of the public entering or coming near to the work site, automobile traffic, and changes in work or worksite throughout the day. Of these, half of the participants said that the cell phone was the most distracting, one said the radio was most distracting, and another cited public interruptions (people walking by the worksite).

Study II

Two participants mentioned non-PED-related distractions that they encounter on the job, including onboard reporting devices and the company-issued radio. Of these devices, the radio was described as equally distracting as PEDs, and onboard reporting devices were described as equally or more distracting. An example of the latter was entering information into Form Ds on a tablet computer within an hour of completing a job; this task can be simple or difficult depending on the amount and complexity of changes to the default information.

4.5.7 Safety Issues

Study I

Participants described the perceptions and attitudes that underlie the safety issues with cell phone use. Seven stated that carrying and using cell phones have become a socially acceptable practice in everyday life. Four said that overconfidence and disregard for the rules are related to cell phone use on the job. They said that many employees do not completely understand the rules and the repercussions of breaking them.

With respect to the effect of cell-phone use on job performance, the two most common issues mentioned were loss of situational awareness and multitasking. Five participants commented that cell phone use

compromises their situational awareness. One participant noticed that when people are on their cell phones they tend to wander around and move toward the tracks. He mentioned that this may be because tracks are relatively free of insect and reptile threats, whereas areas outside of the rail and track beds are heavily wooded in some locations and may contain such threats. Three participants mentioned that they view multitasking as particularly dangerous when people operate a vehicle or machinery. Four participants said that cell phone use distracts either the person using the phone or those near the person using the phone.

Study II

Seven of the nine participants indicated that there is a generational issue with regard to cell phone use on the job. Younger employees are more concerned with carrying and checking their phones than their older and more experienced colleagues. Four of those participants added that they believe the culture of cell phone use in society at large is part of the issue; cell phones have become an integral part of everyday life and their use has spilled into the work place.

Five participants mentioned that PED use on the job is a source of distraction, especially during critical times (e.g., handling switches). Two participants commented that cell phone use on the job impedes situational awareness; it detracts from one's awareness of the surroundings and hinders forming the mental picture of the immediate environment over time. One participant indicated that multitasking while using a PED is an important safety issue to address.

5. DISCUSSION

The examination of PED usage rules and policies in other transportation agencies confirmed that policies on PED distraction are found throughout the country's DOT agencies. These policies respond to the growing use and popularity of electronic devices that agencies view as a trend that can lead to dangerous outcomes, as seen in incidents in the surface, aviation, and marine transportation modes. In response to these incidents, transportation regulators have issued electronic device usage policies specific to their industry. In the case of the U.S. Coast Guard, a rule for operating employees extends to non-operating employees (onboard ships). Here, non-operating boatmen can only use PEDs with permission of the coxswain, while boat operators cannot use them under any circumstances. This appears to be an exception as the researchers did not find rules restricting cell phone use for aircraft maintenance crews working on the ramp or air traffic controllers, for example, although there are more general orders (federal rules) related to distraction and prioritizing duties that can apply to cell phone use among controllers. Thus, only one exception to the application of regulations that apply only to vehicle operators was found in the examination of how other transportation agencies have responded to potential cell phone distraction.

After examining railroad incidents and accidents reported to FRA between 2000 and 2010, the team identified one form that might have contained sufficiently detailed information about the category of employee, the event, causalities, the location of the employee at the time of the incident, and the probable cause. However, this accident report form has only one field to identify the cause of an incident and only one code that could be used to identify the cause as PED usage or distraction; however, the cause classification of "Human Factors" is too broad since it could refer to any kind of human error. Another difficulty in using this form for information about the type and prevalence of incidents and accidents related to PED distraction is that these incidents and accidents result from a combination of risk and exposure to the risk. That is, the most common location was beside the track for both crafts, but this may be the riskiest location simply because these employees work there more often than elsewhere, while other locations could represent higher risk when employees work at those locations. Examination of the narratives on the form's Summary Continuation Sheet identified two incidents involving distraction among MOW personnel or signalmen. Neither incident identified distraction from using a PED. We suggest adding a database field related to distraction and finding ways to enable railroads to collect better information related to the issue of distraction in general, not just PEDs. PEDs represent one form of distraction. Distractions can also come from the competing demands on attention of doing one's job.

The analysis of railroad rules and policies shows variation among railroads in terms of the restrictions placed on PED usage that go beyond the federal regulation that applies only to operating employees. Some rules provide detailed restrictions including specifying situations in which PEDs may not be used and limitations for personnel in specific job roles. For some railroads, a PED may be used only after conducting a safety briefing with "all assigned crew members [where] all must agree on how communication can safely take place." Others were less specific, allowing PED usage "when necessary in conjunction with safe operation," or "in case of an emergency." One railroad was quite specific in

terms of the personnel to whom the rules applied, including mainline operations employees, operations control center employees, yard control center employees, interlocking control tower employees, roadway workers, and yard and shop maintenance and storage facility employees.

There are inconsistencies across railroads' rules in the definition and permissible use of a PED. Some railroads used GCOR or NORAC definitions, and others defined PED more broadly, for example, "any device...of remote use [that] has the potential to divert user's attention...or inhibit their ability to...monitor and...respond to the work environment." A potential benefit of a federal regulation for PED usage is that it can provide a uniform policy and definition of PEDs that would prevail across the industry.

We analyzed the results of efficiency tests for three railroads. These tests examine employees' knowledge and practice of rules, policies, and regulations as a way of evaluating compliance with company rules. At two railroads, virtually all employees whose results were reported passed these tests, but 5.3 percent of trainmen and maintainers did not pass at the third. At this third railroad, only 90 percent passed a test that evaluated compliance with a specific rule about PED usage in proximity to the tracks. The materials included 1 year of exam results, but the railroads differed in the type and amount of information they record, which made it difficult to understand their results. One railroad did not identify whether the results corresponded to different employees or multiple evaluations of one employee and did not include the employee's location and responsibilities at the time of the observation. Another railroad did not indicate the rules that corresponded to the observation results. So, it was not possible to compare the results of a railroad with a specific rule to another with a blanket rule or make other comparisons to determine whether a railroad's rules contribute to the differences in efficiency test results. More abundant and complete information would permit a useful analysis of the factors that affect compliance with railroads' rules regarding PED usage, including those that led to the different compliance rates that were found.

During the individual listening sessions and focus groups, employees provided their perspectives on expanding the federal mandate prohibiting PED use by operating employees to certain non-operating employees. Most participants did not want to expand the federal PED regulation to include non-operating employees without tailoring it to the individual craft and circumstances. At one extreme, participants who did not recommend expanding the rule said that their foremen/direct supervisor should be responsible for instituting and upholding the guidelines related to electronic devices because PED usage is beneficial to the employees and to the railroad. This suggestion is consistent with the finding that current railroad safety procedures lack specificity and uniformity, and thus they may require too much interpretation by employees. For example, they may not state the distance from the track that defines where an employee can use a PED safely, or describe the appropriate practices when receiving a call. This is where a foreman can take the specific job and location into account and provide meaningful PED safety guidance. On the other hand, the employees suggested that the lack of simple, common rules may contribute to misunderstanding the risk and how to reduce it by engaging in safe practices for on-duty PED use. Expanding the federal regulation to non-operating employees could produce uniformity and correspond more accurately to the actual risk of using a PED under specified circumstances. These

opposing opinions raise the issue of how to balance the need for a consistent set of regulations that can be applied across the industry with the need to tailor the regulations and operating rules to address safety at the local level. A one-size solution may not fit the needs of the industry.

The federal rule, if expanded, could be tailored to the employee's particular craft and circumstances. For example, participants regarded PEDs as an important alternative to company-issued radios, which were recognized as insufficient because they are unreliable. However, no participant said that PED use is safe under all conditions. The participants recognized that inappropriate PED use results in multitasking and can result in a loss of situational awareness, which is often a safety issue. Distraction to the point of losing situational awareness is particularly hazardous when an employee may have nowhere else to use a PED except near a track because of hazardous surrounding terrain. Specific exceptions may be necessary if the federal mandate is expanded to certain non-operating employees, just as the current regulation specifies exceptions (e.g., a railroad-supplied cell phone may be used when a company-issued two-way radio fails during a switching operation). However, care would be required to formulate the rule so that it is simple, easy to recall, and clear.

Specific examples of tailored rules (some of which are in current company policies) include the following suggestions from the information meetings:

- MOW employees and signalmen must mute PEDs before they begin working as watchmen or lookouts. Unless there are no other alternatives, they should not carry a PED because they may forget to mute the device. This tailored rule would be consistent with evidence presented earlier on the effects of a ringing cell phone even if the employee does not answer (Holland and Rathod, 2013). Employees do not appear to be aware of the potential distraction from an ignored or muted call given their response to Scenario 8 in Study I in which an employee standing in foul of the track mutes her phone when it rings. The majority of participants who responded to that scenario said that it does not contain a safety issue.
- MOW employees and signalmen must not use PEDs when they are in the foul of a track, or when operating a vehicle or machinery.
- Engineers can use a PED to talk to a yardmaster, dispatcher, or to the Mechanic Help Desk if engine trouble occurs, when radio communications are not effective.
- Car men must not use a PED when performing a maintenance inspection in a repair facility next to an active track (Study II, Scenario 5). Similarly, mechanics should not use a PED while repairing a locomotive on the track (Study II, Scenario 2).
- Car men should be permitted to use a PED to take a photo of a repair issue and for Internet access to blueprints or other repair materials.
- Employees must not use a PED while handling switches.

While some of these examples of tailored rules refer to PED usage in general, others are specific to job roles and responsibilities. In fact, many of the participants in the information meetings discussed work-related usage of electronic devices. In Study I, a majority of the participants said, for example, that they used company-issued cell phones to call supervisors about work plans and to coordinate equipment pick-up and repair. In Study II, participants mentioned company-issued electronic devices including onboard

work order devices that the freight railroad conductors use, electronic scanners that passenger conductors use for ticketing, and cell phones and tablet computers used by car inspectors. Rules tailored to the particular craft can proscribe the safe use of company-issued electronic devices that make work more efficient.

Several participants discussed their use of personal cell phones to perform their duties. For example, a conductor has used his cell phone to call a dispatcher for help assisting a disabled passenger. Another employee described his use of a personal tablet computer in the rail yard to check schedules and rosters. A rule tailored for use in yards could specify safe locations. While not always necessary (several participants said that they rarely use their PEDs for work), PEDs could make their work more efficient and rules could help to ensure that this usage is safe. We suggest further review of and research into these and other uses of electronic devices that support more efficient completion of duty responsibilities when the electronic devices are used appropriately and within established guidelines and regulations. On the other hand, distraction can come from the different kinds of work that the employee must do. The devices provided by the company to accomplish the work may also contribute to distraction. In fact, participants described company-issued radios as potentially distracting devices. Luke, Heavisides, & Basacik (2013) point out that operational use is easier to control than personal use. Other employees can be trained not to call engineers and conductors when they should not be distracted, for example. They also note that it is important for the railroad to set a good example.

Based on what we heard from participants, we believe that the issue of whether federal regulations should allow the limited use of company-issued PEDs and both personal and work-related uses of PEDs requires further study. Our study raises a variety of questions. They include the following:

- Should railroads allow passenger conductors who are provided with company-issued smart phones to call other employees for business-related matters and block numbers that are not associated with work personnel?
- Should railroads allow car inspectors to use their personal cell phones while in the shop and in the field to coordinate work and troubleshoot problems?
- Should railroads allow car inspectors to use smart phones to take photos of equipment and access documents to facilitate making repairs?
- Should freight conductors be allowed to use a cell phone to communicate with industry to coordinate pick-ups and drop-offs?
- Would employees understand the conditions required for the safe performance of the actions mentioned above?

The qualitative evidence gathered in the present study is insufficient to answer these questions.

Developing more comprehensive policies and practices could help to address the perception of some participants that while onboard reporting devices and calls from supervisors are equally or more distracting than PEDs, they are permitted. Modifying the FRA regulation or providing guidance to support the existing FRA regulation to address complexities involved with work-related use of both personal and company-issued devices could help to address these fairness issues.

Regarding the participating employees' perceptions of PED usage and related attitudes, the information meetings indicated that few of the participants carry PEDs (not railroad-issued devices) at work, although this finding may reflect a sample with an average of 24 years of work experience and not the entire railroad population.

All of the participants in Study I said that they recognized the importance of complying with company rules for their safety and that of their coworkers. They said that they learned of the rules through a variety of means: word of mouth from coworkers or supervisors, daily safety briefings, monthly safety meetings, and annual rulebook recertification training. None of the MOW employees and signalmen said that they learned about the FRA regulation from their monthly or annual safety training, and some did not have an accurate understanding of it. MOW employees cannot comply with a practice or policy that they do not understand and for which they have not been educated in how to comply. The FRA regulation applies directly to the operating employees who participated in Study II (conductors and engineers). Their new-hire and annual training covered it, but they were unclear about the distinctions between the federal regulations and the apparently more extensive company rules. Most said that they would be comfortable with implementing electronic device safety culture through a peer-to-peer safety program. All of the participants in Study II said that they only use their cell phones under appropriate conditions, and the reason that most gave was their fear of losing their jobs or of suspension without pay. The issue of calibrating employee perception of the risks of using PEDs to the potential consequences of inappropriately using them deserves further study because employees may not expect to be caught under some circumstances. One participant recommended publicizing anonymous PED rule violations; this could provide a context in which to bring attention to the risks that the rule addresses. Identifying and publicizing opportunities for their appropriate (safe) use also deserves additional consideration as this may reduce their inappropriate use.

Most of the participants in Study II suggested that employees follow the foreman's best practices, which do not necessarily correspond to the FRA regulations or company rules. See section 4.5.4 for several examples of their best practices. Foremen were among those who failed efficiency tests that this study examined. Their input may suggest better ways to formulate policies and practices that work. At the same time, they represent influential employees whom an educational campaign must reach. A second focus of the campaign should be on younger, less experienced employees. Third, FRA (2010) reported that most EO 26 defects were found on short line railroads. They were not included in the present study, but the education and outreach effort should include them.

From the comments of several employees, it is also clear that while any outreach must respect an employee's common sense and personal integrity, the educational campaign must help them through face-to-face discussion to draw the right conclusions, which is not usually possible through computer-based instruction or simply reading a rulebook. It may be counterproductive if "[vehicle fleet owning] company managements set too many rules or if the rules infringe on the employee's own liberty to make decisions" (Kircher, et al., 2012, p. 55). These authors suggest the use of "simulated risk situations while using

communication devices” and considering “simulator-based training components” (p. 56). The repercussions for not complying with the rules also require emphasis and consistent application.

FRA sponsored this work to better understand the circumstances and safety impact of safety-related railroad employees’ use of PEDs in response to the Rail Safety Improvement Act (RSIA) of 2008. As part of this work, we sought to understand how other transportation modes have dealt with the issue of PED distraction and found that other modes’ rules range from “blanket” advisories (aimed at PED usage under all work conditions) to more tailored policies: for example, policies for crew members who operate a ship differ from policies for crew members who are on the ship but do not operate it (Boat Force Policies, 2010). Regulations may apply to operators with specific credentials (FMSCA, 2010; PHMSA, 2010). Examination of railroad rules regarding PED usage showed that PED practices vary from specific to broad, blanket prohibitions. Railroad efficiency test results suggest that employee compliance with railroad restrictions on PED usage varies widely from company to company. The efficiency test results also vary in what they measure, making it difficult to make comparisons across railroads. In Study I, the research team conducted information meetings with MOW employees and signalmen (union, management, and rank-and-file employees) to gather their perspectives. These meetings provided multiple viewpoints on the issues and helped identify pros and cons of expanding the federal rule (49 CFR Part 220). Study II was conducted as a follow-on effort to obtain additional employee input about their attitudes and perceptions regarding PED usage. Focus group participants included both operating and non-operating safety-related railroad employees, including locomotive engineers, conductors, car inspectors, and dispatchers. These employees responded to scenarios where using a PED is in compliance with federal regulations and others where it is not, and discussed the ways in which PEDs and similar, company-issued devices facilitate the performance of specific duties and responsibilities. All these efforts combined to provide the recommendations described below and a qualitative baseline for a survey evaluation of an education and outreach program currently under development by a RSAC working group on electronic device distraction.

6. CONCLUSIONS

One goal of these studies was to gather evidence about the circumstances of electronic device usage, the distraction that may result, and to provide information about the expansion of Restrictions on Railroad Operating Employees' Use of Cellular Telephones and Other Electronic Devices (49 CFR Part 220) to safety-related non-operating railroad personnel. Due to the limitations of this study, including the lack of specific subfields in the Human Factors accident/incident cause category and a representative sample of efficiency test results, its findings do not provide clear support for or against this decision. However, some employees believe that there are advantages to tailoring the regulation for the particular railroad craft if it is expanded. The regulation could be formulated in a way that applies to all portable electronic technologies including smart phones, GPS (global positioning system devices), gaming devices, tablet computers, and music players, and to future portable technological innovations that can distract employees while they are on duty. Since federal regulations are more difficult to modify than company rules, and the technology is evolving, technology-neutral solutions to electronic device distraction are preferable.

A second goal of these studies is to provide a qualitative baseline of employee electronic device usage and attitudes for the evaluation of an education and outreach program that is coordinated by a RSAC working group on Electronic Device Distraction. The information collected during these studies provides a small but diverse set of opinions and perspectives. Representative data require structured interview and survey methods that the present effort did not use. However, the findings from these studies do provide information for the Office of Safety and the RSAC group to explore in future conversations with the industry. The following are conclusions from the information meetings conducted with MOW employees and signalmen (Study I) and locomotive engineers, conductors, dispatchers, and car inspectors (Study II).

1. Personal cell phones are properly stowed when the employee is at work and only company-issued cell phones are carried. Employees frequently use them. Most if not all calls are business-related calls that are made away from the tracks (Study I).
2. Most did not want FRA to expand PED regulations to include their crafts primarily because they consider their company's rules to be sufficient (Study I).
3. Employees frequently commented on use of cell phones for business when company-issued radios were ineffective because the party line was in use by others or the radio signal was too weak (Study I).
4. Overcoming cultural norms that accept cell phone use is regarded as a challenge. However, employees tend to follow the foreman's best practices. The daily briefing is a good opportunity to ensure that MOW employees comply with company and federal EDD policies (Study I).
5. Cell phones are the most commonly carried type of PED among the participating Study II employees. They are sometimes or often used, but reportedly within existing rules and regulations. Most said that the reason is their fear of losing their jobs or of suspension without pay (Study II).

6. Although company-issued radios are generally sufficient for communication purposes, cell phones and tablet computers are at times more effective for communicating business-related information (Study II).
7. The challenges of eliminating safety concerns related to electronic device distraction include their use among younger employees and cultural norms that accept their use. Employees suggested that peer-to-peer programs are acceptable and effective countermeasures (Study II). Peer groups should be encouraged to define the safe way with input from CFR and railroad operating rules and safety rules.

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APPENDIX A. NORAC (10th Edition) AND GCOR (6th Edition) ELECTRONIC DEVICE USAGE RULES

Northeast Operating Rules Advisory Committee (NORAC)

NORAC (p. 5): **ELECTRONIC DEVICE:** An electronic or electrical device used to conduct oral, written, or visual communication; place or receive a telephone call; send or read an electronic mail message or text message; take or look at pictures; read a book or other written material; play a game; navigate the Internet; navigate the physical world; play, view, or listen to a video; play, view, or listen to a television broadcast; play or listen to a radio broadcast other than a radio broadcast by a railroad; play or listen to music; execute a computational function; or, perform any other function that is not necessary for the health or safety of the person and entails the risk of distracting the employee or another employee from a safety-related task. This term does not include:

1. Electronic control systems and informational displays in the locomotive cab or control compartment of a train or track car, or on a remote control transmitter, used to operate a train or track car or conduct a switching operation, including functions associated with controlling switches.
2. Electronic control systems and informational displays used by Train Dispatchers in the performance of assigned duties.
3. A digital watch that functions only as a timepiece.
4. Medical devices prescribed by a licensed practitioner intended for use in the diagnosis, cure, mitigation, treatment, or prevention of disease or other conditions.
5. Railroad-supplied radios.

NORAC (p. 8): **RAILROAD-SUPPLIED ELECTRONIC DEVICE:** An electronic device provided to an employee by the employing railroad for an authorized business purpose. A railroad supplied device will be considered a personal electronic device when it is being used by the employee for a purpose other than an authorized business purpose.

ROADWAY WORKER (p. 8): Any employee of a railroad, or of a contractor to a railroad, whose duties include and who is engaged in the inspection, construction, maintenance or repair of railroad track, bridges, roadway, signal and communications systems, electric traction systems, roadway facilities or roadway maintenance machinery on or near the track or with the potential of fouling a track, and employees responsible for their protection.

Use of Electronic Devices (Rule 716, pp. 126 - 128): An employee shall not use an electronic device if that use would interfere with the employee's or another employee's performance of safety-related duties. No individual in the controlling locomotive cab or control compartment of a train or track car shall use an electronic device if that use would interfere with an employee's performance of safety-related duties.

a. Personal Electronic Devices

1. Prohibited: The unauthorized use of a personal electronic device to perform any function when required to perform service is prohibited. When use is not authorized, personal electronic devices must be turned off and stored out of sight, along with any earpieces, headphones or other similar peripheral devices.

2. Authorized: A standalone calculator may be used for an authorized business purpose, provided this use does not interfere with the performance of any employee's safety-related duties. The use of the voice communication functions of a personal electronic device by an employee other than an employee controlling a moving train or track car is authorized, as follows, subject to the Restrictions governing the use of railroad-supplied devices:

(a) For All Employees:

(1) To respond to or coordinate an emergency situation involving the operation of the railroad or to respond to an emergency encountered while on-duty;

(2) To perform duties directly related to the operation of the railroad when radio communication fails; or

(3) To perform duties directly related to the operation of the railroad when the railroad is not required by federal regulation to provide a working radio. When the railroad is not required by federal regulation to provide a working radio, an employee may use a personal electronic device for assigned duties after a safety briefing, provided all employees responsible for the movement of the train or track car agree that it is safe to do so.

(b) For Roadway Workers: To perform duties directly related to roadway worker activities.

(c) For Members of a Train Crew: To perform assigned tasks directly related to the operation of the railroad when:

(1) The train is stopped;

(2) No member of the crew is riding rolling equipment during a switching operation;

(3) No member of the crew is on the ground;

(4) No employee is assisting in the preparation of the equipment for movement, and

(5) The engineer and conductor perform a safety briefing to confirm that it is safe to do so and other crew members are informed.

b. Railroad-Supplied Electronic Devices: An employee may use a railroad-supplied electronic device only for an authorized business purpose as prescribed below.

1. Authorized Business Purposes: Subject to the Restrictions below, the following are authorized business purposes for railroad-supplied electronic devices by an employee who is not controlling a moving train or track car:

- (a) Emergencies: Use is authorized for voice communication to respond to or coordinate an emergency situation involving the operation of the railroad or to respond to an emergency encountered while on-duty.
- (b) Assigned Tasks Directly Related to Duties: Use is authorized for revenue related functions, delay reporting, mechanical defect troubleshooting and reporting, roadway maintenance work, passenger service requests, and numerical calculations.
- (c) Radio Communication Failure: Use is authorized for voice communication:
 - (1) To perform duties directly related to the operation of the train or track car when radio communication has failed; or
 - (2) To perform duties directly related to the operation of the railroad when the railroad is not required by federal regulation to provide a working radio. When the railroad is not required by federal regulation to provide a working radio, an employee may use a railroad-supplied electronic device for assigned duties after a safety briefing, provided all employees responsible for the movement of the train or track car agree that it is safe to do so.
- (d) Supplemental Reference Materials: The use of digital and display functions of an electronic device is authorized as a supplemental means to refer to a railroad rule, special instruction, timetable, or other directive.
- (e) Documentation of a Safety Hazard: Use is authorized for still photograph documentation of a safety hazard or a violation of a rail safety law, regulation, order, or standard provided the device is turned off immediately after the documentation has been made, unless its use is otherwise permitted.

2. Restrictions

- (a) Use in Locomotive Cab or Control Compartment
 - (1) Use of a railroad-supplied electronic device for an authorized business purpose by an employee controlling the movement of a train or track car is prohibited:
 - i. When the train or track car is moving,
 - ii. When any employee is assisting in the preparation of the equipment for movement, or
 - iii. When any train crew member is on the ground, or riding rolling equipment during a switching operation.
 - (2) An employee, other than the employee operating the controls of a moving train or track car, may use a railroad-supplied electronic device in the controlling locomotive cab or control compartment of a train or track car for an authorized business purpose after a safety briefing, provided all employees in the controlling locomotive cab or control compartment agree that it is safe to do so. Any other use in the controlling locomotive cab or control compartment is prohibited.

(3) When use of an electronic device is authorized, audible ringers or alerts must be turned off and devices set to vibrate, if possible.

(b) Use in Body of Train or Trailing Locomotive: An employee may use a railroad-supplied electronic device for an authorized business purpose while on duty within the body of a passenger train, in a trailing locomotive, or in a railroad business car. Such use must not interfere with any safety related duties.

(c) Use Other than When on a Train or Track Car: The use of a railroad-supplied electronic device for an authorized business purpose when required to perform service other than when on a train or track car is prohibited:

(1) While fouling any track;

(2) While participating in a switching operation;

(3) While required to perform any other safety related duty.

EXCEPTION: A roadway worker fouling a track may use a railroad-supplied electronic device for an authorized business purpose when protected by ontrack safety procedures and not in an area where a distraction could result in being struck by machinery, tools or on-track equipment.

c. Deadheading Employees: Deadheading employees are prohibited from using electronic devices within the controlling locomotive cab or control compartment of a train or track car. Employees in deadhead status located outside the controlling locomotive cab or control compartment of a train or track car may use an electronic device only when such use does not interfere with any employee's personal safety or performance of safety-related duties.

d. Supervisors: Supervisors may use an electronic device for assigned tasks directly related to their duties provided this use does not interfere with the performance of any employee's safety related duties. When necessary to foul a track, the supervisor must ensure protection against trains or other on-track movements is established.

e. Penalties: Any individual who violates these prohibitions or uses any of the described devices without observing any of the restrictions is subject to federal civil penalties and/or disqualification, and company discipline up to and including discharge. If there are any questions or doubt regarding the authorized use of a personal or railroad-supplied electronic device, employees should refrain from any use until the proper authority can be consulted.

General Code of Operating Rules (GCOR)

GCOR: (2010, Rule 1.10, pp. 6 - 7): Games, Reading, or Electronic Devices:

Employees on duty must not:

- Play games.
- Read magazines, newspapers, or other literature not related to their duties when:
 - On a train or engine.
 - Performing safety related activities, or
 - It would delay or interfere with required duties.

This does not prohibit employees from having such material enclosed in their personal luggage.

Personal Electronic or Electrical Devices. Employees are prohibited from using personal electronic or electrical devices such as cell phones, electronic games, TV's, computers, media players (including wearing associated earpieces) or from having such devices turned on while on duty. However, a personal wireless communication device, (cell phone) may only be used for voice communication as a redundant means of communication in the event of railroad-supplied radio failure and in accordance with railroad rules or instructions.

Exceptions. Employees may use a personal cell phone only during a recognized period of break time, meal period or after a job briefing with all crew members specifying that all railroad operations for that crew and employee have been stopped and suspended and the employee is not foul of any track. Such use must not interfere with any safety related duty. Employees may use any means of communication necessary to respond to an emergency situation involving the operation of the railroad or encountered while performing a duty for the railroad.

Railroad Authorized Electronic Devices. In addition to compliance with all railroad radio rules and instructions, the following applies to the use of railroad authorized electronic devices.

1. Except in an emergency, employees must not use a railroad authorized electronic device for purposes other than which it was intended or while:

- Operating the controls of a moving locomotive.
- Standing on the ground in a position foul (within 4 feet of the nearest rail) of any track.
- On the ground and engaged in an active switching operation.
- Any crew member is riding on any piece of equipment outside the cab of the locomotive.
- Any other employee is assisting in the preparation of the train or testing of railroad equipment or brakes.
- Inside the controlling cab of a locomotive or train unless there has been a job briefing and all crew members agree that it is safe to do so; or
- Obtaining or releasing mandatory directives when railroad radio communication is available.

2. Railroad authorized electronic devices may be used for railroad business when it will not interfere with safety related duties:

- In the body of a business car or passenger train.
- For voice communication as a redundant means of communication in the event of radio failure, or
- To access stored electronic rule book files. When doing so, the wireless capability of the device must be disabled.

3. Railroad provided wireless devices with “Push-To-Talk” or “Direct Connect” type features may be used in lieu of a railroad radio to conduct train or switching operations when authorized by the railroad.

**APPENDIX B. NARRATIVES OF INCIDENTS/ACCIDENTS THAT REFER TO
DISTRACTION OR PED USAGE**

Personnel	Physical Action	Location	Equipment Involved	Location of Employee	Cause	Narrative
MOW	Walking	Main/ Branch	Not associated with on-track equipment	Other Location	Undetermined	EMPLOYEE WALKING TO VEHICLE TO GET COMPANY CELL PHONE TRIPPED/SLIPPED ON SNOW COVERED RAIL AND SPRAINED KNEE
MOW	Using hand tool	Yard	Not associated with on-track equipment	Track, Beside	Lack of Communication	EMPLOYEE WAS SECURING A SPIKE MAUL HEAD ONTO A HANDLE WHEN ATTENTION WAS DIVERTED AND HE HIT HIS THUMB WITH ANOTHER MAUL.
MOW	Reaching	Parking Lot	Truck	In/Operating Vehicle	Human Factor	INCIDENT OCCURRED IN A COMPANY VEHICLE EQUIPPED WITH HY-RAIL EQUIPMENT BUT VEHICLE WAS STANDING STILL IN A PARKING LOT AND NOT USING HY-RAIL EQUIPMENT.
Signalmen	Walking	Sidewalk/ Walkway	Not associated with on-track equipment	Other Location	Human Factor	WALKING TO VEHICLE ON ARCHER AVENUE, CROSSED ARCHER AVENUE TO NORTH SIDE, STEPPED ON CURB, BUCKLED GRATING EMPLOYEE DISTRACTED, TWISTED LEFT ANKLE.

APPENDIX C. INFORMATION MEETING GUIDE

Introduction:

I would like to start by thanking you again for your willingness and interest in participating in our study.

We are joined today by colleagues [name all experimenters present and their roles in the study].

The study should take roughly 1.5 to 2 hours and will consist of some general questions regarding your opinions and first-hand accounts of using PEDs and some scenarios in which we will ask you to comment on. We will be taking notes on your comments and observations and any information that we include in our final report will not contain any identifying information. You will receive a \$100 gift card by mail for your time.

This study is looking at the issue of distraction from the use of personal electronic devices (such as cell phones, PDAs, music players, smart phones, note books, tablet computers and electronic readers) by MOW employees and Signalmen personnel. The goal of this study is to compile information from employees and railroads regarding their opinions and experiences with this topic.

Do you have any questions before we begin?

For researchers only

Discussion topics are listed. Please use as a guide.

Topics and Scenarios below are listed to be used prompts in case of a need for probing questions.

Not every topic, question or scenario will be discussed during the each telecom.

Discussion Topics

- 1) Assess whether use of personal electronic devices (PED) (company issued and personal property) while on duty can result in distraction.
- 2) Identify and describe situations when it would and would not be appropriate to use a PED.
- 3) What are specific job functions that would require use of a PED?
- 4) Regulations to help protect the safety of employees while on they are working.

INITIAL QUESTIONS:

- 1) How often, in a typical work day would you say you use your phone? (number of hours)
- 2) What percentage is business related? Personal related?
- 3) What type of business do you usually conduct when you do use your phone for business?

- 4) What rule do you follow regarding personal electronic device use? Is it issued by the RR? What does it state/limit?
- 5) What are the repercussions imposed by the RR if this rule was violated?
- 6) How did you learn about this rule? Safety Briefing? Received training? Memo?
- 7) Do you think that you have been sufficiently trained/are knowledgeable about the RR's rule about personal electronic devices?
- 8) Do you think others that you work with have the same level of knowledge? Do you think they practice what they were taught?
- 9) Is there something about the current rule that you disagree with? What would you change about it?

RULE AWARENESS

1. Are you familiar with E.O. 26, now called "Restrictions on Railroad Operating Employees' Use of Cellular Telephones and Other Electronic Devices"?
2. If the "Restrictions on Railroad Operating Employees' Use of Cellular Telephones and Other Electronic Devices" was expanded to non-operating employees, what would change?
 - a. What aspects of the rule ought to be reviewed with a "new eye" focused on Non-Op employees?
 - b. What aspects of the rule would create issues?
 - c. What aspects of the rule could be adopted successfully by Non-Op employees?

PROGRAMS

- 4) Do you know of any RR that has instituted programs regarding operating hi-rail, or other on/off track vehicles while using a PED?
 - a. What kind of program is it? Peer-to-Peer? Embedded into training? Leading by example?
 - b. Do you think it is successful?
 - c. What could be changed about it?
- 5) What kind of program do you think would be instrumental in changing the safety culture and awareness of PED usage and the distraction it causes?

SAFE VS. UNSAFE SITUATIONS

- 6) Situations in which it would NOT be appropriate to use a PED?
 - a. What "best practice" could be established to make using a PED acceptable in that situation?
- 7) Situations in which it WOULD BE appropriate to use a PED?
 - a. Off-hours

- b. Position in relation to track/work
 - c. Locations within yards/trains
- 8) Any guidelines that may be used for “Best Practices” for non-operating personnel?
 - a. Certain distances to be away from track?
 - b. Certain roles within the gangmen that should NEVER have a PED on their person?
 - c. Certain roles that using and having a PED on their person at all times is necessary?
- 9) Any specific instances which are particularly problematic with regard to enforcing proper PED usage?
 - a. MOW's working alone
 - b. MOW's working in a group
 - c. Walking through the yard
 - d. Driving/using equipment (on and off track vehicles)

APPENDIX D. STUDY I SCENARIOS

- 1) A lead maintainer and a maintainer were assigned to work in a section of track that has been known to have “spotty” radio service. The maintainer acted as the gang watchman and did not have his personal cell phone on his person and was not provided with a company-issued cell device either. These two had just completed their work and the lead maintainer tried to contact the dispatcher on the radio to give up their foul time on the track, but there was too much interference and static to complete the transaction properly. The lead maintainer then asked the maintainer if he could borrow his active cell phone to try to contact the dispatcher. The maintainer took his personal cell phone out of his pocket and gave it to the lead maintainer. The lead maintainer was able to reach the dispatcher and release the foul time and then drove back to the yard.

Issues:

- Maintainer had his cell phone on his person and turned on while working.
- Was it appropriate for the lead maintainer to ask the maintainer to use his personal cell phone to contact dispatcher?
- Would the physical location of the lead maintainer and maintainer in relation to their work area affect the issues within this scenario?
- Did the maintainer uphold the responsibilities of gang watchman when he allowed the lead maintainer to use his cell phone?

- 2) A trackman, while handling a switch for a piece of MW equipment, was talking to his wife on his personal cell phone. His wife had a job interview and wanted to tell him about it. The trackman had a safety briefing about using personal cell phones while working on the tracks earlier in the day. After speaking to his wife on his personal cell phone, he then contacted the gang watchman on the radio to inquire when the track was scheduled to be put back into service while he had the cell phone next to his ear.

Issues:

- Should trackman have his personal cell phone on his person and turned on?
- What are some of the safety implications of the trackman’s actions?
- Suppose the call concerned an emergency situation of some kind (either on the job site or at home)?

- 3) During an inspection, an FRA representative observed a MOW equipment operator with an ear piece, such as a “Bluetooth”, in his ear while he was operating his equipment on the track. He was not observed to be using the device, but his personal cell phone was in a holster, turned on.

Issues:

- Does having the earpiece in his ear, while having his cell phone on his person and turn on affect the performance of his duties?
 - If the phone was turned off, but the earpiece was still inserted, would that change the situation?
 - What would you suggest the MOW equipment operator do?
 - What would you suggest the FRA representative do?
- 4) With the growing use and advancements in Smartphones and the creation of mobile applications (commonly referred to as “apps”), it is possible that future apps may be developed that may assist signalmen and MOW employees when they are out in the field. Such capabilities could be the visual representation of current track and signal information, track warrants/authority or access to “repair databases” to obtain information about when a portion of track or other equipment was last repaired or replaced.

Issues

- What would this kind of technology mean to your current work? What would change in your daily routine?
 - What issues do you think this will create in terms of safety and situational awareness? Similar to that of current PEDs?
 - What kind of restrictions could be placed on this potential technology to ensure safety?
- 5) While riding in the non-leading locomotive, off-duty and not in the company of operating, currently on-duty employees, a signal maintainer took out his personal cell phone and turned on the phone to check the time. His phone indicated that he also had a 3 text messages and 1 new voicemail. He decided to read, listen and respond to each. After doing so, he turned the phone off and put it back into his satchel.

Issues

- Did the signal maintainer violate any regulations?
 - If there was an on-duty, operating employee passing through the cabin that the signal maintainer was occupying to get to the locomotive, would this have created an issue? Would the signal maintainer be in violation? Would the on-duty, operating employee be in violation?
- 6) While riding in the operating cab of a locomotive, a signal supervisor did not turn his phone off. During the trip, his phone rang and he answered it in the presence of the engineer who was operating the locomotive. The phone conversation lasted 5-7 minutes. Afterwards, the signal supervisor did not turn off his cell phone and continued the conversation he was having with the engineer before his phone rang.

Issues:

- What is the safety issue in this scenario?
- Did either of the employees, the signal supervisor or the operating engineer, violate a regulation?
- What would you advise the two employees do in this situation?

- 7) A track employee was observed to be using a cell phone when walking around his hi-rail vehicle on the main line while he was checking to see if the vehicle hi-rail wheels were fully engaged. The employee was bending over and looking under the vehicle as he was talking on his cell phone. The employee then got back into his vehicle and began backing up near a public grade crossing as he continued to talk on his cell phone. There was neither a train nor vehicular traffic in the vicinity as he approached the grade crossing.

Issues:

- Did the track employee violate any rules?
- If there was vehicular traffic or a train in the vicinity would that change whether or not he violated any rules?
- What would you have done differently if you were the track employee?

- 8) A rail track employee was observed with his cell phone clipped to his belt and powered on. While performing her duties, the phone rang in the employees grip. She stopped what she was doing, but remained in the foul of the tracks, removed the phone from her clip, and muted the ringing, placed it back into the clip and continued her duties.

Issues:

- Was the track employee correct in muting her phone? If not, what should she have done?
- What, if any, other issues in this scenario concern you?
- What, if anything, would you suggest the track employee do?

APPENDIX E. STUDY II SCENARIOS

- 1) A passenger train is preparing to shove back into a station platform from the main track. The Assistant Conductor alights from the train onto the right-of-way to unlock the main track switch and line it for the station while the Conductor prepares the back-up hose on the rear car. Suddenly, the Station Trainmaster contacts the Conductor via Nextel Direct Connect asking if there are any unaccompanied minors onboard. Seeing the Assistance Conductor has now finished lining the switch and is heading back to the train, she takes the Nextel from her belt and responds to the Trainmaster. After finishing the brief conversation, she places the Nextel back onto her belt and then tests the backup hose.

Issues:

- Does having the Nextel turned on and on her person against regulations?
 - Is it procedure to answer when the station trainmaster calls the conductor's cell phone?
 - What would you have done in this situation?
- 2) A mechanic, while repairing the engine of a locomotive on the track, was talking to his wife on his personal cell phone. His wife had a job interview and wanted to tell him about it. The mechanic had a safety briefing about using personal cell phones while working on the tracks earlier in the day. After speaking to his wife on his personal cell phone, he then contacted the engineer on the radio for protection while he had the cell phone next to his ear.

Issues:

- Did the mechanic violate any regulations?
 - Does the fact that he was working by himself make a difference? (e.g., if he was working in a gang with other employees?)
 - What do you think about his "multi-tasking"?
- 3) While observing a train crew conducting switching operations, an FRA inspector notices the Conductor has a wearing a Bluetooth earpiece. When questioned, the Conductor states the earpiece is off and his phone is in his truck which is in employee parking lot on the other side of the yard. **[Similar to Scenario #3 in Study I]**

Issues:

- Does having the earpiece in his ear, while having his cell phone on his person and turn on affect the performance of his duties?
- If the phone was turned off, but the earpiece was still inserted, would that change the situation?
- What would you suggest the conductor do?

- What would you suggest the FRA inspector do?
- 4) While riding in the non-leading locomotive, off-duty and not in the company of operating, currently on-duty employees, a deadheading crewmember took out his personal cell phone and turned on the phone to check the time. His phone indicated that he also had a 3 text messages and 1 new voicemail. He decided to read, listen and respond to each. After doing so, he turned the phone off and put it back into his satchel. **[Similar to Scenario #5 in Study I]**

Issues:

- Did the signal maintainer violate any regulations?
 - If there was an on-duty, operating employee passing through the cabin that the signal maintainer was occupying to get to the locomotive, would this have created an issue? Would the signal maintainer be in violation? Would the on-duty, operating employee be in violation?
- 5) After ensuring protection, a utility car man began to conduct a maintenance inspection on a locomotive. The employee was observed using a cell phone as he was checking the undercarriage of the locomotive. The locomotive was parked at a repair facility for routine maintenance, but was next to a main track which runs adjacent to the service facility.

Issues:

- What, if any, is the safety issue in this scenario?
 - What would you do differently?
 - What would you change about this scenario?
 - Does it make any difference that the locomotive was parked in a repair facility versus being inspected elsewhere in the yard?
- 6) An Engineer and Conductor are waiting in the cab of the locomotive to depart while a utility employee drives back in a truck to release some handbrakes on the rear of their train. Knowing they won't be departing for 15 or 20 minutes the Engineer remembers he needs to give his wife some information. He verifies they are set and centered with the generator field switch off, and then conducts a job briefing with his Conductor. After agreeing with the Conductor, he retrieves the phone from his grip, powers it on and texts the information to her. When he finishes, he ensures the phone is shut off and places it back in his grip. Several minutes later the Utility Employee radios he has knocked off the last of the hand brakes

Issues:

- What, if any, is the safety issue?
- Does this kind of situation happen normally?
- What do you agree with the actions of the engineer?
- Does the fact that the Utility employee is on the ground working make a difference?

- 7) An engineer and conductor on the head end of a freight train are stopped at an interlocking. The train dispatcher informs them that they will be holding at that location for at least one hour. They both lean back in their chairs, prop up their feet, and pull out their smart phones. They proceed to make phone calls and text messages.

Issues:

- Is there a safety issue? What is it?
 - Do you agree with the engineer and conductor using their electronic devices during this time?
 - What would you do in this situation?
- 8) A young, technologically savvy engineer and conductor on the head end of a freight train are operating in dark territory (no wayside or cab signals) on single-track main line at 20 mph. The train is traversing open country, offering little stimulus. Addicted to multi-tasking (they are millennials), both the engineer and conductor pull out their smart phones and proceed to make phone calls and text messages.

Issues:

- Are there safety issues?
 - What if the crew was in a signaled territory versus a dark?
 - What if their phone calls and text messages were business related because of being in the dark territory?
- 9) A dispatcher for the local freight transport was just starting his shift. His usual routine is to check the weather reports for his territory using his desktop computer. He takes notes on what looks like a powerful thunderstorm approaching the northeast side of his territory and sets a reminder in his cell phone to check the weather again in an hour to see if the storm's progression has changed. Fifteen minutes into his shift he gets a call on the radio. It's choppy and intermittent, but he is able to pull out that the BNSF1839 locomotive has broken down near that area where the thunderstorm is approaching. The DS then tries to contact the road foreman to give him directions to the broken down train, but the radio is still acting choppy. To keep the office line open for other crews to contact him, the DS uses his cell phone to call the road foreman and relay information to him regarding the location and issue with the broken down train.

Issues:

- Is it okay for the dispatcher to use his desktop to check the weather?
- Is it acceptable to use a cell phone and leave it on the desk as his alarm to check the impending weather?
- Is it okay that the dispatcher uses his cell phone to call the foreman when the radio became intermittent?

- At what point would the dispatcher have no other choice BUT to use his cell phone? Are there other ways of communication that could have been utilized?

APPENDIX F. CODING SCHEME

* Rule vs. Regulation = Company Issued vs. Federally Mandated

* Blanket rule = no exceptions

* Truck = includes “hi-rail vehicles

100. Demographic Information

101. MOW

101a. Bridge and Building

101b. Track department

101c. Safety Assistant

101d. Independent truck driver

101e. Other

102. Signalmen

102a. Signal Maintainer

102b. Signal Foreman

102c. Signal Inspector

102d. Safety Captain

102e. Other

103. RR Lawyer

104. RR Director of Safety

105. Railroad Class (choose 1)

105a. Class 1

105b. Passenger

106. Region of Country (see Appendix A, choose 1)

106a. Region 1

106b. Region 2

106c. Region 3

106d. Region 4

106e. Region 5

106f. Region 6

106g. Region 7

106h. Region 8

107. Years of Experience (choose 1)

107a. >10 years

107b. 11-20 years

107c. > 21 years

108. Works by themselves (majority of the time, >75%)

200. Cell Phone Use (choose three, one from each group: 201-204, 205-207, 208-211)

201. Carries **only Company-Issued Cell** Phone on their person (code if “Yes”)

202. Carries **only Personal Cell Phone** on their person (code if “Yes”)

203. Carries **both Cell Phones** on their person (code if “yes – the individual carries both phones while working)

204. Leaves personal phone in vehicle, locker, or work vehicle.

205. Personnel cell phone carried on person as back up if company issued cell phone does not work.

- 206. Uses cell phone <5 times a day
- 207. Uses cell phones between 6 and 10 times a day
- 208. Uses cell phones >11 times per day.

- 209. <50% of calls for business calls
- 210. Between 51% and 75% business calls
- 211. Between 76% and 99% business calls
- 212. 100% business calls, no personal calls.

- 213. Cell phone used on tracks.
- 214. Cell phone used on/near work truck.
- 215. Cell phone used away from tracks (not near truck), greater than foul of track.
- 216. Cell phone used in vehicles en route to job sites by driver.
- 217. Cell phone used in vehicles en route to job sites by passenger(s).
- 218. Cell phone used in moving/on track vehicles by driver.
 - 218a. Cell Phone used in stopped/on track vehicle by driver
 - 218b. Cell phone used in moving/on track vehicle through blue tooth by driver
- 219. Cell phone used in moving/on-track vehicles by passenger(s).
- 220. Cell phone used while waiting for transportation to job sites (work completed).
- 221. Cell phone used for emergencies

- 222. Using the radio is sufficient.
- 223. Radio is too “busy” with chatter.
- 224. Radio use is intermittent/unreliable (signal is weak).

- 300. Business Conducted Using Cell Phones (select all that apply)
 - 301. Call co-workers about equipment/software issues.
 - 302. Text coworkers about equipment/software issues.
 - 303. Call co-workers about their location.
 - 304. Text co-workers about their location.
 - 305. Call co-workers to coordinate work schedules.
 - 306. Text co-workers to coordinate work schedules.
 - 307. Calls to or from supervisor regarding work plans
 - 308. Texts from supervisors regarding work plans.
 - 309. Calls from repair facility coordinating pick up of equipment, schedule of repair, etc.
 - 310. Texts from repair facility coordinating pick up of equipment, schedule of repair, etc.
 - 311. Utilizes direct-connect feature
 - 312. Utilizes internet features
 - 313. Call regarding safety issues. (made and/or received)
 - 314. Text regarding safety issues. (made and/or received)

- 400. Company-Issued Rule Awareness (choose 1)
 - 401. Learned of rule through company website, email, etc.
 - 402. Learned of rule through word-of-mouth.
 - 403. Learned of rule through union email, website.
 - 404. Learned of rule through daily briefing.
 - 405. Learned of rule through monthly meeting.

406. Learned of rule through yearly meeting
500. Company Issued Rule (select all that apply)
- 501. Sets distance limits of PED usage near tracks.
 - 502. Sets limitations on PED usage while operating vehicle.
 - 503. Rule corresponds to state law regarding cell phone use and driving (“hands-free laws”)
 - 504. Specific roles named in gang that cannot have PED on their person.
600. Federal Rule Awareness (E.O. 26) (select all that apply)
- 601. Learned of rule through company website, email, etc.
 - 602. Learned of rule through word-of-mouth.
 - 603. Learned of rule through union email, website.
 - 604. Learned of rule through daily briefing.
 - 605. Learned of rule through monthly meeting.
 - 606. Definition given of the regulation.
700. Safety Issues (select all that apply)
- 701. Situational Awareness.
 - 702. Distraction (using a cell phone).
 - 703. Distraction (near someone using a cell phone).
 - 704. Generational divide (older versus younger).
 - 705. Overcoming cultural norms/socially acceptable practices.
 - 706. Multi-tasking
 - 707. Overconfidence/disregard for the rules
 - 708. Understanding of rule’s implications and repercussions not completely, 100% understood among employees
800. Training Practices (select all that apply)
- 801. Yearly computer-based, rules-review.
 - 802. Yearly classroom, rules-review.
 - 803. Yearly computer-based and classroom rules-review.
 - 804. Monthly Safety meeting – held by Safety Captain
 - 805. Monthly Safety meeting – held by company administrator
 - 806. Bi-annual Captain Safety meeting
 - 807. On-your-own, at-home rules-review
 - 808. Peer-to-Peer, observational training
 - 809. Daily Safety Briefing conducted
 - 810. Training topics vary based on instructor’s discretion
 - 811. Computer-based training (CBT) available
 - 812. Weekly conference call, meeting, etc.

813. Bi-weekly conference call, meeting, etc.

900. Thoughts on federal regulation expansion

- 901. “Blanket regulation” is needed (for both operating and non-operating employees).
- 902. Rule needed but tailored to the needs of job requirements.
- 903. Company policy in place is sufficient.
- 904. Federal regulation expansion NOT needed.
- 905. Federal regulation expansion needed.
- 906. Company rule needed.
- 907. Company rule NOT needed.
- 908. Use of best practices are sufficient (not put in place by company or Feds).
- 909. Company policy in place is not sufficient.

1000. Example of policy already put in place (regarding PEDs).

1000a. Example of possible future policy, practice, rule, or regulation

1001. Other Distractions

- 1001a. Equally distracting
- 1001b. Superior distraction

1100. General Comments

- 1101. Final Comments
- 1102. Example of actual occurrence/incident
- 1103. Description of Safety Captain Program.

2000. Scenario Analysis

- 2100 – Scenario 1
- 2200 – Scenario 2
- 2300 - Scenario 3
- 2400 - Scenario 4
- 2500 - Scenario 5
- 2600 - Scenario 6
- 2700 - Scenario 7
- 2800 - Scenario 8

__00 = Yes, there is a safety issue

__01 = No, there is not a safety issue

__02 = “What ifs”/Additional details (that affect the severity or whether or not there is a safety issue). - ** Provide comment**

Example: 2100 = Yes, there is a safety issue (in Scenario 1); 2401 = No, there was not a safety issue (in Scenario 4)

Regions, separated by State, according to FRA regions.

Region 1

Connecticut
Maine
Massachusetts
New Hampshire
New Jersey
New York
Rhode Island
Vermont

Region 2

Delaware
Washington, D.C.
Maryland
New Jersey from Camden south
Ohio
Pennsylvania
Virginia
West Virginia

Region 3

Alabama
Florida
Georgia
Kentucky
Mississippi
North Carolina
South Carolina
Tennessee

Region 4

Illinois
Indiana
Michigan
Minnesota
Wisconsin

Region 5

Arkansas
Louisiana
New Mexico
Oklahoma
Texas

Region 6

Colorado
Iowa
Kansas
Missouri
Nebraska

Region 7

Arizona
California
Nevada
Utah

Region 8

Alaska
Idaho
Montana
North Dakota
South Dakota
Oregon
Washington
Wyoming

APPENDIX G. EXAMPLES OF EFFICIENCY TESTS AND RESULTS

Table 8: *Results of Passenger Railroad [6] Observational Efficiency Test for PED Usage*

Department	Total	Complied	Failed	Actions	
				Mentoring	Verbal Warning
MOW Equipment Operator	153	153	0	N/A	N/A
MOW Foreman	333	330	3	2	1
MOW Operator	3	3	0	N/A	N/A
MOW Supervisor	99	99	0	N/A	N/A
MOW Other	693	691	2	0	2
Signal Equipment Operator	1	1	0	N/A	N/A
Signal Equipment Foreman	67	67	0	N/A	N/A
Signal Supervisor	27	27	0	N/A	N/A
Signal Other	505	503	2	1	1

Table 9: *Narrative Results of Passenger Railroad [6] Efficiency Test on PED Rule*

Employee Group	Received Mentoring	Received Verbal Warning
MOW Foreman	Failure to follow orders regarding electrical devices	
MOW Foreman	May have sent text page while inspecting-warned by	
MOW Foreman		FRA Emergency Order #26, Qualifying employee on company time
MOW Other		Using his cell phone
MOW Other		Tried to use cell phone while on track
Signal Other	Observed employee with wireless device in ear	
Signal Other		Told not to use personnel cell phone on company property

Table 10: *Results of Passenger Railroad [5] Observational Efficiency Tests for PED Usage*

Efficiency Exam	Description	Total	Complied	Failed	Action
1	<p>Employees are prohibited from using:</p> <ul style="list-style-type: none"> • A television, radio or similar device (not company issued) • Company issued electronic devices to make personal calls • Company issued devices in proximity to a track or by an on-ground employee where there is a danger of being struck by moving train or equipment (unless protection is provided by another ground employee) 	75	72	3	Verbal Counseling
2	<p>PED may be used on or about the tracks for company business only when the employee is:</p> <ul style="list-style-type: none"> • Not within 10 ft. of rail (when feasible) • Never within 4 ft. 	40	36	4	Verbal Counseling
3	Employee does not watch TV, listen to an unauthorized electronic device or any other unauthorized electronic device when required to perform service	163	155	8	Verbal Counseling
4	Employee does not use a cell phone while operating the controls of a moving train or engine	1	1	0	N/A
5	Employee does not use a cell phone while occupying the controlling cab of a moving train unless it relates to their duties	2	2	0	N/A

ABBREVIATIONS AND ACRONYMS

APTA	American Public Transportation Association
ATDA	American Train Dispatchers Association
BLET	Brotherhood of Locomotive Engineers and Trainmen
BMWED	Brotherhood of Maintenance of Way Employees Division
BRS	Brotherhood of Railroad Signalmen
CBT	Computer-Based Training
CDL	Commercial Driver's License
CFR	Code of Federal Regulations
CMV	Commercial Motor Vehicle
EO	Emergency Order
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
GCOR	General Code of Operating Rules
GPS	Global Positioning System
InFO	Information for Operators
MOW	Maintenance of Way
NHTSA	National Highway Traffic Safety Administration
NORAC	Northeast Operating Rules Advisory Committee
NTSB	National Transportation Safety Board
PC	Personal Computer
PDA	Personal Digital Assistant
PED	Personal Electronic Device
PHMSA	Pipeline and Hazardous Materials Safety Administration
RSAC	Railroad Safety Advisory Committee
RCL	Remote Control Locomotive
RSIA	Rail Safety Improvement Act of 2008
SMART	Sheet Metal, Air, Rail and Transportation Workers Union
TWU	Transportation Workers Union
USCG	United States Coast Guard