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Information and Communications Technology Survey of Class I Railroad Train, Yard, and Engine Workers

DOT/FRA/ORD-22/03

Final Report | January 2022

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6. AUTHOR(S)
Heidi D. Howarth, Ph.D. (0000-0002-1150-6432)
Megan E. France (0000-0001-7224-3982)
Juna Z. Snow, Ph.D. (0000-0003-1536-159X)
Michael A. Harnar, Ph.D. (0000-0002-5640-0738)

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14. ABSTRACT
This research assists the Federal Railroad Administration (FRA) in its desire to improve its understanding of railroader Information and Communications Technology (ICT) access, use, confidence, and preferences to create better safety-related programs and outreach campaigns for the industry. In conjunction with labor union partners, researchers surveyed a random sample of Class I train, yard, and engine (TY&E) railroaders during the summer of 2020. Responses generalized to the population and suggest relationships between ICT study variables and various railroader demographic differences, as well as differences between groups of railroaders depending on their preferences, confidence with ICT tasks, and use of ICT devices. Results pertaining to the *Railroaders' Guide to Healthy Sleep* (RGHS) website provide qualitative data for FRA to use strategically.

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Survey, questionnaire, needs assessment, *Railroaders' Guide to Healthy Sleep,* train yard and engine, TY&E, demographics, human factors, Information and Communications Technology, ICT

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METRIC/ENGLISH CONVERSION FACTORS

ENGLISH TO METRIC

LENGTH (APPROXIMATE)

1 inch (in)	=	2.5 centimeters (cm)
1 foot (ft)	=	30 centimeters (cm)
1 yard (yd)	=	0.9 meter (m)
1 mile (mi)	=	1.6 kilometers (km)

AREA (APPROXIMATE)

1 square inch (sq in, in^2)	=	6.5 square centimeters (cm^2)
1 square foot (sq ft, ft^2)	=	0.09 square meter (m^2)
1 square yard (sq yd, yd^2)	=	0.8 square meter (m^2)
1 square mile (sq mi, mi^2)	=	2.6 square kilometers (km^2)
1 acre = 0.4 hectare (he)	=	4,000 square meters (m^2)

MASS - WEIGHT (APPROXIMATE)

1 ounce (oz)	=	28 grams (gm)
1 pound (lb)	=	0.45 kilogram (kg)
1 short ton = 2,000 pounds (lb)	=	0.9 tonne (t)

VOLUME (APPROXIMATE)

1 teaspoon (tsp)	=	5 milliliters (ml)
1 tablespoon (tbsp)	=	15 milliliters (ml)
1 fluid ounce (fl oz)	=	30 milliliters (ml)
1 cup (c)	=	0.24 liter (l)
1 pint (pt)	=	0.47 liter (l)
1 quart (qt)	=	0.96 liter (l)
1 gallon (gal)	=	3.8 liters (l)
1 cubic foot (cu ft, ft^3)	=	0.03 cubic meter (m^3)
1 cubic yard (cu yd, yd^3)	=	0.76 cubic meter (m^3)

TEMPERATURE (EXACT)

[(x-32)(5/9)] °F = y °C

METRIC TO ENGLISH

LENGTH (APPROXIMATE)

1 millimeter (mm)	=	0.04 inch (in)
1 centimeter (cm)	=	0.4 inch (in)
1 meter (m)	=	3.3 feet (ft)
1 meter (m)	=	1.1 yards (yd)
1 kilometer (km)	=	0.6 mile (mi)

AREA (APPROXIMATE)

1 square centimeter (cm^2)	=	0.16 square inch (sq in, in^2)
1 square meter (m^2)	=	1.2 square yards (sq yd, yd^2)
1 square kilometer (km^2)	=	0.4 square mile (sq mi, mi^2)
10,000 square meters (m^2)	=	1 hectare (ha) = 2.5 acres

MASS - WEIGHT (APPROXIMATE)

1 gram (gm)	=	0.036 ounce (oz)
1 kilogram (kg)	=	2.2 pounds (lb)
1 tonne (t)	=	1,000 kilograms (kg)
	=	1.1 short tons

VOLUME (APPROXIMATE)

1 milliliter (ml)	=	0.03 fluid ounce (fl oz)
1 liter (l)	=	2.1 pints (pt)
1 liter (l)	=	1.06 quarts (qt)
1 liter (l)	=	0.26 gallon (gal)
1 cubic meter (m^3)	=	36 cubic feet (cu ft, ft^3)
1 cubic meter (m^3)	=	1.3 cubic yards (cu yd, yd^3)

TEMPERATURE (EXACT)

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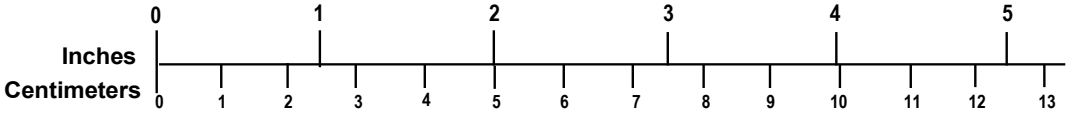
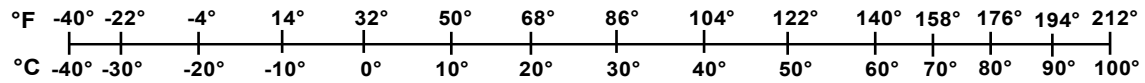
QUICK INCH - CENTIMETER LENGTH CONVERSION



QUICK FAHRENHEIT - CELSIUS TEMPERATURE CONVERSIO



For more exact and or other conversion factors, see NIST Miscellaneous Publication 286, Units of Weights and Measures. Price $2.50 SD Catalog No. C13 10286

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The Volpe National Transportation Systems Center team would like to thank the Brotherhood of Locomotive Engineers and Trainmen and the International Association of Sheet Metal, Air, Rail and Transportation Workers-Transportation Division for their support and cooperation in this effort. In particular, without the support of union leadership, the team would not have been able to reach Class I railroad employees to collect data, and the unions' role in promoting the survey on multiple occasions during the data collection period helped to achieve a high response rate and findings that apply to the general population of train, yard, and engine railroaders.

The team also would like to acknowledge all the individual railroaders who participated in this study and thank them for taking the time to participate in the pilot test, complete the survey questionnaire, and share their unique perspectives.

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Executive Summary

Information and Communications Technology (ICT) refers to *the technology and tools used to share, distribute, communicate, and gather information*. The Federal Railroad Administration (FRA) regularly uses ICT to disseminate research findings and to increase safety awareness. For example, the *Railroaders' Guide to Healthy Sleep* (RGHS) website is an example of an FRA-sponsored ICT-based program: the site is a non-regulatory educational resource designed to help train, yard, and engine (TY&E) employees address factors within their control to mitigate fatigue.

While various studies have examined ICT use among the general population, to date there have not been any studies regarding TY&E railroaders' ICT use, confidence, and preferences. To address this research gap, FRA contracted the Volpe Transportation Systems Center (Volpe) to conduct a needs assessment survey of TY&E railroaders from 2015 to 2021. This work was conducted at Volpe and remotely due to the COVID-19 pandemic. The objectives of this study were to generate baseline data from railroad employees across three key domains: (a) ICT access, use, and preferences; (b) familiarity with and use of the RGHS website; and (c) demographic characteristics. The results of this study will help FRA understand how best to communicate safety-related information to the railroader population.

The Volpe team relied on close collaboration with two labor unions, the Brotherhood of Locomotive Engineers and Trainmen (BLET) and the International Association of Sheet Metal, Air, Rail and Transportation Workers-Transportation Division (SMART-TD), to collect data from a random sample of Class I TY&E employees.

Survey administration took place over the course of 8 weeks and consisted of five mailings: a survey announcement letter, two survey packets (including a cover letter, consent form, and questionnaire), and two reminder postcards. These procedures are consistent with best practices for survey research. Survey invitees could either complete the questionnaire on paper and return it by mail, or complete it online using a confidential, unique access code included in the survey packet.

With a response rate of approximately 25 percent, the team received a sufficient number of responses to assert that the findings of this study can be generalized to the population of TY&E railroaders.

This research contributes to an updated baseline data collection of U.S. Class I TY&E railroader demographics. Additionally, it assists FRA in its desire to improve its understanding of railroader ICT access, use, confidence and preferences to create better safety-related programs and outreach campaigns for the railroad industry.

This study presents several opportunities for future research. For example, FRA could use these results as a baseline to assess change over time through similar, periodic assessments of this group of workers. Similarly, as this study focused only on TY&E railroaders; in the future, this research could be expanded to include workers in other railroad crafts.

1. Introduction

The Federal Railroad Administration (FRA) desired to learn how best to communicate safety-related information to train, yard, and engine (TY&E) railroaders and to understand more about this target audience's awareness and use of the *Railroaders' Guide to Healthy Sleep* (RGHS) website.[1] To investigate these interests, the Volpe Transportation Systems Center (Volpe) conducted a national survey of TY&E railroaders, collecting data during the summer of 2020. The FRA Office of Research, Development and Technology (RD&T) sponsored this survey.

The purpose of this research is not to issue recommendations or regulations to industry. Rather, it is to explore how FRA and other industry stakeholders can best effectively and efficiently communicate safety-related information to the railroad worker population.

1.1 Background

FRA invests in and creates various safety-related messaging campaigns and programs for the railroad industry. The success of these campaigns and programs is dependent, among other things, upon railroaders' awareness of them. Utilizing appropriate and effective communication strategies is essential to boost awareness of safety-related campaigns and programs.

Technology as a mode and medium for communicating information has become the norm. Information and Communications Technology (ICT) refers to the *technology and tools used to share, gather, and communicate information.* As the railroad industry adopts these practices to communicate about safety, organizations should understand the ways and the extent to which their target audiences use technology. By understanding the needs of their intended users, organizations are able to tailor their resources and efforts to not only meet those needs, but also create more impactful programs.

This study was the first known data collection effort of its kind that examined ICT use within the railroader population. While similar studies have examined ICT use among the general population, these were not appropriate for use or modification for FRA's specific purposes. These include a Federal Census ICT Survey[2] for expenditures on capitalized and non-capitalized equipment; the U.S. Postal Service annual Household Diary Study,[3] which includes questions about household internet access, use, and some attitude items; and the Federal Census Current Population Survey,[4] which includes a section on broadband internet access and use. Each of these provides valuable information that may or may not apply to the railroad population. As there is no way to isolate (i.e., identify and stratify) the Class I railroad TY&E employee population specifically from the results of these studies, FRA sponsored the current study to address this knowledge gap.

[1] *Railroaders' Guide to Healthy Sleep* website.

[2] United States Census Bureau. Information & Communication Technology Survey (ICTS).

[3] United States Postal Service. Household diary.

[4] United States Census Bureau. Current Population Survey (CPS).

1.1.1 ICT Access, Use, and Preferences

There are many avenues of information dissemination and sharing. Railroaders may readily adopt some ICT technologies and others not at all (e.g., use a smartphone, but not a smartwatch); duration of use across technologies may differ as well.

Understanding how much and how frequently railroad employees use computer technology and various information sources (e.g., printed and online or electronic materials) in their daily lives will inform FRA's understanding of how to best reach this audience with non-regulatory information and educational and safety promotional material.

Additionally, understanding use or non-use of specific ICT by railroaders could be critical to the development of FRA programs. For instance, if a lot of railroaders do not use blog sites, FRA would need to consider whether investing significant resources in developing blog sites is a wise use of funding.

Preferences and attitudes towards ICT are important predictors for use and acceptance (Spence, Deyoung, & Feng, 2009). Much of the research on ICT use shows that those with positive attitudes are more innovative and have a higher perception of the advantages of ICT (Verdegem & De Marez, 2011). This is important for designing future communication campaigns and for gaining a clear understanding of baseline TY&E railroader preferences towards ICT.

Finally, railroaders may be more confident performing some technology-related tasks over others (e.g., using an internet search engine versus using online community sites). Online training is increasingly using interactive learning and testing tools. Those who are very confident with ICT tools and tasks may find online training relatively easy to manage, while others who are slow to adopt technology may be less comfortable.

Understanding railroaders' preferences and confidence with ICT will help FRA deliver information through media and tools appropriate to their audience.

1.1.2 The Railroaders' Guide to Healthy Sleep Website

The RGHS website (see footnote #1) is an example of an FRA-sponsored ICT program. It is a non-regulatory educational resource tailored to a TY&E employee target audience and designed to address factors under an individual's control that can help mitigate fatigue, and thereby improve safety.

The website features scientifically valid information about the mechanics and importance of sleep and sleep hygiene, tools to anonymously monitor and self-assess sleep quantity/quality and risk for sleep disorders and proven practical tips and strategies for improving sleep health and well-being. Additionally, from 2012 until 2019,[5] the site featured an *Anonymous Sleep Disorders Screening Tool* that railroaders could use to assess if they had symptoms indicating the risk of a possible sleep disorder, in which case the Tool recommended seeing a healthcare provider for further evaluation.

[5] The external server hosting the Anonymous Sleep Disorders Screening Tool experienced a catastrophic failure in November 2019. At the time of this publication, the Tool remains offline and appears as "under construction" on the RGHS site.

This survey provided an opportunity to gather insight and obtain baseline data pertaining to the awareness and use of the website by this target audience and to gauge how this program can influence development of future communication campaigns. Once FRA has an understanding of railroaders' familiarity with the website, it will be better positioned to design, deliver, and improve content and outreach campaigns for this resource and others.

1.1.3 TY&E Railroader Demographics

When designing ICT resources, understanding the demographic profile of the target audience is also important. This knowledge allows program managers to better tailor program resources and efforts to reach the intended user. The most recent, relevant study undertaken to understand railroader demographics took place over a decade ago. Gertler and DiFiore (2009) conducted a survey to better understand the work schedules and sleep patterns of train and engine (T&E) railroaders that included several demographic items. The research reported here used a similar approach and added to the work of Gertler and DiFiore (2009) by including yard employees. Therefore, the researchers collected updated demographic information for a random sample of TY&E employees. These data may be a useful revised baseline for monitoring future demographic changes for this group of railroad employees.

1.2 Objectives

The objectives of this study were to obtain generalizable baseline data from a sample of TY&E railroad employees across three key domains: (a) ICT access, use, and preferences; (b) familiarity with and use of the RGHS website; and (c) demographic variables.

Three key research questions guided this survey study:

1. Which types of ICT do TY&E railroaders use most?
2. How much do TY&E railroaders use ICT?
3. How do TY&E railroaders use the *Railroaders' Guide to Healthy Sleep* website?

Researchers omitted a fourth, originally planned research question addressing attitudes towards ICT. Due to requirements of the Office of Management and Budget's (OMB) approval process (see Section 1.3.1), the Volpe team removed a multi-item attitude scale from the survey instrument. Instead, the researchers revised the first research question to better reflect the data the team expected to gather from the questionnaire.

The Volpe team relied on close collaboration with two national rail labor unions to collect data from a random sample of their membership in order to address these research questions.

1.3 Overall Approach

The overall approach to this study included the following: OMB approval, stakeholder engagement, survey administration, communication strategy, and analysis and reporting.

1.3.1 OMB Approval

Working closely with the Volpe team, FRA sought Paperwork Reduction Act (PRA) clearance for the ICT study after the development of the initial survey instrument. OMB approved this information collection on January 31, 2019, under OMB control number 2130-0624.

1.3.2 Stakeholder Engagement

The Volpe team engaged with liaisons from the Brotherhood of Locomotive Engineers and Trainmen (BLET) and the International Association of Sheet Metal, Air, Rail and Transportation Workers-Transportation Division (SMART-TD). The Volpe team conferred with the union liaisons at benchmark points throughout the project to ensure that the study addressed their needs and FRA's, but also that the survey materials and products reflected an appropriate tone and used language relatable by their members. The support of the union's senior leadership, documented in a signed Letter of Commitment (LoC), was essential to the successful execution of this effort.

1.3.3 Pilot Test

Using the OMB-approved survey instrument, Volpe conducted a pilot test with union members at regional labor meetings. As a result of the pilot, the research team made minor non-substantive changes to clarify item wording and improve document formatting and layout prior to conducting the formal survey administration.

1.3.4 Survey Administration

Using a random, proportional sample of BLET and SMART-TD members, survey administration took place over the course of 8 weeks and consisted of five mailing phases including a survey announcement letter, two sets of survey packets, and two sets of reminder postcards. Survey invitees could either complete the questionnaire on paper and return it by mail, or complete it online using a unique access code included in the survey packet.

1.3.5 Communication Strategy

There was no incentive offered for completing the survey. To encourage responses, the team developed a communications strategy delivered by the unions to their members to raise awareness of the ICT survey by emphasizing the value of the research to the labor unions and the members themselves. Communications also sought to enhance members' trust, noting the use of unique codes to de-identify and keep confidential the participants' identity.

1.3.6 Analysis and Reporting

Following data collection, the Volpe team cleaned, compiled, and analyzed responses to present results tailored to each labor union and aggregated findings to FRA.

1.4 Scope

The scope of this survey included Class I TY&E active (i.e., "actively running trains") railroaders working in the United States, all of whom are represented by either of the two national labor unions and study partners, BLET and SMART-TD. Using a random sample ensured that, with a sufficient response rate, survey findings would be generalizable to all Class I TY&E railroaders.

1.5 Organization of the Report

The authors organized this report into the following sections:

Section 2 discusses ICT access, use, and preferences of Class I TY&E employees.

Section 3 presents study procedures and analysis results.

Section 4 offers findings from the current study and provides documented limitations.

Section 5 concludes the research noting recommendations for additional work.

Appendix A includes the questionnaire that respondents received as part of two survey packet mailings.

Appendix B contains the text used for the survey mailing materials.

Appendix C provides examples of materials that the research team developed for the labor unions to support the communications and outreach strategy.

2. Study Design

The objectives of this study were to describe the ICT access, use, and preferences of Class I TY&E employees. Achieving these objectives required a nationwide survey.

As required for Federal data collection efforts involving more than nine participants, FRA sought PRA clearance for the proposed study after the scoping and design of the initial survey instrument (see Section 2.3 for additional details on the instrument). OMB approved this information collection in January 2019.

The following sections describe the team's partnership with labor unions, the sampling plan and calculations used to ensure that findings would be generalizable to the TY&E railroader population, the survey instrument (i.e., questionnaire) used to collect data, and the study procedures.

2.1 Partnership with Labor Unions

Throughout this study, the team regularly engaged with representatives from the BLET and SMART-TD as study partners to ensure that the study design included the perspectives of labor in addition to those offered by the Volpe team and FRA.

The labor unions allowed the Volpe team to conduct a pilot test of the survey at regional labor meetings (see Section 2.3.1) during the summer of 2019, at which time the Volpe team met with senior leadership and secured their verbal approval to move forward with the full OMB-approved study.

To formalize leadership's support for the full study, researchers met with representatives from both unions in October 2019 to draft a LoC, which was finalized and officially signed shortly thereafter. The LoC outlined the various roles and responsibilities for the unions and Volpe.

The Volpe team and labor union partners collaborated to establish the criteria for study inclusion (see Section 2.2.2). The unions also committed to securely sharing contact information for a random sample of their membership with the Volpe team so that those members could be contacted for the survey (see Section 2.2.5), and agreed to a communication strategy to encourage members to participate in the survey (see Section 2.4.2).

2.2 Sampling Plan

The following sections outline the potential respondent universe, the sampling criteria, required sample size, predicted response rate, and sample draw procedures used for this study.

2.2.1 Potential Respondent Universe

Volpe sampled active TY&E craft employees within U.S. Class I railroads because they represent the largest portion of the industry.

Researchers calculated the potential respondent universe at approximately 70,000 actively working railroad TY&E employees in the United States. Most U.S. TY&E employees, approximately 41,000, were members of the SMART-TD. The remaining ~29,000 were members of the BLET. TY&E employees who work for short line railroads and are not represented by a labor organization were not included in this study.

Both the BLET and the SMART-TD maintained databases with the names, mailing addresses, and date of birth for their members, and agreed to work with the Volpe team to generate a random sample to participate in the study.

2.2.2 Sampling Criteria

The researchers worked closely with union-designated liaisons to establish sampling inclusion and exclusion criteria. These criteria narrowed the sample to only members actively running trains so that the Volpe team could avoid contacting railroaders who did not meet the criteria.

The final sampling criteria listed in Table 1 were based on agreements between the Volpe team and the labor unions on how to define an "active TY&E railroader" for inclusion in the study sample:

Table 1. Inclusion and exclusion criteria for active TY&E railroader sample

Include:	Exclude:
– Train Yard & Engine job, i.e., actively running trains/working out on properties* *For BLET, include part-time elected Officers, as they continue to run trains and work on properties. – Class I (including Amtrak) carrier – Employees in active train service, including those temporarily out of service for any of these reasons: • Military Service • Discipline • Sick/Injury (short-term disability)	– Full-time Officers and Union staff* *For SMART-TD, exclude all Officers, as part-time elected officers could not be parsed from full-time Officers. – Furlough – Disability (long-term/Railroad Retirement Board-designated) – Union Staff

The unions applied the criteria and reported their total counts as of March 2020. The effective sampling frame was 63,766 after these exclusions. A total of 34,803 were SMART-TD members (54.6 percent) and the remainder (28,963) were BLET members (45.4 percent).

2.2.3 Required Sample Size

Researchers used Equation 1 to compute the required sample size.

Equation 1. Formula for sample size calculation (Dillman, D. A., 2007)

$$n = \frac{(\mathrm{N})(\mathrm{p})(1-\mathrm{p})}{(\mathrm{N}-1)\left(\frac{\mathrm{B}}{\mathrm{C}}\right)^2 + (\mathrm{p})(1-\mathrm{p})}$$

n = sample size needed

N = population size

p = proportion of population differences

B = acceptable amount of sampling error

C = Z statistic associated with the confidence level; 1.96 for 95% level

Confidence in generalizations was set to the industry standard of 95 percent. A 50/50 distribution of proportions was assumed because it is the most conservative and this study is not focused on testing any particular population differences.

Sampling error is directly related to an acceptable margin of error; this study was set at +/- 5 percent. This choice was based on the balanced consideration of effort and value. Reducing the margin of error may lead to a more precise understanding of this population, but in turn would significantly increase the number of responses necessary to generalize with some validity (e.g., at 3 percent the required sample would go from 382 to 1,056).

With the selection of a 5 percent margin of error, if 59 percent of the sample strongly agrees with a statement, it is possible to say with some confidence that the population's response would be between 54 and 64 percent. Given the descriptive nature of this study, this margin of error was acceptable, so the study team targeted 382 responses.

2.2.4 Predicted Response Rate

This collection had not been conducted previously, so the team had to estimate the response rate from other similar efforts and research on survey methods. In previously approved studies with subgroups of the TY&E employee population, the response rates ranged from 21–50 percent.[6] Most of those studies included substantial incentives and required more extensive participation. While one study with a similar population reported a 36 percent response rate with no incentives; the team found no documentation of the methods that were used to garner that rate.

The current study did not offer an incentive to encourage participation. Given a lack of documentation that would support making reliable assumptions about an expected response rate for the TY&E employee population without an incentive, the team used existing research outside the railroad community to inform a response rate calculation. Dillman (2007) found that by applying incentive and outreach efforts, surveys can obtain 20–30 percent response rates. Therefore, in the absence of any evidence to assume that the railroad industry participants would be more or less likely to participate than the general population, the team chose to oversample with the assumption of a 25 percent response rate.

[6] OMB 2130-0558/0570/0577/0588 Sleep Studies garnered 49.9/46/33/21 percent response rates. A Track Inspection Study garnered 36 percent response rate with no incentives.

Given that the team required at least 382 respondents to allow this study's results to be generalized to the population with a 5 percent margin of error, calculations generated a sample size of 1,528 (which with a 25 percent response rate, yields 382).

With the complications of the COVID-19 pandemic and the potential for associated delays, to proactively avoid the need for a second sample draw due to the likelihood of incomplete and therefore unusable records, the researchers ultimately requested 2,292 records (i.e., a 50 percent increase).

2.2.5 Sample Draw

The size of the requested sample draw from each of the two union databases was proportional to that organization's representation in the sampling frame of 63,766, for a total of 2,292 total member records. The Volpe team provided each union with specific instructions to draw a random sample from its database.

As part of the LoC, representatives for each union agreed to securely transmit members' information to allow the Volpe team to mail survey materials and reminders. Each unions' draw included these fields:

- First name
- Last name
- Mailing address
- Birthdate

2.2.6 Finalized Sample

Upon receiving the random sample of 2,292 union member records, the Volpe team removed any incomplete records, such as those missing mailing addresses. This resulted in a set of 2,196 potential survey invitees. Using this number, a lower response rate (17 percent) would yield enough responses to generalize findings to the TY&E railroader population.

2.3 Survey Instrument

With no existing instruments available to generate the necessary data to meet FRA's objectives, the team compiled a questionnaire that adapted various items and scales focused on the acceptance and use of ICT. The instrument was a paper-based questionnaire with an online completion option. Constructs included ICT access, usage, confidence, and preferences. Items included those that provided insight into participants' awareness and use of the RGHS website and a set of demographic questions to help situate analyses and provide an update to the baseline established by Gertler and DiFiore (2009). Each of these is described in more detail below.

After performing a literature review to identify the ICT constructs, areas of interest, and examples of previously employed items, researchers developed and submitted a questionnaire for OMB approval.

The RGHS and railroader demographics items were of secondary importance to the ICT items, yet the ICT items received the most attention during the PRA process. Ultimately, required changes affected the Volpe team's ability to work with the data as expected. These challenges are discussed further in Section 4.2.

2.3.1 Pilot Test: Regional Labor Meetings

Researchers piloted the approved instrument with TY&E railroaders at each union's regional meetings in 2019. The purpose of the pilot was to test the usability of the questionnaire, i.e., readability, layout, etc.

The Volpe team collected 173 completed questionnaires during the pilot test. Researchers recruited a convenience sample across four regional labor meetings. Though the team offered an online completion option, all respondents completed the questionnaire on paper; the team attributed this to the presence of research team members handing out questionnaires in person. To ensure the questionnaire's usability for a railroader target population as well as FRA's research purposes, the Volpe team specifically requested feedback on item clarity and readability, and reviewed item responses for data quality.

Based on the pilot responses and respondent feedback, researchers further refined the instrument to improve readability and clarity. For example, the team adjusted wording and formatting for some items that had confused pilot test respondents or had been frequently skipped over. The researchers also improved and clarified the skip logic ("if yes/no, then…") in places on the printed questionnaire to help respondents complete the appropriate items only.

Note that these edits were "non-substantive," as they dealt with phrasing and appearance of items rather than content and were thus permitted under the existing OMB approval.

2.3.2 Survey Questionnaire

The final questionnaire contained 26 questions, some of which had multiple subparts for a total of 51 items. See Table 2 for the areas of interest, or domains, included in the questionnaire and examples of corresponding items. The team prepared the survey using the Snap Surveys software platform to create a paper and online version.

Table 2. Questionnaire domains and example items

Domain	Example Items
ICT (Access, Use, Preferences, and Confidence)	Please select all the ways that you connect to the internet/the web.
	How many hours per week, on average, do you typically use [the following] computer technology at home for work or personal use?
	How often do you use these information sources? [List of Electronic and Printed Materials]
	How confident are you in performing [the following] technology-related tasks?
RGHS	Have you heard of the *Railroaders' Guide to Healthy Sleep* website?
	How did you learn about the website?
	Did you find what you were looking for on the website?
	What steps or actions, if any, did you take after visiting the website?
Demographics	In which operations do you work? [Freight or Passenger]
	Which type of freight/passenger work do you currently do?
	What is your current craft, at the time of this survey?
	What is the highest level of education you have completed?
	What is your sex?
	What is your age?
	What is your race?

The full questionnaire is included in Appendix A. The team estimated that the questionnaire would take no more than 20 minutes to complete.

2.4 Procedure

The survey administration phase consisted of five mailings across an 8-week period. These mailings included:

1. Announcement letter
2. First survey mailing
3. First reminder postcard
4. Second reminder postcard
5. Second survey mailing

This staged mailing approach followed best practices for survey data collection methodology by providing advanced notice, reminders, and multiple opportunities to complete the questionnaire. In addition to mailing printed copies of the questionnaire, the Volpe team included instructions for confidential online completion in all but the announcement letter mailing.

Additionally, Volpe developed a communications plan with support of the unions, and created various tailored communications for each union to support outreach and promotion of the survey. Outreach was especially important for this survey, as there was no incentive for participation.

The following sections describe the study procedures, including the assignment of unique participant IDs, the communication strategy used to encourage participation, and the survey mailings, in additional detail.

2.4.1 Unique Participant IDs

Once the Volpe team received the sample from the unions, the team assigned unique ID Codes to each remaining participant. A single file stored the ID Codes and linked them to the personal information collected from the union database. The team only used the personal information collected from the union database to create mailing labels and postcards for the study. For all other purposes, the team used these ID Codes, e.g., to track participation in the study and to conduct de-identified analyses. The team made every effort to keep the analysts blind to personally identifiable information (PII) and to protect the PII from any exposure beyond the study, including deleting personal information as soon as possible.

2.4.2 Communication Strategy

A vital part of the methodology for this study is the development of a phased communication strategy with the support of, and for execution by, labor union partners. The strategy included publicizing the survey effort by providing the following for consideration and use: a press release, a one-page frequently asked questions (FAQs) document for internal distribution to membership, and a series of social media posts promoting each phase of the survey administration. The messaging specified union leadership endorsement of the research and the value in participating in the study if selected as part of the random sample.

The first component of these communications, a press release published by both BLET and SMART-TD, announced the joint study and encouraged anyone who received a questionnaire to participate. The press release successfully generated interest in the research among rail news outlets; *Progressive Railroading* published it and it inspired a feature story in *Freight Waves* (Progressive Railroading, 2020) (Marsh, J., 2020). The second component of the communication strategy provided a one-page FAQ document to union officers for the purposes of disseminating to their members or to refer to when answering questions about the survey. The final component included consistent social media messaging across the duration of the survey administration. The Volpe team worked with the unions to provide a series of posts for use on Facebook and Twitter across each mailing stage: informing membership about the survey effort, providing updates about various mailings to those randomly selected to participate, and reminding members to complete the survey either on paper or online before it closed.

Throughout the three components of the communication strategy, the Volpe team consistently utilized existing, approved language in messaging emphasized the support of union leadership, the importance of the research, and benefits to the union from members' participation: an

improved understanding of how to effectively communicate safety-related information. For examples of study communication materials, see Appendix B.

2.4.3 Mailing Phases

The following sections describe the materials included in each of the five mailing phases. Copies of these materials are found in the appendices.

Announcement Letters

The Volpe team mailed the announcement letter to the full invited random sample of 2,196 members across the two unions. It informed the invited union members about the purpose of the survey and notified them that they would be receiving a survey packet in approximately 1 week.

First Survey Mailing

The first survey mailing or "survey packet," included a cover letter, informed consent form, and the questionnaire, as well as a prepaid return envelope to return a completed questionnaire to the Volpe team. Researchers stapled the cover letter, consent form, and questionnaire together for ease of assembly, though did not request return of the cover letter with the completed questionnaires.

The Volpe team assigned each randomly selected participant a unique identification code to confidentially track survey packets. Researchers affixed a label bearing the unique code to both the cover letter and to the first page of the questionnaire.

The cover letter, similar to the announcement letter, explained the rationale behind and importance of the survey effort, indicated joint support from the unions including signatures from both current Presidents, and encouraged members to participate. It also contained information for how to complete the questionnaire online at a specified uniform resource locator, or URL, rather than on paper, by inputting the unique code affixed to the cover letter and first page of the questionnaire. Finally, the letter included the survey's planned close date, added using a date stamper due to timeline uncertainties introduced by the COVID-19 pandemic and to allow the Volpe team to print materials further in advance.

The consent form explained the benefits and any risks associated with participating in the survey data collection. To avoid requesting identifying information, the form asked participants to check a box marked "yes" or "no" to indicate their consent or to decline participation (invitees could also decline by simply not responding). Instructions on the form requested its return along with the questionnaire, if completed.

The questionnaire printed on three double-sided pages. The consent form and cover letter each additionally printed as single-sided pages. Researchers included a business-sized return envelope pre-addressed to the Volpe research team with pre-metered postage. Researchers affixed participant address labels produced using a mail-merge to 9x12 inch durable outer envelopes and coordinated with the Volpe mailroom for postage metering and mailing via the U.S. Postal Service (USPS).

Reminder Postcards

At 2-week intervals, the third and fourth mailings each consisted of reminder postcards printed on 5x7 inch postcard paper. The postcards encouraged recipients to complete the questionnaire they had recently received in the mail, or to go online to respond. A mail-merge printed recipients' address information on one side and unique code on the other, protected by a scratch-off sticker, with instructions for how to enter the code to complete the questionnaire online. The postcards also included instructions for how to request a new paper copy of the questionnaire.

The text for the two postcards differed slightly, with the first emphasizing the importance of participation and the second emphasizing the time remaining before the survey end date.

The Volpe team did not send reminder postcards to those who had already returned a paper questionnaire or to those who completed the questionnaire online prior to the postcard mailing dates.

Second Survey Mailing

As in the first survey packet mailing, the second survey mailing consisted of a cover letter, consent form, questionnaire, and pre-paid return envelope.

The language of the second cover letter was slightly modified to reflect an extended close date and encourage recipients to participate before the deadline. The language of the consent form and questionnaire were identical to the first survey mailing.

The Volpe team did not send a second survey mailing to those who had already returned their paper questionnaire or to those who completed the questionnaire online prior to the second survey packet mailing date.

2.4.4 Participant Database

Successfully administering this survey without sending unnecessary materials to respondents required a regularly updated database of survey invitees and respondents.

In some cases, the mailing addresses that the unions had on file for some members were no longer accurate—perhaps due to employment changes such as retirements or layoffs, or railroaders simply moving without updating their address with the union. Additionally, some addresses may have changed after the Volpe team obtained the sample from the unions.

This led to a number of mailings that returned to Volpe marked "return to sender" or "unable to forward." The Volpe team handled these in one of two ways:

- When USPS provided a forwarding address, the team corrected the address in the participant database and resent the materials to the updated address.
- When USPS could not provide a forwarding address, the team deemed the invitee "unreachable" and removed them from the recipient list for future mailings. (Note: The team excluded these "unreachable" invitees from response rate calculations.)

The team also tracked incoming survey responses, both on paper and online, and removed those who had responded already from the recipient list for future mailings. At each mailing stage the team prepared materials using the most up-to-date version of the recipient list.

3. Analysis of Survey Data

This section presents analysis procedures and the results of these analyses.

3.1 Cleaning the Data

The first step in the process was to clean the data and combine them into a working aggregated database. Cleaning the data included identifying respondents that did not fit the agreed-upon respondent "selection criteria," despite being invited to participate, (e.g., recent retirees or those no longer working a TY&E job) and removing them from the dataset.

Researchers gathered data using two modes: a) online using the survey software platform for this study, Snap Surveys, and b) via paper questionnaires mailed to each potential respondent. Each mode required different cleaning: researchers first scanned paper questionnaires into Snap Surveys, creating a database of responses for comparison with each paper questionnaire. The paper questionnaires included routing guidance (i.e., "skip logic") that was often ignored by respondents, creating a large amount of unusable data that required interpolating and cleaning during the scanning process. In contrast, the Volpe team was able to design the online instrument to route respondents through the necessary questions, so very little cleaning was required.

The team also examined any write-in comments that respondents provided when selecting "other" as a response, and reclassified them into one of the provided response categories where appropriate. In some cases, the team sought input from labor union representatives before making these reclassifications.

Once cleaning was complete, researchers exported the paper respondent database from Snap Surveys as a spreadsheet. The online survey platform provided an export function to extract the data in a spreadsheet that was easily imported into Excel. Both spreadsheets were combined to create an aggregated database in Excel. This database was imported into SPSS and most analyses were then completed in SPSS version 27.

3.2 Survey Response Rate

Researchers mailed the survey to 2,196 TY&E railroaders as described in Section 2.2. About 10 percent (220) of these were invalid addresses with no forwarding address available, leaving a reachable sample of 1,976. Of this potential respondent pool, 512 responded to the survey. Four responses were duplicates (2 people completed both a paper questionnaire and an online response, and 2 completed 2 paper questionnaires) that were aggregated into single responses, leaving a completed respondent dataset of 508 records. This produced a final response rate of 25.7 percent. After removing those not fitting the sampling criteria (see Section 2.2.2), 485 records comprise the final dataset (24.5 percent of the invited sample). Among these 485 respondents, 28.2 percent chose to complete the questionnaire online, while the majority (71.8 percent) completed it on paper.

3.3 Nonresponse Bias Study

OMB (2006) requires that a nonresponse bias analysis be conducted if the response rate for any key item falls below 70 percent or if the overall response rate for the study falls below 80 percent. Given that the response rate was ~25 percent, a nonresponse bias study compared the mean age of respondents to those of the invited sample. For several reasons, age is an important

characteristic for assessing potential bias. First, research has shown that use of technology is more prevalent with younger users. In addition, age is highly correlated with years of work experience and seniority. The date of birth was obtained from the union database and their age was computed (as of the start date of the study). The survey instrument asked for respondent age. An independent samples *t*-test was computed comparing respondents to those invited (i.e., after removing invalid addresses) and the results indicated the respondents ($M = 49.33$, $SD = 9.24$, $N = 485$) were significantly older than the non-respondents ($M = 45.30$, $SD = 10.46$, $N = 1{,}495$) ($t = 8.064$, $p < 0.001$, 2-tailed) with a confidence interval of 2.98 to 5.07. The mean difference of 4.03 years is a small to medium effect size (Hedges' $g = 0.396$). While this difference of about 4 years between respondents and non-respondents is significantly different, a small to medium effect size reduces its importance, as did discussions with the union leadership involved in the project which indicated that this difference was not practically significant for this study.

3.4 Overall Analysis Approach

For the first two study areas (i.e., ICT and demographics) the team took a staged approach to analysis. As is customary, researchers first conducted descriptive statistics for each item. Then, the team conducted statistical analyses on these ICT and demographic items. This included creating ordinal variables from several of the items that contained rating scales, which allowed the team to examine correlations and quantitatively compare groups of study respondents.

Sections 3.5 and 3.6 summarize the descriptive findings for the demographics questions and ICT items included in the survey, while Section 3.7 explains the statistical analyses and their results in greater detail.

For the final study area (RGHS website use), the number of responses was not sufficient to perform deeper statistical analyses; therefore, the team provided only descriptive statistics in Section 3.8.

3.5 Demographic Characteristics

The questionnaire contained a number of items about respondents' demographic characteristics, including both personal demographics (e.g., sex, age, and race) and work-related demographics (e.g., years of experience and current craft). The descriptive results of responses to these items are described in the following sections. Unless reported otherwise, if the number of respondents for an item (or "*N*") is not indicated, the item accounts for all 485 study participants and notes any missing data.

3.5.1 Sex and Age

Most respondents—95.9 percent—were male. Only 3.1 percent of respondents were female, and 1 percent of respondents left this item blank. Due to the small number of female respondents, it was not meaningful to compare results by sex.

It is possible that some of the respondents who left this item blank were female, but did not feel comfortable identifying as such on the questionnaire. Though the Volpe team took precautions to fully protect the identity of all respondents, some may have feared that identifying as female would make their responses (more) recognizable in an industry with such a small percentage of females. It is also possible that respondents who left the item blank did so because neither of the

available response options—required as part of the OMB approval process—accurately reflected their identity.

The age range of respondents was from 20 to 69 years old, with an average age of 49.3 years and a median age of 49 years. Looking at the age distribution of survey respondents in Figure 1 also supports the notion that the railroad industry is skewed toward an older workforce, showing a distribution with the 20–29 age group being severely underrepresented at 1 percent, nearly 50 percent of respondents being 50 or older, and 84.3 percent being 40 or older.

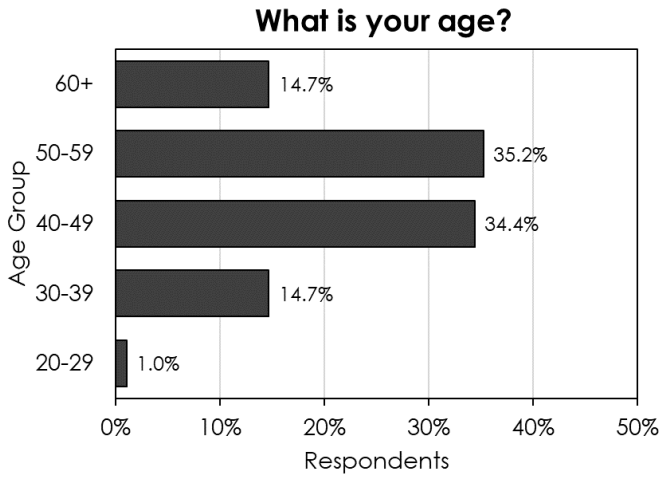

Figure 1. Distribution of respondents by age group (*N* = 477)

3.5.2 Race and Ethnicity

Two items addressed the participants' race and ethnicity. In the first of these items, 7.0 percent of respondents indicated that they were of Hispanic, Latino, or Spanish origin.[7] Most respondents (90.5 percent) were not of Hispanic, Latino, or Spanish origin, and another 2.5 percent of survey respondents left this item blank.

The following item asked respondents to indicate their race by selecting one or more race categories. Table 3 shows the percent of total respondents who selected each option. The most commonly selected response was "White" (84.7 percent), followed by "Black or African American" (9.5 percent). The remaining options "American Indian or Alaska Native," "Asian," and "Native Hawaiian or Other Pacific Islander" were selected by less than 4 percent of all respondents, and 3.5 percent of survey respondents left this item blank.

Because this item permitted multiple response choices, some respondents identified as more than one race. There were a total of 10 respondents who selected more than one option (about 2 percent of respondents). These multi-racial respondents, along with those who chose not to respond, explain why the percentages in Table 3 do not add to 100.

[7] The questionnaire specified that "for this questionnaire, Hispanic, Latino, and Spanish origins are not races."

Table 3. Race (select one or more)

Response	Count	Percent
White	411	84.7%
Black or African American	46	9.5%
American Indian or Alaska Native	13	2.7%
Asian	6	1.2%
Native Hawaiian or Other Pacific Islander	4	0.8%

Note that, as in the case of the sex item, the number of respondents who left these two items blank may reflect the sensitivity of the requested information, or that respondents did not feel that the response options reflected their identity. For example, those who indicated that they were of Hispanic, Latino, or Spanish origin in some cases left the race item blank. As required by the Office of Management and Budget and due to the Census at that time, the questionnaire instructions specified that "for this questionnaire, Hispanic, Latino, and Spanish origins are not races;" however, those who indicated Hispanic, Latino, or Spanish origin may not have additionally identified with any of the race options provided. Other respondents may have feared that identifying as a race other than "white" would make their responses more identifiable in an industry that is predominantly white. In the absence of a "prefer not to respond" or "other" option for these items, it is difficult to determine respondents' motivations for leaving these items blank.

3.5.3 Education and Experience

Figure 2 shows the education levels of respondents, with most reporting that they completed "some college" (37.6 percent) or have a high school level education (30.6 percent). The Volpe team defined "high school level" as "some high school," "high school graduate," or "GED." Another 30.3 percent of respondents hold either a bachelor's or associate degree, and 1.5 percent have an advanced degree (which includes those who indicated "master's degree" or "PhD").

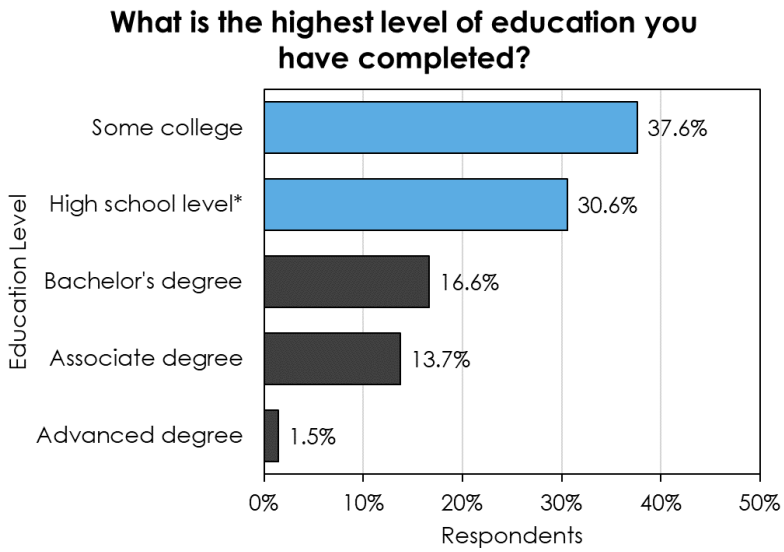

Figure 2. Highest education level (*N* = 481)

Additionally, 12.5 percent of respondents (*N* = 481) indicated that they had attended a railroad trade school (e.g., Modoc Railroad Academy).

In terms of railroad experience, survey respondents reported an average of 18.2 years in the railroad industry (*N* = 484). The median was 17 years in the industry, with responses ranging from 1 to 46 years. Given the average age of 49.3 years among respondents, some may have worked other jobs prior to entering the railroad industry, while others took a railroad job early in their working years.

3.5.4 Type of Position

Figure 3 shows the current crafts reported by survey respondents. Unsurprisingly, the most commonly reported crafts are locomotive engineer (49.8 percent) and conductor (36.7 percent). Another 8.7 percent reported working as yard foremen/switchmen, 2.1 percent work as brakemen, and 0.4 percent work as hostlers. Among the 2.3 percent who work as "other" crafts, nine respondents indicated that they work as yardmasters, while one reported being a peer trainer and one is a cutback engineer.

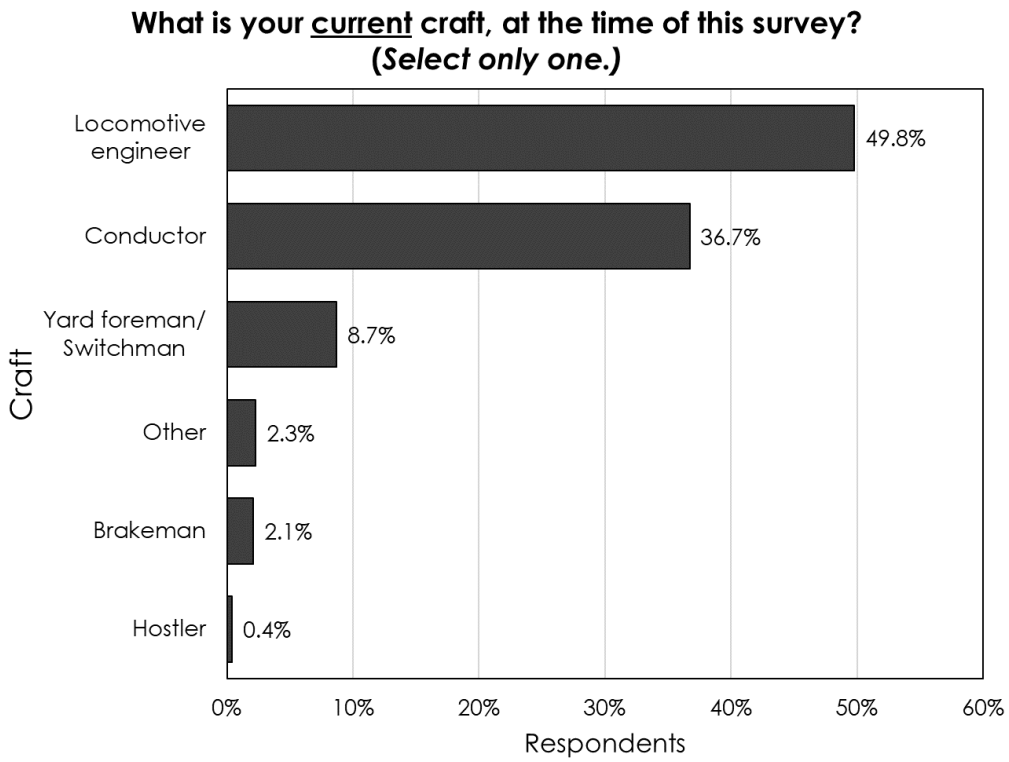

Figure 3. Current TY&E craft (*N* = 482)

Among those who indicated "yard foreman/switchman" as their current craft, 71.4 percent were also RCL operators (*n* = 42).

3.5.5 Type of Work

Most respondents (93.2 percent) indicated that they work freight operations (*N* = 482). Only 6.8 percent (32 respondents) work passenger or commuter operations.

Within both freight and passenger operations, the most common types of work were pool and extraboard. Figure 4 shows the percentage of respondents who reported each type of work.

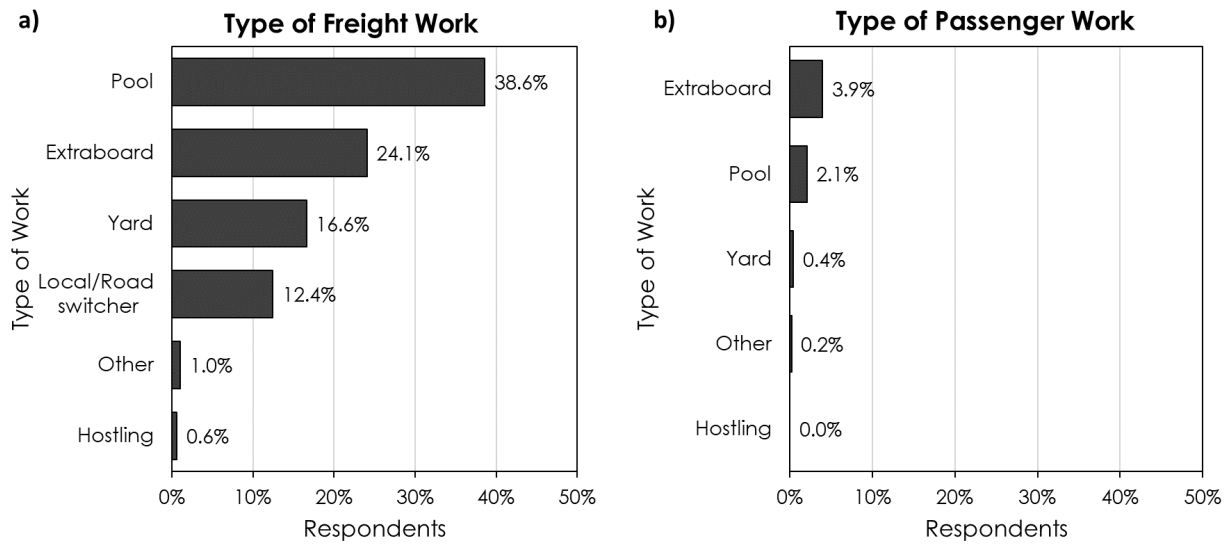

Figure 4. Type of freight or passenger work (*N* = 482)

The 1.0 percent of respondents who perform "other" freight work wrote in the following explanations: "currently on medical leave," "detached instructor," "safety rep," "peer trainer," and "trainee." No explanation was provided by the "other" passenger respondent.

3.5.6 Summary of Demographic Characteristics

In comparison with previous research conducted for FRA that also collected demographic information for a similar sample of T&E service workers (Gertler & DiFiore, 2009), the current results offer many similarities and some differences. Comparable to this research, only a very small percentage of participants in the Gertler and DiFiore (2009) study were female (2 percent). Also, with regard to the type of work reported, the current research found that 6.8 percent of respondents work in passenger operations, whereas 7 percent of the Gertler and DiFiore (2009) sample worked in passenger operations.

Unexpectedly, for this study, the mean respondent age was 49.3 years; Gertler and DiFiore (2009) reported an average age of 45.4 years. This suggests that there might be a slightly older workforce. It is impossible to know definitively, but it is likely that this resulted from a combination of factors: first, the increasing use of Precision Scheduled Railroading (PSR), by Class I railroads to direct rail traffic resulting in freight volumes declining and a need for fewer employees (Railfan & Railroad Magazine, n.d.). The least senior and therefore typically younger employees are, in practice, the first to be furloughed and many have not been brought back to work. Additionally, the emergence of the COVID-19 pandemic in the spring of 2020 resulted in an even greater additional number of furloughs (Marsh, J., 2020). The adverse effect of these two factors coinciding with the study's 8-week survey administration period may have been enough not only to mask a decrease in average railroader age, but also to increase the mean age.

As expected for this workforce, most respondents were white and not of Hispanic, Latino, or Spanish origin, and the most common level of education completed was "some college" or a "high school level" education. Over 90 percent of respondents reported working in freight operations. For both freight and passenger operations, pool and extraboard were the most common types of work, accounting for over 60 percent of respondents. A breakdown of the

reported type of work indicated that over 85 percent of respondents worked as either locomotive engineers or conductors.

3.6 ICT Access, Use, Confidence, and Preferences

Another set of questions included in the survey addressed respondents' ICT access, use, preferences, and confidence. The descriptive results of responses to these items are described in the following sections. As in the previous section, unless reported otherwise, if the number of respondents for an item (or "*N*") is not indicated, 485 study participants are accounted for, and any missing data are noted.

3.6.1 Access to the Internet

Respondents access the internet in many different ways, as shown in Figure 5. The most common way of connecting to the internet was via "mobile (phone, tablet, hotspot)," used by 84.1 percent of all respondents. This was followed by use of a cable modem (54.6 percent), DSL (20 percent), and fiber-optic (18.1 percent).

Only a handful of respondents used older technology, i.e., "dial-up," or did not know how they connect. The two "other" responses indicated that they access the internet using a computer at work.

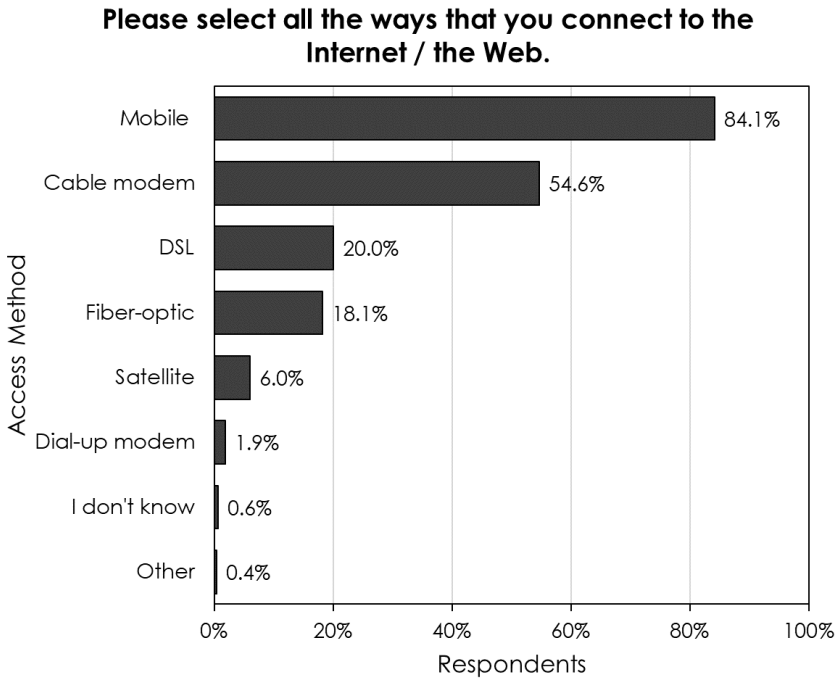

Figure 5. Methods of internet access (*N* = 485)

Note that most respondents (73.0 percent) indicated that they use more than one means of connecting to the internet. Therefore, these percentages add to significantly more than 100 percent.

3.6.2 Computer Technology Use

Respondents also regularly use a variety of computer technologies, or "devices," as shown in Figure 6. Smartphones were the most commonly used devices overall, selected by 92.4 percent of respondents; they were also used most heavily, with 39.2 percent of respondents reporting use totaling "10 or more" hours per week. The next most commonly used devices included "desktop or laptop computers and tablets," at 74.0 percent, followed by "tablets," at 52.6 percent. Less than half of respondents reported using other types of devices: 35.1 percent use "smart TVs or speakers," 7.6 percent use "smartwatches," and 2.7 percent reported using other devices.

Among the 13 respondents who indicated that they use other devices, 2 specified that they use "gaming consoles for streaming services," while another 11 did not specify what type of device they use.

Note that for this item, respondents who selected "I don't use this" and those who left the item blank are grouped together. Despite the option to select "I don't use this," many respondents only selected a response for one or two devices and left the rest blank; therefore, the Volpe team inferred that lack of response to this item was equivalent to an "I don't use this" response.

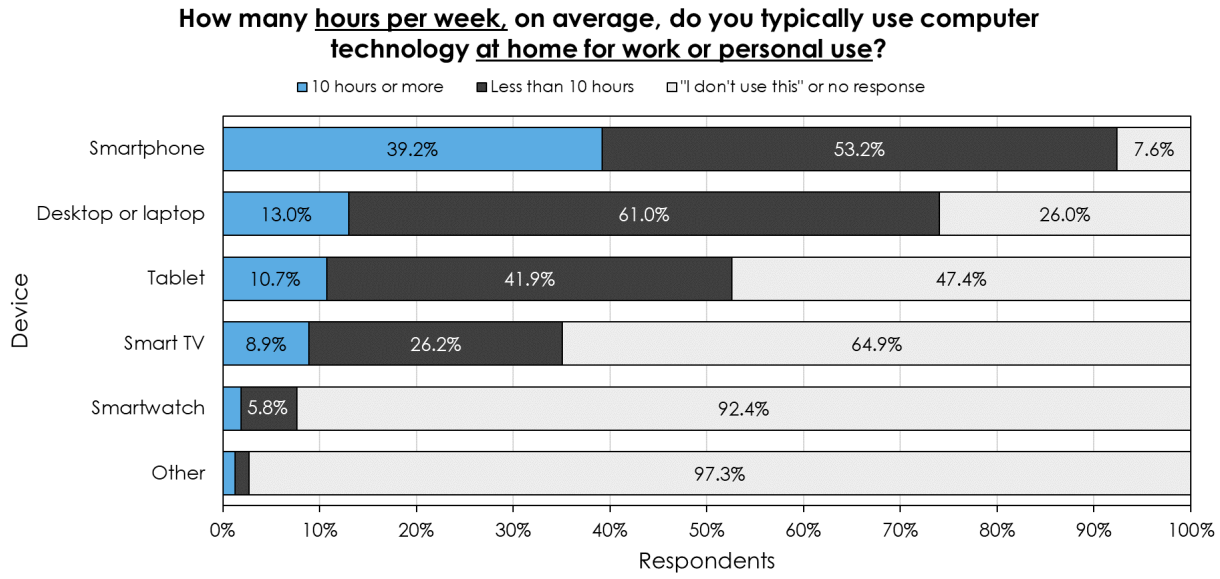

Figure 6. Average weekly use of computer technology (*N* = 485)

Figure 7 provides additional detail about how often respondents use each device type. As this figure omits respondents who reported that they do not use each device, it allows for simple visual comparison of use rates: that is, the greater area in the plot, the more each device is used. Consistent with the previous figure, smart TV/speaker, smartwatch, and other devices are used far less than smartphones, desktop or laptop computers, and tablets.

Interestingly, across all devices, the most common response was "1–4 hours." This is true even of smartphones; however, respondents did report much more frequent usage of smartphones than of other device types: 63.7 percent use smartphones for more than 1–4 hours, compared to 23.9 percent for laptop and desktop computers and 21 percent for tablets.

In fact, 16.1 percent of respondents use a smartphone more than 15 hours per week, which is more than twice the number of respondents using desktop or laptop computers as often, and more than three times the number of respondents using tablets with the same frequency.

When looking only at respondents who use a device between 1–4 hours, desktop and laptop computers were the device used by the most respondents in that range, followed by tablets and smartphones.

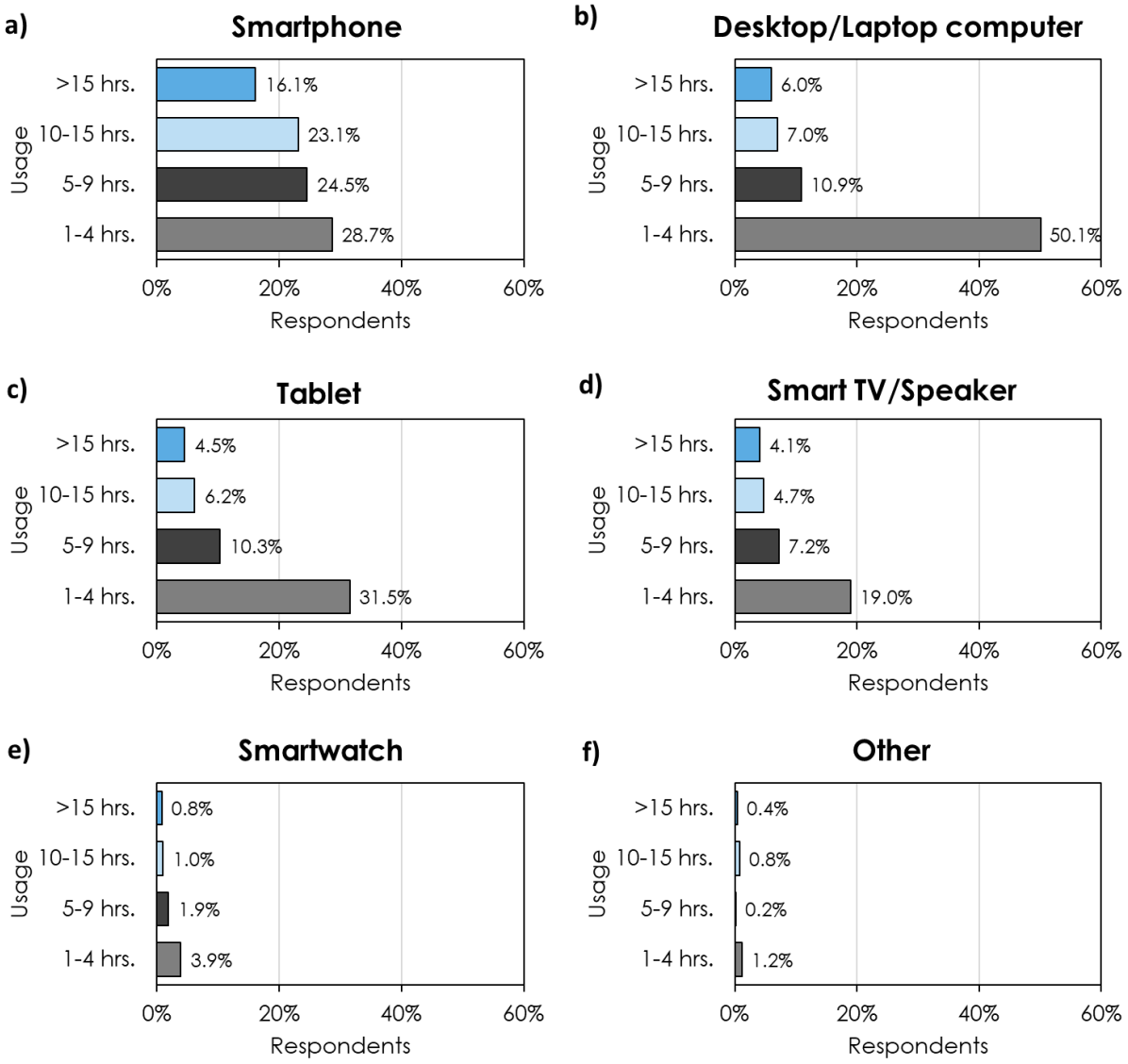

Figure 7. Average weekly use of computer technology, by device (*N* = 485)

It is also important to note that while these data reflect how often respondents use the various devices at home for work or personal use, it does not distinguish between the two.

3.6.3 Print and Online Materials Use

A two-part item investigated how frequently respondents use print and online or electronic materials.

Printed Materials

The first part of this survey item asked about frequency of use for the following printed information sources:

- Newspapers, Print (New York Times, Wall Street Journal, USA Today, a local paper, etc.)
- Magazines, Print (Progressive Railroading, Railway Age, Sports Illustrated, Reader's Digest, etc.)
- Newsletters, Print (union, community, hobby, etc.)
- Postings (flyer, poster, informational fact-sheet, hand-out, etc.)
- Other

Respondents indicated how often they use these materials on a scale ranging from "frequently" to "never," as summarized in Figure 8. The material used most overall was newsletters, at 78.8 percent of respondents. Looking across "frequently" and "sometimes" responses, newsletters were still the most common with 42.3 percent use.

Magazines were used by 70.9 percent of respondents overall, with 37.9 percent using them "frequently" or "sometimes," and newspapers were used by 61.5 percent of respondents, with 32.6 percent using them "frequently" or "sometimes." While postings were used more than newspapers overall (by 65.1 percent of respondents), only 30.5 percent use them frequently or sometimes, putting them behind newspapers when "rare" use is disregarded.

Lastly, 6.3 percent (27 respondents) reported that they use "other" information sources; with 3.5 percent indicating that they use "other" sources frequently or sometimes. Among these, two respondents specified that they use books as information sources, and an another two indicated that they use work related printed materials or work orders. The remaining 27 "other" respondents did not specify what other printed information sources they use—some of these could have been selected unintentionally.

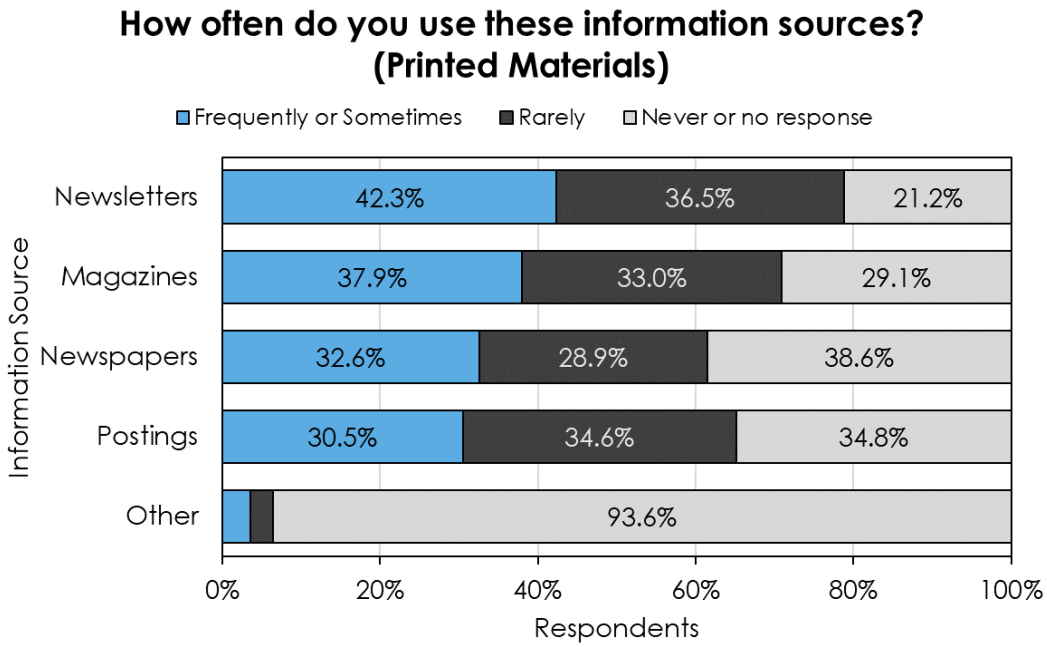

Figure 8. Frequency of use—printed materials as information sources (*N* = 485)

Figure 9 provides additional detail on those who use each of these information sources (i.e., respondents who selected "never" and respondents who left these items blank are not shown). The order of items in this figure matches the order of Figure 8 with those used "frequently" or "sometimes" by a larger number of respondents shown first.

However, within the "frequently" response categories, newspapers are revealed to be used frequently by 11.8 percent of respondents (see "c"), which is greater than the number of respondents that use newsletters or magazines frequently (see "a" and "b"). Similarly, magazines are used frequently by more respondents (10.1 percent) than newsletters (7.8 percent).

Figure 9. Frequency of use—printed materials as information sources, by source (*N* = 485)

Online or Electronic Materials

The second part of this item asked about frequency of use of the online or electronic materials as information sources, including:

- Newspapers, Online (nytimes.com, latimes.com, etc.)
- Magazines, Online (thedailybeast.com, trn.trains.com, etc.)
- Email distribution lists (listservs, e.g., local union lists, etc.)
- Internet websites (cnn.com, webmd.com, progressiverailroading.com, railwayage.com, etc.)
- RSS feeds (stock market, news sites, carrier feed, etc.)
- Videos (youtube.com, etc.)
- Podcasts (letstalktrains.com, etc.)
- Blog sites (gizmodo.com, mashable.com, tmz.com, etc.)
- Online communities (NextDoor, Facebook, Twitter, Instagram, LinkedIn, etc.)
- Mobile device communications (text message, voicemail, WhatsApp, etc.)
- Other

Respondents rated their use of these materials on the same scale ranging from “frequently” to “never,” as summarized in Figure 10.

Mobile communications were used most, by 96.3 percent of respondents overall and by 89.1 percent "frequently" or "sometimes." Mobile communications were followed by videos, which were used by 89.9 percent of respondents overall and 70.7 percent frequently or sometimes. The next most popular online materials were online communities, websites, and email distribution lists, which were all used by at least three-quarters of respondents.

Though websites and email distribution lists are both used more overall than online communities (i.e., used by 81.0 and 80.4 percent of respondents respectively, versus 76.1 percent), online communities surpass these materials in terms of respondents who use them "frequently" or "sometimes" (i.e., excluding "rarely"): A total of 62.7 percent of respondents used online communities "frequently" or "sometimes," while 60.6 percent used websites with the same frequency, and only 52.6 percent did so with email distribution lists.

Over half of respondents reported that they use RSS feeds, online newspapers, or online magazines, and between 25 and 50 percent of respondents use these information sources "frequently" or "sometimes." Podcasts, blog sites, and "other" online materials were used the least. Less than half of respondents reported using these materials, and less than 25 percent use them "frequently" or "sometimes".

Only 3.1 percent of respondents (15) reported using "other" online or electronic materials overall (2.3 percent "frequently" or "sometimes"). Of these, two wrote in that they use "TV news or sports," one wrote in "Google," and one wrote in "e-books." The other 11 did not specify what "other" online or electronic materials they use.

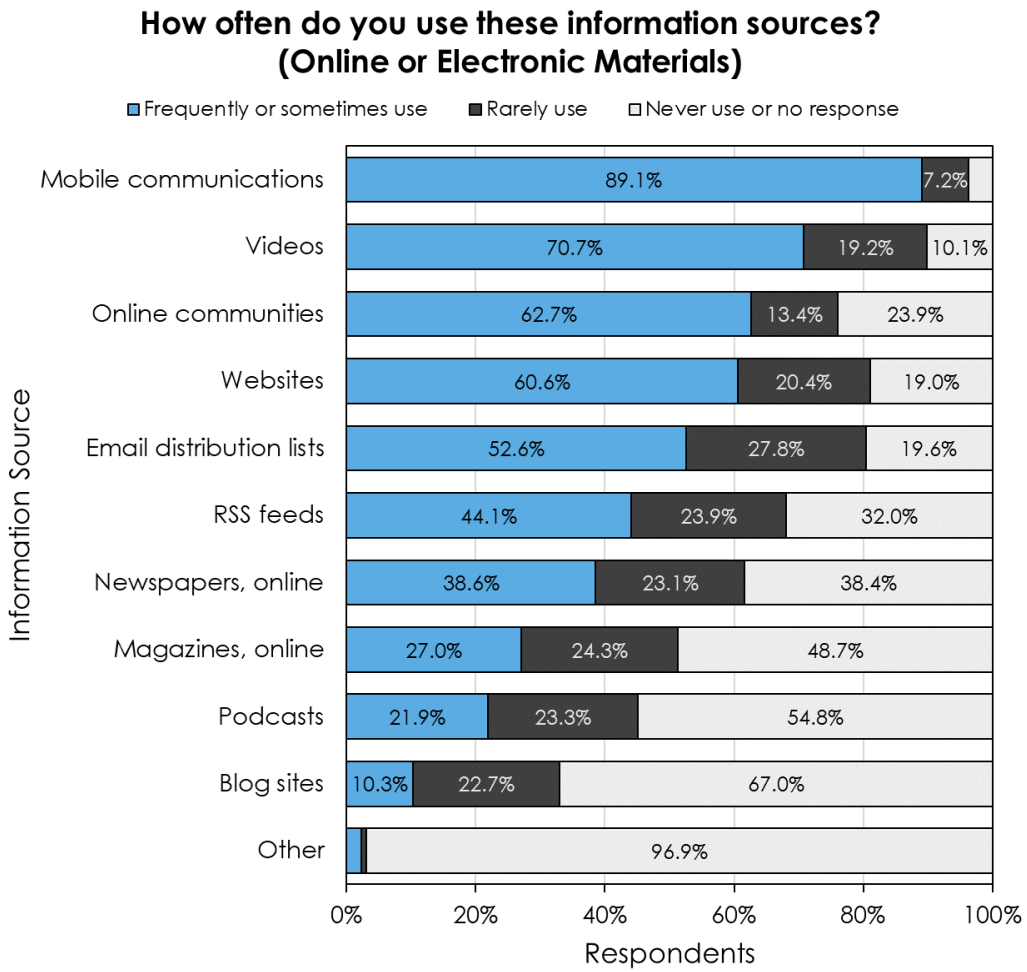

Figure 10. Frequency of use—online or electronic materials as information sources (*N* = 485)

Figure 11 provides additional detail on those who use each of these information sources (i.e., those who responded "never" and respondents who left these items blank are not shown), excluding "other" online and electronic materials as they were used so rarely. Because this figure shows only respondents who use these materials, the greater the colored area in the plot, the more use each material receives. This allows for a simple visual comparison: that is, it is evident that mobile communications and videos are used more often than podcasts and blog sites.

The order of items in this figure matches the order of Figure 10 with those used "frequently" or "sometimes" by a larger number of respondents shown first. However, Figure 11 separates these two responses for greater granularity. Looking at only "frequently" responses reveals that online communities are used frequently by 40.4 percent of respondents (see "c"), which is greater than the number of respondents that use videos frequently (see "b"). Similarly, podcasts ("i") are used "frequently" by more respondents (9.3 percent) than online magazines ("h;" 5.8 percent).

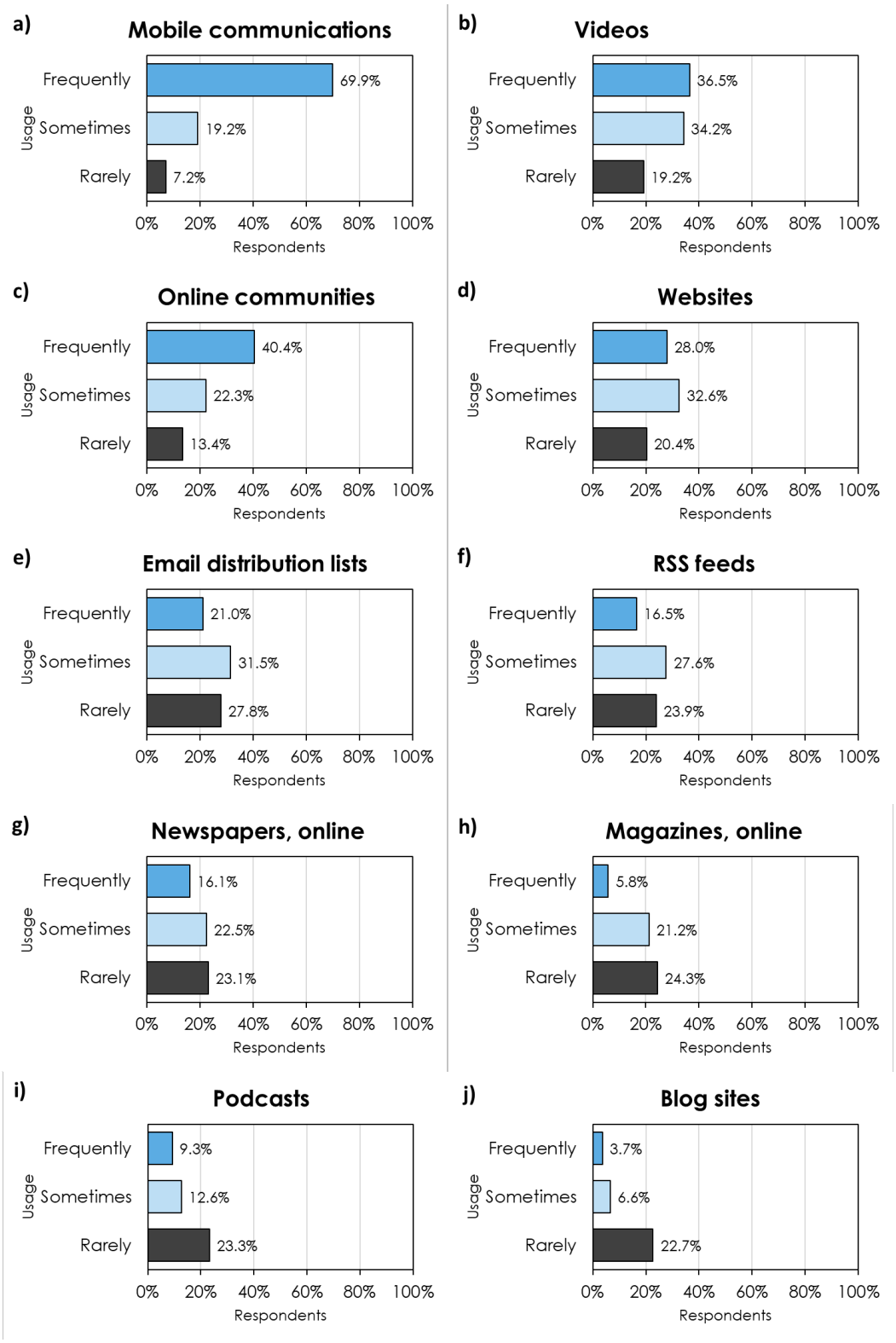

Figure 11. Frequency of use—online or electronic materials as information sources, by source ($N = 485$)

Summary of Materials Usage

The previous sections described respondents' use of printed and online or electronic materials. Most of these materials are categorized either as printed or online/electronic, with the exception of newspapers and magazines which exist in both formats. Figure 12 provides a comparison between these in terms of frequency of use, excluding non-users (i.e., those who responded never and respondents who left the item blank). This reveals that while more respondents use online newspapers "frequently" than print newspapers, the opposite is true for magazines.

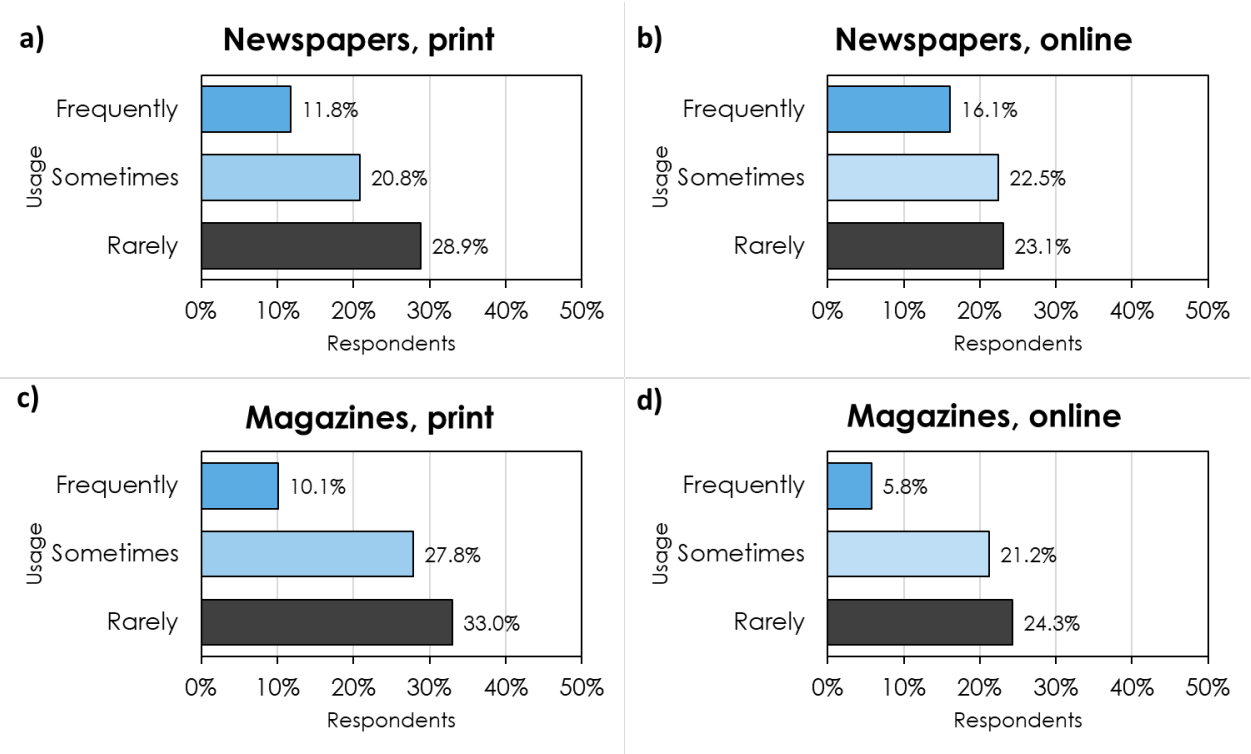

Figure 12. Comparison of frequency of use for print and online newspapers and magazines (*N* = 485)

Figure 13 provides a side-by-side comparison of the percent of respondents using each of these materials. Printed materials are shown in blue, while online and electronic materials are shown in dark grey. While printed materials are not used as often as some electronic materials, they are toward the middle of the rankings in terms of overall use.

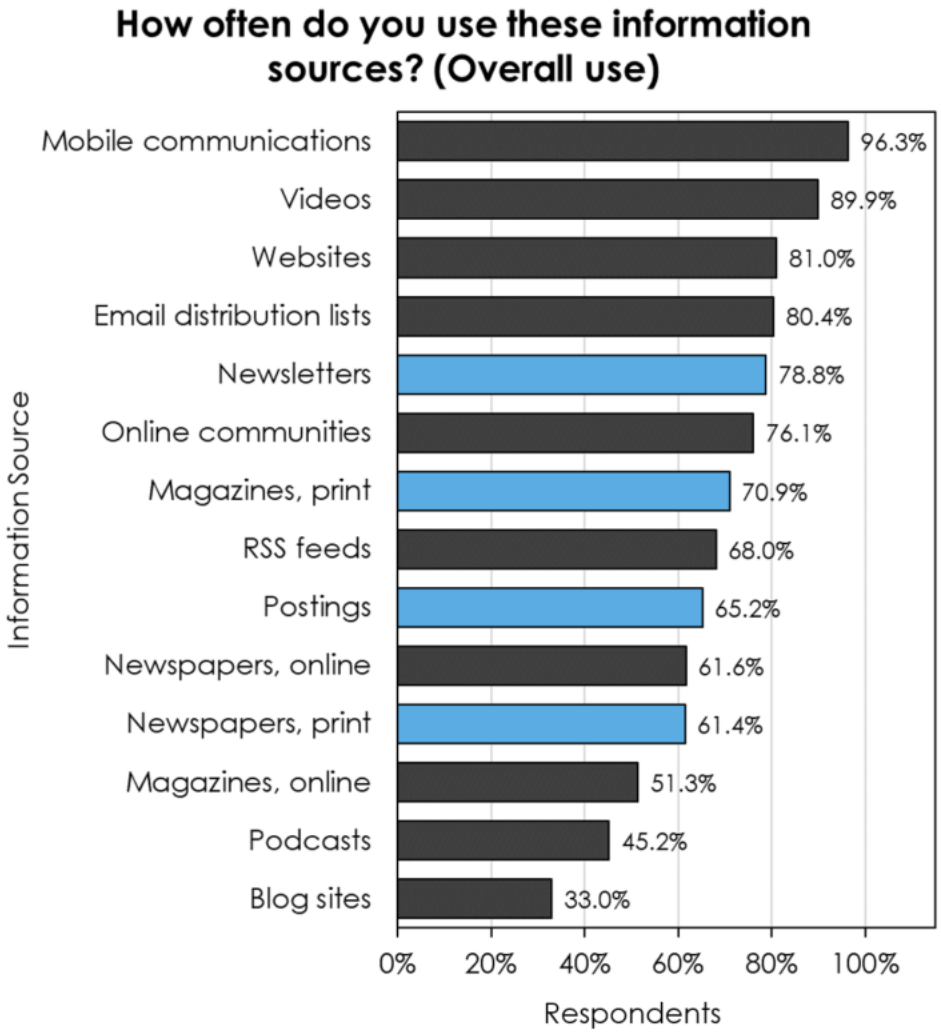

Figure 13. Patterns of overall use of printed and online or electronic materials as information sources (*N* = 485)

Figure 14 provides an alternate perspective, focusing only on respondents who indicated that they use each material "frequently." As noted previously, print newspapers are the printed material used "frequently" by the most respondents; however, fewer respondents report "frequent" use of printed materials relative to online and electronic materials, with all four printed materials landing in the bottom half in this ranking.

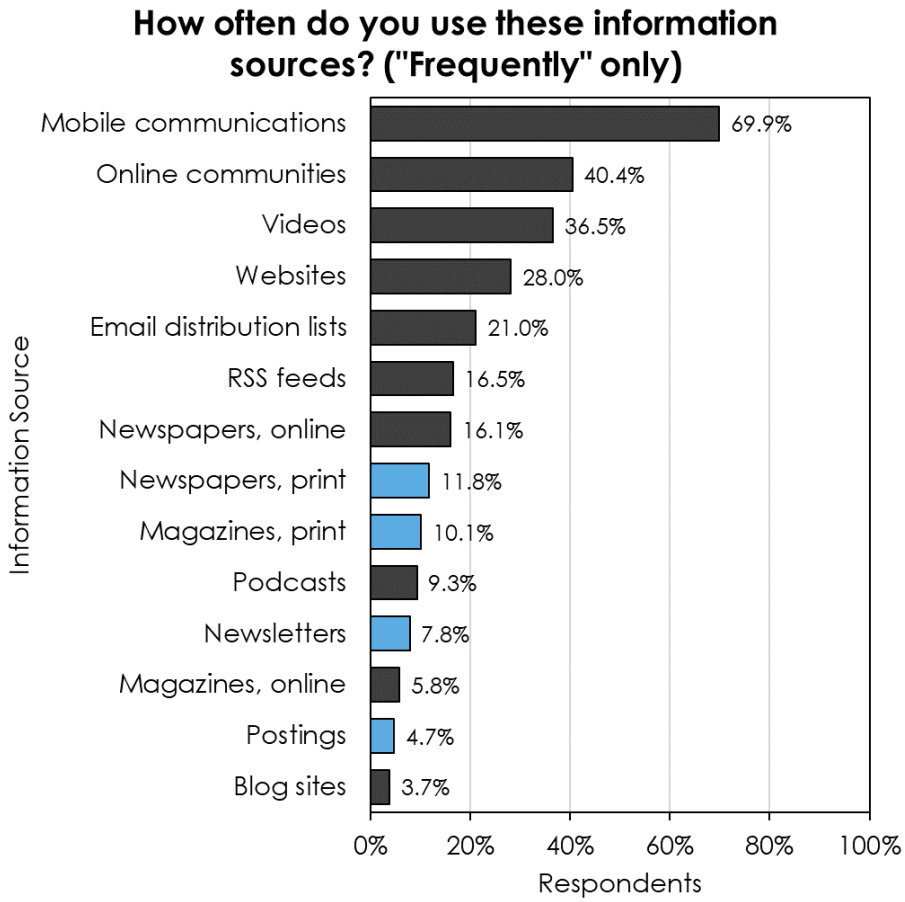

Figure 14. Patterns of "frequent" use of printed and online or electronic materials as information sources (*N* = 485)

Note that much like the previous item, which addressed device usage, this item only asks about frequency of use for each type of material and does not distinguish between work and personal use. Some of the frequently used materials, such as mobile communications and online communities, may not be appropriate ways to communicate safety-related information to railroaders if they are primarily used for personal activities. However, understanding which materials railroaders use more is nonetheless important information when considering how to communicate with them.

3.6.4 Confidence in Technology-Related Task Performance

The respondents' confidence in performing technology-related tasks varied depending on the task. Figure 15 summarizes the respondents' confidence levels. Respondents reported the greatest confidence around using internet search engines: 81.4 percent were "extremely" or "moderately" confident with this task. They had the least confidence in subscribing to blogs and feeds: 21.0 percent were "not at all confident" in performing this task.

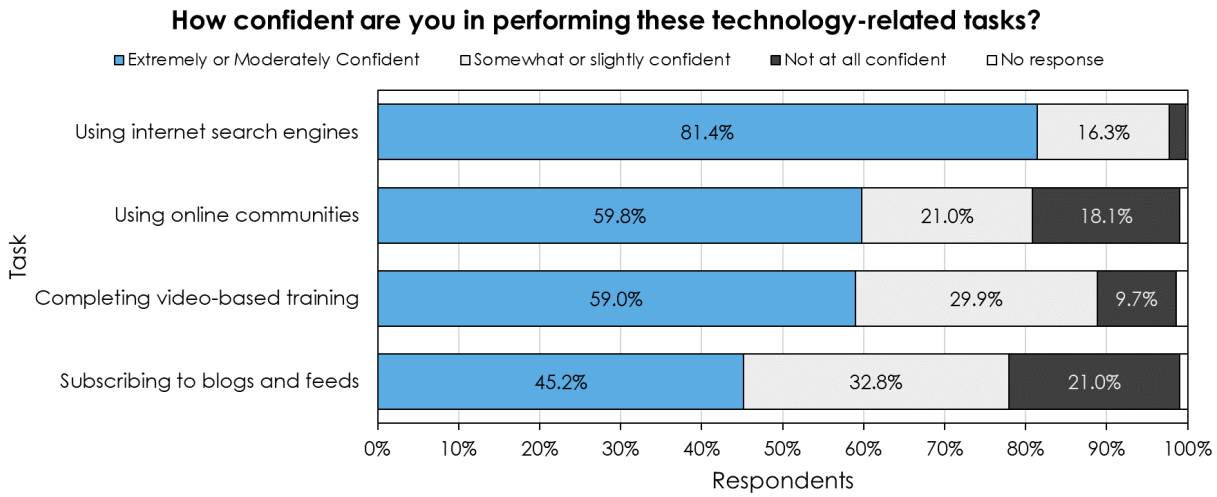

Figure 15. Confidence performing technology-related tasks (*N* = 485)

Though similar numbers of respondents were "extremely or moderately confident" in using online communities and completing video-based training, Figure 16 shows additional differences in the respondents' confidence levels for these two tasks: more respondents were "extremely" confident in using online communities, while more were "moderately" confident in completing video based training.

Additionally, the respondents' confidence levels for using online communities and subscribing to blogs and feeds were more split, with nearly as many "not at all confident" as "extremely" confident at the latter task.

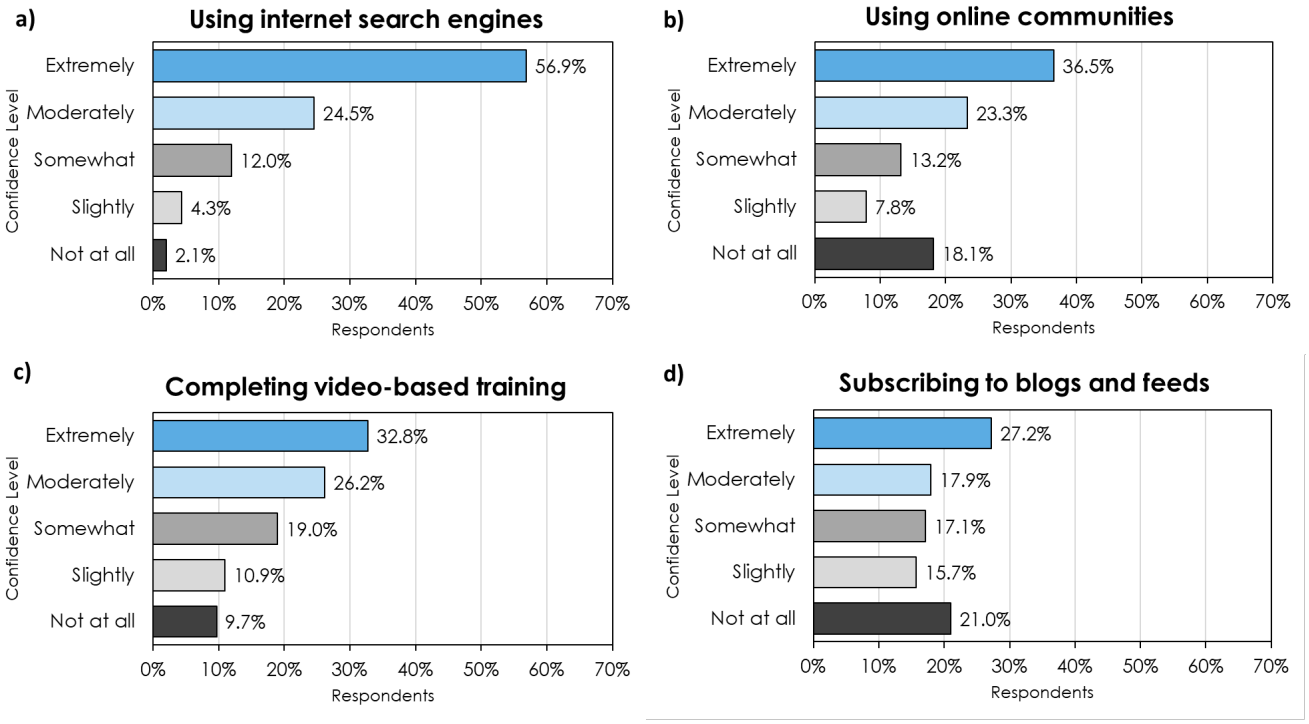

Figure 16. Confidence in performing technology-related tasks, by task (*N* = 485)

3.6.5 Preference for Print or Electronic Communications

Figure 17 shows respondents' sentiments regarding receiving information printed on paper or electronically.

For both preference items, more respondents selected "agree" to receiving information printed on paper (34.4 percent) or electronically (36.1 percent) than they "strongly agreed" regarding either preference. Taken together, total of 55.4 percent "agree" or "strongly agree" to preferring paper, while 67.0 percent "agree" or "strongly agree" to preferring electronic information. While similar numbers of respondents were undecided across both items, a greater number of respondents selected "disagree" or "strongly disagree" to preferring paper (25.0 percent total) than to preferring electronic information (14.2 percent). This is interesting given that 71.8 percent of respondents completed the questionnaire on paper.

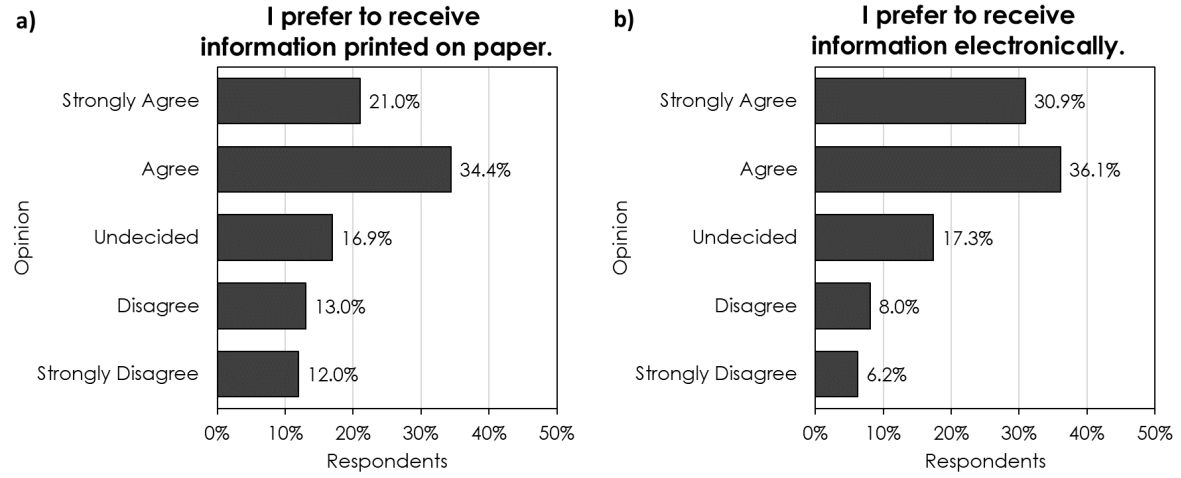

Figure 17. Preferences for receiving information printed on paper or electronically (*N* = 485)

Note that percentages for these two graphs do not add to 100 percent because it does not show respondents who left 1 of the items blank (7 respondents or 1.4 percent for "a" and 13 respondents or 2.7 percent for "b"). However, the percentages in the figure are out of 485 total respondents as only 1 person left both items blank and this allows for a more straightforward comparison to other survey items.

Figure 18 shows a "highlight table" for how respondents answered both of these items to visualize the relationship between preference for paper materials and preference for electronic materials. A darker shade of blue indicates a greater number of respondents. Interestingly, not all respondents preferred one of these methods of receiving information over the other: the most common response pattern, seen among 13.6 percent of respondents, was actually to select "agree" to both, and a total of 27.4 percent selected either "agree" or "strongly agree" for both items (see "a").

However, many respondents did have a preference, including the 24.1 percent of respondents who "agree" or "strongly agree" to preferring electronic communications and "disagree" or "strongly disagree" to preferring receiving information on paper (see "b"). On the contrary, 13.6 percent of respondents "agree" or "strongly agree" to preferring information printed on paper

and “disagree” or “strongly disagree” to preferring to receive information electronically (see “c”). Overall, these responses suggest a negative correlation between preference for print and preference for electronic communications, which will be explored in the analysis section.

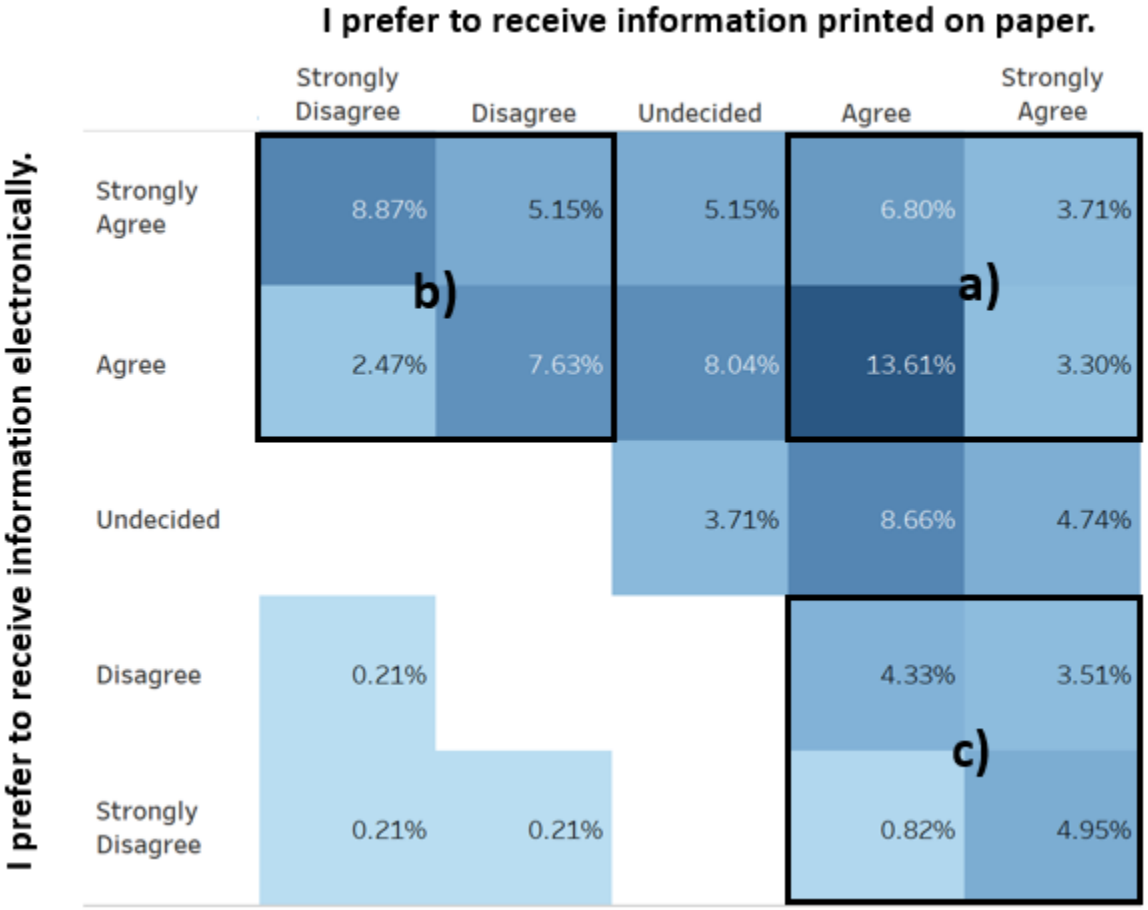

Figure 18. Relationship between preferences for receiving information printed on paper and electronically (*N* = 466)

Note that percentages for this figure do not add to 100 percent because it does not show those who did not respond to both items (19 respondents). For this same reason, percentages may be slightly lower than those in Figure 17 if totaled by row or column.

3.6.6 Summary of ICT Items

These findings describe how respondents connect to the internet, how often they use computer technology or use printed and online or electronic materials as information sources, their confidence levels with technology-related tasks, and their preferences for print or electronic communications. These items are further explored in the following section, which examines relationships among the variables, as well as relationships to the respondents’ demographics and mode of survey completion, whether online or paper.

3.7 ICT Items: Analyses

Building upon the descriptive data presented in the previous section, the team created a set of ordinal variables for the ICT items to examine correlations and compare groups of respondents.

These analyses and findings are described in the following sections.

3.7.1 Computed Ordinal Variables

The Volpe team created ordinal variables from several of the ICT items to perform correlations among key variables.

For example, for the survey item that asked how many hours per week respondents use various computer technologies (i.e., "devices"), the team created an ordinal variable called "device use" by attributing values from 0 to 4 to the five categorical response options. The team attributed 0 to "I don't use this," 1 to "1–4 hrs.," 2 to "5–9 hrs.," 3 to "10–15 hrs.," and 4 to ">15 hrs." The team replicated this format of variable creation for the information sources ("print materials use" and "online materials use"), information delivery mode preference for print communications" and "preference for electronic communications"), and "confidence in performing technology-related tasks." The following six ordinal items for ICT use and preferences resulted:

a) **Device use:** The questionnaire asked participants how many hours per week, on average, they typically use computer technology at home for work or personal use. Response options included "I don't use this," "1–4 hrs.," "5–9 hrs.," "10–15 hrs.," and ">15 hrs." These responses were coded as ordinal, creating response options of 0–4. Note that while the list of devices included desktop or laptop, tablet, smartphone, smartwatch, smart TV, and other, the last three choices garnered very few responses and so were dropped from this analysis. Thus, the "device use" composite score was created by adding the usage amount selected for desktop, tablet, and smartphone and dividing them by three.

b) **Print materials use:** The questionnaire asked participants how often they use various print materials (e.g., newspapers, magazines, newsletters, and postings) as information sources. Responses on a four-point scale of never (0), rarely (1), sometimes (2), and frequently (3) were coded as ordinal, creating a set of response options. These responses were then averaged across the number of items, excluding "other," which received too few responses to meaningfully include in this analysis.

c) **Online materials use:** The questionnaire asked participants how often they use various online materials (e.g., online newspapers, email distribution lists, internet websites, and podcasts) as information sources. Responses on a four-point scale of never, rarely, sometimes, and frequently were coded as ordinal, creating response options of 0–3. These responses were then averaged across the number of items excluding "other," which received too few responses to meaningfully include in this analysis.

d) **Preference for print communications:** The questionnaire asked participants to rate their agreement with the statement "I prefer to receive information printed on paper." Responses on a five-point scale from strongly disagree to strongly agree were coded as ordinal, creating response options of 1–5. This item was not averaged as there was only one rating scale included in the item.

e) **Preference for electronic communications:** The questionnaire asked participants to rate their agreement with the statement "I prefer to receive information electronically (e.g.,

using a computer, tablet, smartphone, text, etc.)." Responses on a five-point scale from strongly disagree to strongly agree were coded as ordinal, creating response options of 1–5. This item was not averaged as there was only one rating scale included in the item.

f) **Confidence in performing technology-related tasks:** The questionnaire asked participants "how confident are you in performing these [four] technology-related tasks?" (e.g., using an internet search engine, subscribing to blogs, using online communities, and completing video-based training on the internet). Responses on a five-point scale from not at all confident to extremely confident were coded as ordinal, creating response options of 1–5. These responses were then averaged across the four task items.

Additionally, the team created an ordinal variable for education level to allow education to be included in correlation analyses. The questionnaire asked for the participants' highest level of education, from junior high school to doctoral degree. These responses were coded as ordinal, creating response options of 1–9.

3.7.2 Correlations

The first analysis of the study data tested for relationships among the variables. Researchers entered the seven variables noted in Section 3.7.1 into a *Spearman's rho* rank order correlation analysis, along with age and years in the industry. Table 4 summarizes these correlations, and the following sections describe them in greater detail.

Table 4. Descriptive statistics and correlations by variable

Variable	*N*	*M*	*SD*	1	2	3	4	5	6	7	8	9
1. Age	477	49.33	9.24	–								
2. Years in the industry	484	18.24	8.52	0.522**	–							
3. Print materials use	459	1.14	0.73	0.140**	0.111*	–						
4. Online materials use	432	1.44	0.60	-0.229**	-0.100*	0.234**						
5. Device use	367	1.56	0.77	0.002	-0.064	0.096	0.387**					
6. Confidence	475	2.65	1.11	-0.342**	-0.232**	0.003	0.533**	0.347**				
7. Education level	481	5.19	1.14	-0.004	-0.125**	0.130**	0.136**	0.149**	0.176**			
8. Preference for electronic communications	478	3.79	1.16	-0.266**	-0.199**	-0.163**	0.395**	0.281**	0.512**	0.097*		
9. Preference for print communications	472	3.41	1.30	0.246**	0.161**	0.327**	-0.206**	-0.091	-0.340**	-0.099*	-0.486**	

*$p < .05$; **$p < .01$

Demographic Characteristics Correlations

This analysis found correlations for each of the demographic characteristics included: age, years in the industry, and education level.

Age

Age was positively correlated with years in the industry ($r = 0.522$, $p < 0.001$), use of print materials ($r = 0.140$, $p = 0.003$) and preference for print communications ($r = 0.246$, $p < 0.001$). Age was negatively correlated with use of online materials ($r = -0.229$, $p < 0.001$), confidence in performing technology-related tasks ($r = -0.342$, $p < 0.001$), and preference for electronic communications ($r = -0.266$, $p < 0.001$). This means that the older railroaders use more print materials, have been in the industry longer and have higher preference for print communications. It also means they use fewer online materials, have lower confidence in performing technology-related tasks, and have lower preference for electronic communications.

Years in the Industry

Years in the industry is positively correlated to use of print materials ($r = 0.111$, $p = 0.018$) and preference for print communications ($r = 0.161$, $p < 0.001$) and negatively correlated with online materials use ($r = -0.100$, $p = 0.038$), confidence in performing technology-related tasks ($r = -0.232$, $p < 0.001$), education level ($r = -0.125$, $p = 0.006$), and preference for electronic communications ($r = -0.199$, $p < 0.001$). This means that those in the industry longer use more print materials and have higher preference for print communications, they use fewer online materials, have less confidence in performing technology-related tasks, are less educated, and have lower preference for electronic communications.

Education Level

Education level was positively correlated with preference for electronic communications ($r = 0.097$, $p = 0.035$) and negatively correlated with preference for print communications ($r = -0.099$, $p = 0.033$). Those with a higher education level generally had a higher preference for electronic communications and a lower preference for print communications.

ICT-Related Correlations

This analysis also found a number of significant and interesting correlations for the ICT variables.

Device Use

Using computer technology devices at home for work or personal use was positively correlated with confidence in performing technology-related tasks ($r = 0.347$, $p < 0.001$), education level ($r = 0.149$, $p = 0.004$), and preference for electronic communications ($r = 0.281$, $p < 0.001$). Those that use devices more have greater confidence in performing technology-related tasks, are more educated, and have higher preference for electronic communications.

Print Materials Use

Using print materials as information sources was positively correlated with the use of online materials ($r = 0.234$, $p < 0.001$), education level ($r = 0.130$, $p = 0.005$), and preference for print communications ($r = 0.327$, $p < 0.001$). It was also negatively correlated with preference for

electronic communications (r = -0.163, p < 0.001). This means that those who use more print materials as sources of information also use more online materials, have higher preference for print communications, have lower preference for electronic communications, and are more educated.

Online or Electronic Materials Use

Using online materials as information sources was positively correlated with device use (r = 0.387, p < 0.001), confidence in performing technology-related tasks (r = 533, p < 0.001), education level (r = 0.136, p = 0.005) and preference for electronic communications (r = 0.395, p < 0.001). Online materials use was also negatively correlated with print communication preference (r = -0.206, p < 0.001). This means that those who use more online materials also use their electronic devices more, have higher confidence in performing technology-related tasks, are more educated, and have higher preference for electronic communications. It also means that those that use more online materials have lower preference for print communications.

Confidence in Performing Technology-Related Tasks

Confidence in performing technology-related tasks was positively correlated with education (r = 0.176, p < 0.001) and preference for electronic communications (r = 0.512, p < 0.001) and negatively correlated with preference for print communications (r = -0.340, p < 0.001). Those with higher confidence in performing technology-related tasks were more educated, had higher preference for electronic communications and had lower preference for print communications.

Communications Preference

Preference for electronic communications was negatively correlated with preference for print communications (r = -0.486, p < 0.001). This means that those that have higher preference for electronic communications have lower preference for print communications.

3.7.3 Comparisons Between Study Groups Using T-Tests

The team conducted a series of comparisons between study groups.

Though not purposefully built into the design of the study, a naturally occurring quasi-experimental grouping arose in the data, in that study participants were invited to complete the survey instrument on paper or via an online link. Some chose to complete the instrument on paper while others chose online completion. The team compared these two groups and found significant differences between them in terms of ICT use and preferences; these differences are described below.

The team also compared conductors and locomotive engineers, the two most commonly reported crafts among respondents, and found several significant differences. Other demographic characteristics, such as sex, race, and freight vs. passenger operations, were not suitable for this type of comparison due to the large discrepancy in group sizes for these characteristics (e.g., there were not enough female respondents to make generalizable claims about the population of female railroaders in comparison to the population of male railroaders).

Comparing Online Completers to Print Completers

In an effort to test the hypothesis that significant differences exist between those who completed the instrument online compared to those who completed it on paper, independent sample t-tests

were run comparing the groups on various demographic and ICT-related variables. Table 5 summarizes these variables, along with the number of respondents (*N*), mean (*M*), and standard deviation (*SD*) for paper and online completers for each variable. A thick line separates the demographic items from the ICT items.

Table 5. Summary data comparing paper and online completers

Variable	Mode	*n* (subsample)	*M*	*SD*
Years in the railroad industry	Paper	347	18.80	8.81
	Online	137	16.82	7.56
Age	Paper	342	49.96	9.29
	Online	135	47.51	8.88
Education level	Paper	345	5.16	1.13
	Online	136	5.24	1.15
Device use	Paper	257	1.48	0.75
	Online	111	1.74	0.76
Print materials use	Paper	326	1.17	0.75
	Online	134	1.07	0.67
Online materials use	Paper	304	1.37	0.58
	Online	128	1.58	0.59
Preference for print communications	Paper	339	3.56	1.29
	Online	133	3.00	1.22
Preference for electronic communications	Paper	342	3.63	1.22
	Online	136	4.17	0.85
Confidence	Paper	342	2.49	1.13
	Online	134	3.06	0.94

Table 6 shows the results of these independent samples *t*-tests. The rows highlighted in light blue in the table represent a significant difference; these differences are discussed in greater detail below. A thick line separates the demographic items from the ICT items.

A key assumption of the *t*-test is that the two groups have a homogeneity of variance in the variable being tested. While a Levene's test for equality of variances found this assumption did not hold for a few of the variables (indicated by an * in Table 6), the large number of data points in each group makes this assumption less important. Nevertheless, a *t* statistic not assuming homogeneity of variance was computed for variables with a significant Levene's test and those are reported where appropriate.

Table 6. Independent samples *t*-tests comparing paper and online completers

Variable	*t*	*df*	Significance (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference: Lower Bound	95% Confidence Interval of the Difference: Upper Bound
Years in the railroad industry*	2.460	288.343	0.014	1.971	0.801	0.394	3.547
Age	2.621	475	0.009	2.445	0.933	0.612	4.278
Education level	-0.695	479	0.487	-0.08033	0.11555	-0.30738	0.14673
Device use	-2.997	366	0.003	-0.25836	0.08621	-0.42789	-0.08884
Print materials use*	1.396	276.265	0.164	0.09978	0.07149	-0.04094	0.24051
Online materials use	-3.499	430	0.001	-0.21702	0.06202	-0.33892	-0.09512
Preference for print communications	4.350	470	0.000	0.56637	0.13022	0.31050	0.82225
Preference for electronic communications*	-5.529	353.948	0.000	-0.54489	0.09855	-0.73870	-0.35108
Confidence*	-5.587	287.358	0.000	-0.57188	0.10235	-0.77333	-0.37042

Significant Differences between Online and Paper Completers

There were significant differences between online and paper completers in terms of preference for electronic communications, preference for print communications, confidence in performing technology-related tasks, online materials use, and device use.

- **Preference for electronic communications:** The paper completers ($M = 3.63$, $SD = 1.22$, $n = 342$) reported less agreement with this statement than online completers ($M = 4.17$, $SD = 0.85$, $n = 136$), $t(353) = 5.529$, $p < 0.001$, two-tailed. The difference of 0.545 on a 1–5 scale was significant, the 95 percent confidence interval around the difference between group means was relatively narrow (0.351 to 0.738) and the effect size was medium (Hedges' $g = 0.479$).

- **Preference for print communications:** The paper completers (M = 3.56, SD = 1.29, n = 339) reported more agreement with this statement than online completers (M = 3.00, SD = 1.22, n = 133), $t(470) = 4.350$, $p < 0.001$, two-tailed. The difference of 0.566 on a 1–5 scale was significant, the 95 percent confidence interval around the difference between group means was relatively narrow (0.310 to 0.822), and the effect size was medium (Hedges' g = 0.441).
- **Confidence in performing technology-related tasks:** The paper completers (M = 2.49, SD = 1.13, n = 342) reported less confidence than online completers (M = 3.06, SD = 0.94, n = 134), $t(287) = 5.587$, $p < 0.001$, two-tailed. The difference of 0.572 on a 1–5 scale was significant, the 95 percent confidence interval around the difference between group means was relatively narrow (0.370 to 0.773) and the effect size was medium (Hedges' g = 0.528).
- **Online materials use:** The paper completers (M = 1.37, SD = 0.58, n = 304) reported using less online materials than online completers (M = 1.58, SD = 0.59, n = 128), $t(430) = 3.499$, $p = 0.001$, two-tailed. The difference of 0.217 on a 0–3 scale was significant, the 95 percent confidence interval around the difference between group means was relatively narrow (0.095 to 0.340) and the effect size was small to medium (Hedges' g = 0.360).
- **Device use:** The paper completers (M = 1.48, SD = 0.75, n = 257) reported less device use than online completers (M = 1.74, SD = 0.76, n = 111), $t(366) = 2.997$, $p = 0.003$, two-tailed. The difference of 0.258 on a 0–4 scale was significant, the 95 percent confidence interval around the difference between group means was relatively narrow (0.089 to 0.428) and the effect size was small to medium (Hedges' g = 0.345).

There were also differences between online and paper engineers in terms of years in the industry and age; however, these differences are likely not practically significant due to wide confidence intervals and small effect sizes, as described below.

- **Years in the railroad industry:** The paper completers (M = 18.80, SD = 8.81, n = 347) had more years in the industry than online completers (M = 16.82, SD = 7.56, n = 137), $t(288) = 2.460$, $p = 0.014$, two-tailed. The difference of 1.971 years was likely not practically significant because the 95 percent confidence interval around the difference between group means was relatively wide (0.394 to 3.547) and the effect size was small[8] (Hedges' g[9] = 0.234).
- **Age:** The paper completers (M = 49.96, SD = 9.29, n = 342) were older than online completers (M = 47.51, SD = 8.88, n = 135), $t(475) = 2.621$, $p = .009$, two-tailed. The difference of 2.445 years was likely not practically significant because the 95% confidence interval around the difference between group means was relatively wide (.612 to 4.278), the bottom of the interval is very close to zero, and the effect size was small (Hedges' g = 267).

[8] Statistics How To. Cohen's D: Definition, Examples, Formulas. [Online].

[9] Social Science Statistics. Effect Size Calculator for T-Test. [Online].

Areas with No Significant Differences between Online and Paper Completers

There were no significant differences between online and paper engineers in terms of print materials use and education level, as summarized below.

- **Print materials use:** The paper completers ($M = 1.17$, $SD = 0.75$, $n = 326$) reported using more print materials than online completers ($M = 1.07$, $SD = 0.67$, $n = 134$), $t(276) = 1.396$, $p = 0.164$, two-tailed. The difference of 0.998 on a 0–3 scale was not significant, the 95 percent confidence interval around the difference between group means was relatively wide (-0.040 to 0.241) and the effect size was very small (Hedges' $g = 0.137$).
- **Education level:** The paper completers ($M = 5.16$, $SD = 1.13$, $n = 345$) reported less education than online completers ($M = 5.24$, $SD = 1.15$, $n = 136$), $t(479) = 0.695$, $p = 0.487$, two-tailed. The difference of 0.080 on a 0–9 scale was not significant, the 95 percent confidence interval around the difference between group means was (-0.309 to 0.147), and the effect size was miniscule (Hedges' $g = 0.070$).

Comparing Conductors and Locomotive Engineers

Participants were asked to report their current craft and most were either conductors (36.7 percent) or locomotive engineers (49.8 percent). As with the online vs. paper completers, an independent samples *t*-test was computed for each of the variables included in Table 7. A thick line separates the demographic items from the ICT items in the table.

Table 7. Summary data comparing conductors and locomotive engineers

Variable	Mode	*n* (subsample)	*M*	*SD*
Years in the railroad industry	Conductor	177	13.42	7.12
	Engineer	240	22.19	7.93
Age	Conductor	173	46.54	9.78
	Engineer	237	51.53	8.13
Education level	Conductor	176	5.28	1.12
	Engineer	238	5.11	1.14
Device use	Conductor	139	1.60	0.68
	Engineer	175	1.56	0.83
Print materials use	Conductor	169	1.07	0.76
	Engineer	227	1.27	0.71
Online materials use	Conductor	160	1.44	0.58
	Engineer	210	1.44	0.61
Preference for print communications	Conductor	174	3.38	1.37
	Engineer	231	3.46	1.23

Variable	Mode	*n* (subsample)	*M*	*SD*
Preference for electronic communications	Conductor	177	3.82	1.10
	Engineer	234	3.78	1.21
Confidence	Conductor	177	2.84	1.04
	Engineer	231	2.56	1.16

Table 8 shows the results of these independent samples *t*-tests. As in Table 6 an asterisk indicated that a Levene's test revealed heterogeneity of variances, so a *t*-test not assuming equal variances is reported for these items. The rows highlighted in light blue represent a significant difference; these differences are discussed in greater detail below. A thick line separates the demographic items from the ICT items.

Table 8. Independent samples *t*-tests comparing conductors and locomotive engineers

Variable	*t*	*df*	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference: Lower Bound	95% Confidence Interval of the Difference: Upper Bound
Years in the railroad industry*	-11.647	415	0.000	-8.764	0.752	-10.243	-7.285
Age	-5.465	328.484	0.000	-4.984	0.912	-6.778	-3.190
Education level	1.464	412	0.144	0.16496	0.11268	-0.05654	0.38647
Device use	0.413	311.648	0.680	0.03522	0.08518	-0.13238	0.20282
Print materials use*	-2.733	394	0.007	-0.20326	0.07437	-0.34946	-0.05705
Online materials use	0.017	368	0.986	0.00107	0.06279	-0.12239	0.12454
Preference for print communications	-0.639	349.630	0.523	-0.08389	0.13127	-0.34206	0.17428
Preference for electronic communications*	0.324	395.142	0.746	0.03716	0.11466	-0.18826	0.26258

Variable	*t*	*df*	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference: Lower Bound	95% Confidence Interval of the Difference: Upper Bound
Confidence*	2.626	396.264	0.009	0.28694	0.10926	0.07215	0.50174

Significant Differences Between Conductors and Locomotive Engineers

There were significant differences between locomotive engineers and conductors in years in the industry, age, confidence in performing technology-related tasks, and use of print and online materials.

- **Years in the industry:** Conductors (M = 13.42, SD = 7.12, n =177) reported fewer years in the railroad industry than locomotive engineers (M = 22.19, SD = 7.93, n =240), $t(415) = 11.647$, $p < .001$, two-tailed. The difference of 8.764 was significant, the 95 percent confidence interval around the difference between group means was (7.285 to 10.243), and the effect size was very large (Hedges' g = 1.154).
- **Age:** Conductors (M = 46.54, SD = 9.78, n =173) were younger than locomotive engineers (M = 51.53, SD = 8.13, n = 237), $t(328) = 5.465$, $p < 0.001$, two-tailed. The difference of 4.984 was significant, the 95 percent confidence interval around the difference between group means was (3.190 to 6.778), and the effect size was medium (Hedges' g = 0.563).
- **Confidence in performing technology-related tasks:** Conductors (M = 2.84, SD = 1.04, n = 177) reported slightly higher confidence in performing technology-related tasks than locomotive engineers (M = 2.56, SD = 1.16, n = 231), $t(396) = 2.626$, $p = 0.009$, two-tailed. The difference of 0.287 was significant, the 95 percent confidence interval around the difference between group means was (0.072 to 0.502), and the effect size was small (Hedges' g = 0.252).
- **Use of print materials:** Conductors (M = 1.07, SD = 0.76, n = 169) reported slightly lower use of print materials as information sources than locomotive engineers (M = 1.27, SD = 0.71, n = 227), $t(394) = 2.733$, $p = 0.007$, two-tailed. The difference of 0.203 was significant, the 95 percent confidence interval around the difference between group means was (0.057 to 0.349), and the effect size was small (Hedges g = 0.273).

Areas with No Significant Differences Between Conductors and Locomotive Engineers

There were no significant differences between locomotive engineers and conductors in preferences for print and electronic communications, device use, or education level:

- **Education level:** Conductors (M = 5.28, SD = 1.12, n = 176) reported slightly more, though not significant, education than locomotive engineers (M = 5.11, SD = 1.14, n = 238), $t(412) = 1.464$, p = 0.144, two-tailed. The difference of 0.165 was not significant,

the 95 percent confidence interval around the difference between group means was (-0.057 to 0.387), and the effect size was very small (Hedges' $g = 0.150$).

- **Device use:** Conductors ($M = 1.60$, $SD = 0.68$, $n = 139$) reported slightly more, though not significant, use of electronic devices than locomotive engineers ($M = 1.56$, $SD = 0.83$, $n = 175$), $t(311) = 0.413$, $p = 0.680$, two-tailed. The difference of 0.035 was not significant, the 95 percent confidence interval around the difference between group means was (-0.132 to 0.203), and the effect size was miniscule (Hedges' $g = 0.052$).
- **Preference for print communications:** Conductors ($M = 3.38$, $SD = 1.37$, $n = 174$) reported slightly lower preference for print communications than locomotive engineers ($M = 3.46$, $SD = 1.23$, $n = 231$), $t(349) = 0.639$, $p = 0.523$, two-tailed. The difference of 0.084 was not significant, the 95 percent confidence interval around the difference between group means was (-0.342 to 0.174), and the effect size was miniscule (Hedges' $g = 0.062$).
- **Preference for electronic communications:** Conductors ($M = 3.82$, $SD = 1.10$, $n = 177$) reported slightly higher preference for electronic communications than locomotive engineers ($M = 3.78$, $SD = 1.21$, $n = 234$), $t(395) = 0.324$, $p = 0.746$, two-tailed. The difference of 0.037 was not significant, the 95 percent confidence interval around the difference between group means was (-0.188 to 0.263), and the effect size was miniscule (Hedges' $g = 0.034$).
- **Use of online materials:** Conductors ($M = 1.44$, $SD = 0.58$, $n = 160$) reported using the same amount of online information sources as locomotive engineers ($M = 1.44$, $SD = 0.61$, $n = 210$), $t(368) = 0.017$, $p = 0.986$, two-tailed.

Summary of Differences Between Online and Paper Completers

The major findings of this comparison are not surprising: conductors have been in the industry fewer years and are younger than locomotive engineers. While conductors also reported slightly higher confidence in performing technology-related tasks and slightly lower use of print materials as information sources than locomotive engineers, these were smaller effects.

3.7.4 Summary of Analyses

These analyses revealed a number of correlations between study variables, along with significant differences between groups of respondents. The discussion section (see Section 4) explores implications of these findings.

3.8 RGHS Awareness and Use

This section of the survey addressed respondents' familiarity with and use of an FRA ICT resource, the RGHS website. Questionnaire items addressed whether respondents had heard of the site, whether they had visited it, and whether they had completed the site's *Anonymous Sleep Disorders Screening Tool.* Questions also addressed how recently or how often respondents had visited the site, and what actions (if any) they took after visiting. Lastly, the instrument also provided an opportunity for respondents to provide recommendations about what would make the site more useful to railroaders. The results of these items are summarized in the following sections.

3.8.1 Knowledge of the Website

Among the 485 survey respondents, 17.9 percent had heard of the RGHS website. This amounts to 87 respondents, below the threshold for generalizing findings to the broader population of TY&E railroaders; however, these results can still provide valuable qualitative and anecdotal information about railroader familiarity and use of this educational resource.

Those who had heard of the site were asked to indicate how they learned about it, as shown in Figure 19. Most indicated that they had heard about it from their union (46 percent) or carrier (46 percent), though others learned about the site through FRA (6.9 percent). Some did not know or could not recall (11.5 percent). Another 3.4 percent indicated that they learned about the site through other sources, including two respondents that wrote that they learned about RGHS from the ICT survey mailing itself.

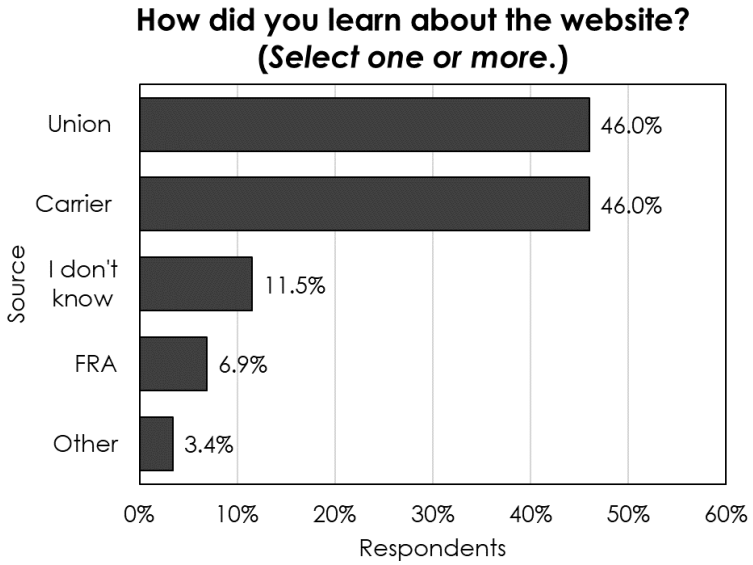

Figure 19. How respondents learned about the RGHS website (*n* = 87)

3.8.2 Website Visits

Not all respondents who had heard of RGHS (*n* = 87) had also visited the site: 54.0 percent, when asked about their most recent visit indicated that they had not done so. However, the remaining 46.0 percent (40 respondents) had visited, some as recently as within the past week.

Figure 20 shows how recently respondents had visited the website. A total of 27.5 percent visited within the last 6 months (including those who visited "within the last week," "more than a week ago," or "more than a month ago"). Another 30.0 percent had visited "more than 6 months ago" but within the past year, and 42.5 percent had visited more than a year ago.

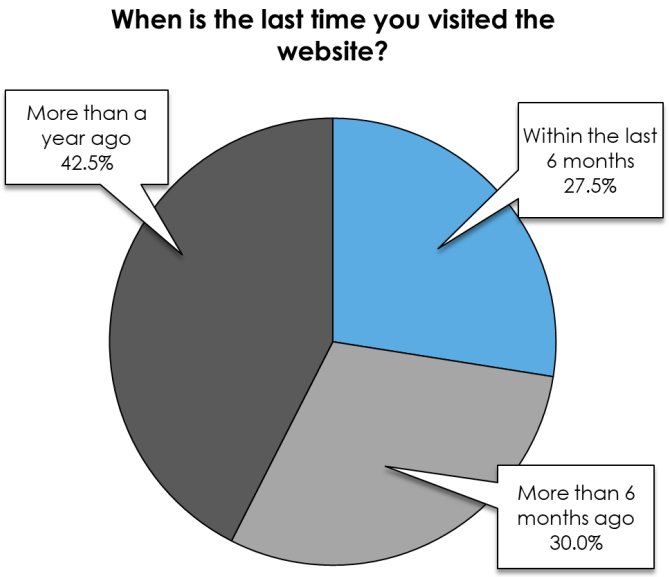

Figure 20. Most recent visit to the RGHS website (*n*=40)

Among those who had visited the site, around half (48.7 percent, or 19 respondents) indicated that they visit regularly. Table 9 shows the visit frequency for these repeat site visitors.

Table 9. Frequency of visits to the RGHS website (*n*=19)

Response	Count	Percent
Once a week or more	2	10.5%
Once a month or so	4	21.1%
Twice a year or so	4	21.1%
Once a year or so	9	47.4%

3.8.3 Anonymous Sleep Disorders Screening Tool

Among those who had visited the site (*n*=40), 5 respondents (12.5 percent) reported that they had completed the *Anonymous Sleep Disorders Screening Tool.* Some respondents (7.5 percent) were not familiar with the Tool, and the remainder (80.0 percent) indicated that they had not completed it.

When asked if the Tool recommended seeking care for possible sleep disorders, two respondents indicated "yes," another two indicated "prefer not to answer," and one indicated "no." Two of these respondents then indicated that they did see a healthcare provider: one who had been advised by the tool to seek care, and one who had responded "prefer not to answer."

3.8.4 Website Usefulness

While most site visitors (59.0 percent) reported that they were "just browsing" and not looking for anything in particular on the RGHS website, another 23.1 percent indicated that they found what they sought on the site (see Figure 21). When prompted to comment with additional details,

three respondents left comments, which are listed in Table 10, along with whether they found what they were looking for.

Interestingly, only one of the respondents who indicated that they did not find what they were looking for left a comment to explain this response. It is possible that others who selected "no" did so because (a) the issues they experienced are beyond the scope of the website to address, or (b) they were not looking for anything specific, and "I was just browsing" would have been a more appropriate response.

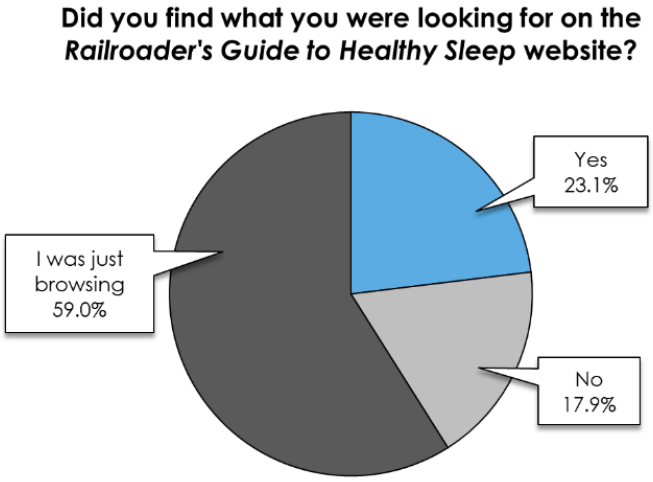

Figure 21. Usefulness of visits to the RGHS website (*n*=39)

Table 10. Comments regarding what respondents were looking for on the RGHS website

Did you find what you were looking for?	Please share any additional details, like what you were looking for on the website.
Yes	"How to be tested for sleep apnea"
I was just browsing	"Looking to see what this website is about. If it would benefit me. It's been some time since I've been on this site."
No	"[It] doesn't apply to the railroad service that I am in. Everything they suggest to do the railroad won't let me. I am on call and the train lineups they put out are terrible. I don't know when to sleep and then I go to sleep and the phone rings."

The final two items of this section asked, "What steps or actions, if any, did you take after visiting the website?" and "What would make the website more useful to railroaders, like you?" Despite a limited number of site visitors, comments provided suggest that the site was valuable to those who did visit.

After visiting, respondents reported taking a range of actions to improve their sleep, such as seeking medical care, managing their time differently, tracking their sleep, paying attention to sleep hygiene, and doing additional research. Table 11 shows selected comments.

Table 11. Actions taken after visiting the RGHS website

Comment theme	Examples
Seeking medical care	"[Did] a sleep test"
Time management	"Worked on getting more rest before work"
Sleep tracking	"Started paying attention to my sleep habits times and amount"
Sleep hygiene	"I've taken some of the steps to prep my room for sleeping for instance, room darkening shades, setting the temperature down…"

Respondents' recommendations for how to make the site more useful also addressed several themes, including greater site promotion, the need for frequent site updates, and content that reflects railroaders' irregular schedules; examples are included in Table 12.

Table 12. Recommendations to improve the RGHS website

Comment theme	Examples
Site promotion	"More advertising, let people know it's available and how it benefits you. And to know that the carriers has no access to the information we report to it"
Site updates	"Constant updates be it daily or weekly" "The last time I visited the site the screening tool was under construction"
Recognition of irregular schedules	"Real life answers. Not sleep on a schedule, go to bed at the same time daily"

Two comments specifically noted that they would like content that is realistic for railroaders' who do not have regular schedules. This is currently a focus of the site, so it is unclear whether these respondents are requesting something beyond what the site currently includes, or are indicating that this is something they currently find useful about the site and of which they would like to see more.

Across both open-response items, respondents sometimes provided comments that were not related to the site, but reflected challenges to healthy sleep. For example, one respondent indicated that what would be useful would be the "railroad taking time to update lineups." Another commented that seeking medical care for sleep is a challenge, writing "We don't have time to go & set up a doctor's appointment! We have no sick time to use."

3.8.5 Summary of RGHS Items

Overall, though knowledge of the RGHS website among respondents was limited, approximately half who were aware of the site have visited. Although most site visitors were "just browsing," some were looking for specific information, such as how to be tested for sleep apnea, and were able to find it on the site. Around half of the respondents who visited the site do so regularly, with some visiting as often as once a week, suggesting that railroaders see value in the site as a resource.

Respondents took a range of actions after visiting to improve their sleep, such as seeking medical care, managing their time differently, tracking their sleep, paying attention to sleep hygiene, and doing additional research. Though relatively few respondents reported using the *Anonymous Sleep Disorders Screening Tool,* which is complicated by the fact that it has been offline since November 2019, several of those who did use the Tool (i.e., in the more distant past) reported that they saw healthcare providers, suggesting that the Tool has been beneficial for some.

To make the site even more useful, respondents recommended greater site promotion, more frequent site updates, and providing actionable "real life answers" to improve railroaders' sleep. As some respondents made recommendations already within the site's scope, it is worth considering how existing content can be further improved in the event there remain unmet audience needs. Further, more frequent site updates could be especially valuable to those who visit the site regularly, with new content to boost their engagement.

4. Findings and Limitations

Findings from the current study provide insights into railroader ICT access, use, confidence and preferences, as well as the relationship of ICT with relevant railroader demographic characteristics. These findings address FRA's interest in learning about how to best reach TY&E railroaders when creating safety-related messaging campaigns and programs for the railroad industry. Additionally, the study offers useful information regarding railroaders' familiarity with and use of the RGHS website that FRA can utilize to design, deliver, and improve content and outreach campaigns for this resource and others.

4.1 Key Study Findings

Researchers obtained sufficient responses for study findings to be generalizable to the U.S. railroad industry's TY&E population at the time of the survey. The following subsections highlight the key study findings organized by the research questions and their relationship to railroader demographics (see Section 1.2).

4.1.1 Demographics

To situate study findings, it is first important to understand the population of railroaders surveyed. The researchers anticipated seeing changes to the composition of the TY&E workforce since the last known comparable survey over a decade ago. Instead, many characteristics were similar. For example, this workforce is still male dominated and did not report differences in years worked in the industry. Surprisingly, this trend did not hold for age, which despite being expected to decline, instead increased on average by close to 4 years. Researchers speculated that this may have been due to younger, less-experienced employees being furloughed as a result of the increasing use of PSR and the COVID-19 pandemic, which coincided with the survey administration period, thereby further skewing the age distribution toward an older workforce.

4.1.2 Which Types of ICT Do TY&E Railroaders Use Most?

To address this research question, the team sought to understand overall use (versus non-use) of various ways to access the internet, as well as what types of computer technologies (devices) are most commonly used. The team also looked at overall use of various printed and online or electronic information sources.

Internet Access and Devices

The vast majority of respondents (73.0 percent) indicated that they use more than one means to access the internet. The most common was "mobile" (e.g., phone, tablet, and hotspot), reported by 84.1 percent of all respondents. This was followed by cable modem, DSL, and fiber-optic.

Smartphones were the most commonly used devices, selected by 92.4 percent of respondents, followed by nearly three-quarters of respondents using desktop or laptop computers and tablets, and over half reporting tablet use. Less than half of respondents reported using other types of devices, such as smart TVs, speakers, or smartwatches.

This finding suggests that it may be important to make ICT resources for railroaders mobile-friendly, since railroaders viewed websites and other resources most frequently using a

smartphone or via the mobile web. In contrast, it may not currently be practical to target smartwatch users because they represent a very small portion of the railroader population.

Information Sources

Findings related to frequency of use of printed information sources, suggested that respondents most commonly used newsletters (78.8 percent). This was followed by magazines and postings. Somewhat surprisingly, printed newspaper use (61.5 percent), came in at the bottom of the list (when disregarding "other" responses).

Similarly, for online or electronic materials, mobile device communications, such as text message and voicemail, were used most (96.3 percent) followed by videos, websites, and email distribution lists (80.4 percent). Conversely, overall, podcasts and blog sites were the least likely to be used as electronic or online information sources, with over one-half and two-thirds of respondents, respectively, "never" using these information sources.

Interestingly, over two-thirds of respondents reported that they used RSS feeds (68 percent), more than reported overall use of online newspapers and online magazines. This seemed unusually high; upon closer inspection, the description of RSS feeds in the instrument included "news sites," which may have confused respondents and artificially inflated their reported use of RSS feeds.

Comparing use across both printed and online or electronic information sources, although printed materials were not used as often as some electronic materials, they fall toward the middle of the rankings in terms of overall use.

Though these findings were useful for understanding which types of ICT railroaders use, it is also important to understand how frequently railroaders use them—for this, the team delved deeper into the survey's ICT items.

4.1.3 How Much Do TY&E Railroaders Use ICT?

To answer this research question, the team sought to understand reported frequency of use for various computer technologies or devices, and to more closely examine the frequency of use responses for various printed and online or electronic materials as information sources. The team also examined respondents' confidence and preferences regarding ICT as part of this research question.

Devices

Interestingly, across all devices, the most common response indicated an average range of "1–4 hours" per week, suggesting that overall, TY&E railroaders were not heavy ICT device users. Note that while on duty, personal electronic device use (e.g., smartphones) is banned by regulation, so relatively low ICT device use is not surprising. Since this item is an estimate of average weekly personal and work use where on-the-job use is forbidden, it is likely that reported totals reflect primarily off duty (i.e., personal) use. Across device types, respondents reported much more frequent use of smartphones than other devices: 63.7 percent reported using smartphones for *more than* 1–4 hours, compared to 23.9 percent for laptop and desktop computers, and 21 percent for tablets.

In addition to being the most commonly used device overall, smartphones were also used most heavily, with 39.2 percent of respondents reporting use totaling 10 or more hours per week and 16.1 percent reporting more than 15 hours per week. This is more than twice the number of respondents using desktop or laptop computers this often, and more than three times the number of respondents using tablets with the same frequency.

This reinforces the prior suggestion that it may be important to make information and communications technology resources for railroaders mobile-friendly, as smartphones were not only used by more railroaders than other devices, they were also used more frequently.

Information Sources

In several cases, the types of ICT that railroaders used most frequently were different from those that railroaders used more overall.

For example, when the "frequently" and "sometimes" categories of responses related to printed information sources were combined, respondents reported using newsletters the most (42.3 percent). However, for "frequent" use only, respondents used printed newspapers most frequently, followed closely by magazines, with newsletters dropping to third place.

Combining "frequently" and "sometimes" responses for online or electronic materials use, the results parallel those of overall use for mobile communications and videos, 89.1 percent and 70.7 percent, respectively. However, a different pattern emerged for online communities, websites, and email distribution lists. The respondents indicated more frequent use (i.e., "frequently" or "sometimes") similarly to "rare" use, or non-use/no response. For example, use of email distribution lists reported as "frequently" or "sometimes" combined to 52.6 percent, whereas use of email distribution lists reported as "never/no response" or "rarely" combined to 48.4 percent. A similar pattern of responses held for reported use of websites and reported use of online communities, with heavy users/non-users at both ends of the spectrum. For "frequent" reported use only, the highest percentage of respondents used mobile device communications (69.9 percent), followed by online communities, videos, websites, and email distribution lists (21.0 percent).

Unlike the other printed and online or electronic materials, newspapers and magazines were listed across both formats. While respondents reported using online newspapers "frequently" or "sometimes" 6 percent more than they do print newspapers (32.6 percent), the opposite relationship existed for magazines, where print copies were used more frequently.

This information is valuable for FRA when considering how to best reach their target audience; in some cases, it may be more effective to choose communications through materials that were used frequently, but not as widely (e.g., print newspapers), while in other cases it may be appropriate to choose communications methods that were used more widely, even if they were not used as frequently (e.g., email distribution lists).

4.1.4 ICT Confidence

Respondents' confidence in performing technology-related tasks varied across the four tasks examined in this questionnaire. As shown in Figure 15, respondents reported the greatest confidence around using internet search engines: 81.4 percent were "extremely" or "moderately" confident with this technology-related task. They expressed the least confidence in subscribing to blogs and feeds: 21.0 percent were "not at all confident," which is close to the same percentage

of respondents who reported feeling "extremely" confident doing so (27.2 percent). This lack of confidence aligns with the finding discussed above that blog sites were the least commonly used electronic or online information source. It also suggests that trends in the rise of the popularity of social media were not uniform, especially when it comes to formats that have been in use for a while and perhaps have fallen out of favor over time, or their popularity has fluctuated. Awareness of such areas where a portion of railroaders were "not at all confident" may help FRA avoid communication strategies that would be ineffective for certain members of their target audience.

4.1.5 ICT Preferences

A single question assessed respondent preferences for receiving information printed on paper or electronically. Just over two-thirds of respondents "agreed" or "strongly agreed" that they preferred receiving electronic information, while over half "agreed or "strongly agreed" that they preferred paper.

The fact that more respondents agreed or strongly agreed to preferring electronic information is interesting given that, in fact, a full 71.8 percent of respondents chose to complete the questionnaire on paper rather than online. There are several possible reasons for this.

First, as a partial explanation, the highlight table (see Figure 18) demonstrates that respondent preferences for receiving information on paper and electronically were not mutually exclusive, though the two variables were negatively correlated. Interestingly, the most common response pattern shows that over one-quarter of respondents actually "agree" or "strongly agree" that they prefer information printed on paper and "agree" or "strongly agree" that they prefer information printed electronically. In the current study, indicating a preference for electronic information may be paired with an equally strong preference for printed information.

Additionally, the larger percentage of respondents who chose to complete the questionnaire on paper may also be explained using the previously mentioned highlight table if one tallies the percentage of respondents who "strongly agreed" or "agreed" to receiving information on paper, while also adding those who reported being undecided, totaling 71.3 percent of respondents.

Lastly, it may simply have been easier for respondents to complete the questionnaire on paper, as that is how they received it. The paper questionnaire included a prepaid return envelope to make participation as simple as possible. Completing the questionnaire online required navigating to the provided URL and entering the unique code included in the survey packet, which perhaps acted as a sufficient barrier to online completion such that the survey saw increased paper completion rates.

Overall, though, this item suggests that railroaders' preferred communications methods vary: some prefer electronic communications over paper communications or vice versa, while some prefer both equally and others still are undecided. For those who are undecided or indicated equal preference for both methods, it may be that preferences are context-dependent and therefore not captured in this questionnaire item.

4.1.6 Correlations

Most of the significant correlational findings were not surprising, such as the positive relationship between respondent age and reported years working in the railroad industry. Of interest to the current objectives, the significant correlations discussed next are noteworthy.

Respondents who were more educated tended to report greater device use, preferred electronic communications and were more confident in performing various technology-related tasks, such as using online communities or search engines.

Older railroaders tended to also have lower confidence in performing technology-related tasks, were more likely to prefer print communications, displayed a weaker preference for electronic communications, and used fewer online materials.

Interestingly, those who tended to use more print materials as sources of information also tended to use more online materials, suggesting that certain railroaders are simply "information consumers" whether the source is online or printed.

Additionally, the analysis revealed a negative correlation between years in the industry and level of education. This means that the younger railroaders are likely more educated than more seasoned railroaders.

One somewhat surprising finding, in combination with other results provides an important insight. The use of print materials positively correlated with education level, meaning that those who used more print materials as sources of information also tended to be more educated. Combined with the result that education level also positively correlated with online or electronic materials use, device use, and confidence in performing technology-related tasks, this means that the more educated the railroader, the more they tend to use multiple information sources (e.g., print and online/electronic materials), the more they likely use computer technology devices at home for work and personal tasks, and the more confident they tend to be in performing technology-related tasks. Therefore, newer, younger, and more educated railroaders may be best-reached by using technology-based communications.

4.1.7 Online and Paper Completers

Statistical comparisons of the naturally occurring quasi-experimental grouping of respondents who completed the survey instrument on paper (i.e., paper completers) versus those who completed it online (i.e., online completers) clearly indicated that these two groups differ.

Online completers displayed a higher preference for using online or electronic information sources and a lower preference for using printed information sources. Online completers also exhibited greater confidence in performing technology-related tasks, such as completing video-based training, and reported using computer technology (i.e., ICT devices) more.

This finding is important as it suggests that approximately 30 percent of respondents, were "tech-savvy" and preferred outreach, communications, and/or information sources that were electronic or online. Despite receiving a paper copy of the survey on at least one occasion, ultimately, some respondents did not desire to respond to a print communication. Additionally, for someone to respond online, it required at least two additional steps to be able to use an ICT device: (1) typing the study URL to navigate to the questionnaire; (2) entering a unique participant ID to submit responses.

In contrast, the other approximately 70 percent preferred print communications and materials, were less confident in performing various technology-related tasks, and used their ICT devices less.

These findings suggest that *using only one method of outreach may not be sufficient to reach the full railroader population*, as at least two distinct demographics can be identified within this

population. FRA may wish to consider the needs and preferences of these distinct groups when creating and distributing safety-related messaging.

4.1.8 How Do TY&E Railroaders Use the RGHS Website?

Survey results regarding the awareness and use of the RGHS website were not generalizable to the larger population, but offered valuable qualitative and anecdotal information on which FRA can base future actions.

Although knowledge of the RGHS website among respondents was somewhat limited, approximately half of those who were aware of the site had visited it. The vast majority of respondents reported that they heard of the site from their union or carrier, and only just under 7 percent indicated that they learned of the website from FRA. FRA could consider whether or not it desires to promote the site itself, or engage with union and other key stakeholders to do so. These outside stakeholders may act as independent sources of trust for railroaders, who are known to be a regulator-skeptical audience.

Of the respondents who knew of the website, nearly half had visited it. Of this group, nearly half indicated that they did so regularly, suggesting that site visitors see sufficient value in the site to return. Over one-quarter reported visiting within the last 6 months and another nearly one-third had visited over 6 months ago, but within the last year (i.e., at the time of the study)—so most respondents were fairly recent visitors. In working to understand the reported usefulness of the website, nearly 60 percent of the visitors noted that they were "just browsing," however just over 23 percent indicated that they found what they were looking for, such as "how to be tested for sleep apnea."

Overall, despite a limited number of reported visitors, open-ended responses suggest that the site can be a valuable resource for those who engage with its content. In response to the item that asked about what respondents did after visiting to improve their sleep, the respondents who had visited the site reported a number of actions around themes including working on time management, seeking care from a healthcare provider, paying attention to sleep hygiene, and sleep tracking.

Themes provided by respondents regarding how to improve the usefulness of the site included implementing regular updates, promoting the site, and adding specific content regarding particular noted issues.

The number of completed survey questions related to the *Anonymous Sleep Disorders Screening Tool* was small (see Section 4.2) but they captured the sensitivity of the topic of sleep disorders among railroaders. Interestingly, one of the respondents who reported seeing a doctor regarding possible sleep disorders opted not to share whether the Tool had recommended this step or not. It is also possible that some respondents who had in actuality completed the Tool may not have felt comfortable disclosing that information, even in an anonymous survey.

While it is encouraging to know that some users were regular visitors, there is certainly room for improvement when it comes to engaging with the target audience and promoting the RGHS website. Web best practices suggest frequent content updates, checks to ensure minimal site downtime, technology updates as necessary, and regular outreach and promotion across various channels.

4.2 Study Limitations

As with most studies, the research team discovered limitations to their efforts over the course of the project. Some limitations to this research came from the scope of the finalized questionnaire following OMB approval, while others related to technical difficulties surrounding the RGHS website, and finally a number of limitations came from administering the survey during the COVID-19 pandemic. The following sections summarize these limitations.

4.2.1 Questionnaire Limitations

The OMB approval process introduced limitations to the overall length of the questionnaire and inclusion of specific items. For example, due to requirements of the approval process, the Volpe team removed a multi-item attitude scale from the survey instrument. Without this scale, the team could not answer one of the originally planned research questions addressing attitudes towards ICT. As a result, the team omitted that research question from the analysis.

Additionally, the OMB approval process required combining items that asked about use of ICT at home for work or personal use. The resulting items asked about use for either purpose; therefore, while the team was able to answer research questions regarding which types of ICT railroaders use and how much they use them, the team was not able to examine the specific purposes for which railroaders use ICT.

4.2.2 RGHS Website Limitations

Technical difficulties in the form of an external server failure meant that the Anonymous Sleep Disorders Screening Tool, part of the RGHS website, went offline in November 2019. Therefore, the Tool was unavailable during the survey administration period and some period prior. It is impossible to know to what degree the 6 months that the Tool was offline impacted Tool completion rates reported during the survey. However, this outage likely had negative effects on the questionnaire items addressing the Tool, and quite possibly on those addressing the website overall, as the website was missing one of its key features.

The RGHS website also experienced some downtime starting in August 2019 through the end of October 2019. As a result of an unanticipated security issue, FRA was required to take the site down in mid-August and was required to adjust the original URL to a .gov domain (see footnote #1).

As this change occurred within the year prior to survey administration, it is likely that the website's downtime and restoration at a different URL impacted the frequency of site use and the quality of the collected survey data regarding the RGHS website. The RGHS items were the only survey items that were not generalizable to the larger population due to low response rates.

4.2.3 COVID-19 Pandemic Limitations

Survey preparation and administration largely coincided with the onset of COVID-19 in the U.S. and the resulting health pandemic.

The Volpe team successfully completed all five mailing phases; however, there was a slight delay between obtaining the TY&E railroader sample from the unions' databases and beginning the 8-week mailing period. This could have increased the number of incorrect addresses or inactive railroaders (e.g., recent retirees or furloughed employees) included in the mailings. The

team removed any respondents who did not meet inclusion criteria during data cleaning, and the survey response rate was sufficient to generalize to the TY&E railroader population even with the number of invalid mailing addresses the team encountered, so the impact of these limitations does not seem to have been severe. However, it is possible that the pandemic impacted the survey results in other ways that the team could not measure.

5. Conclusion

This research updated baseline data of U.S. Class I TY&E railroader demographics. Additionally, it provided FRA a greater level of understanding of railroader ICT access, use, confidence, and preferences. The improved understanding could support the creation of more appropriate safety-related programs and outreach campaigns for the railroad industry.

The research updated the known demographics of railroad employees. Interestingly, the demographics of the current sample of railroaders, which included TY&E employees, were similar to those reported by Gertler and DiFiore (2009) in their study of T&E employees. The findings of the current study were generalizable to railroad employees, and addressed the study objective and three research questions related to ICT and the RGHS website.

Examining the types of ICT railroaders' use and how much they use them provided several interesting implications for FRA:

- It may be important to make ICT resources for railroaders mobile-friendly. Smartphones were used by more railroaders than other devices, and mobile web was the most common reported way of accessing the internet.
- In some cases, the types of ICT that railroaders used *most frequently* were different from those that were used *most widely*, i.e., by the largest percent of railroaders. This information is valuable for FRA to consider how to best reach their target audience.
- Railroaders' confidence in performing technology-related tasks varied across tasks. Recognizing these differences may help FRA identify effective communication strategies.
- Despite a negative correlation between preference for print and preference for electronic communications, not all railroaders exhibited strong preferences for either. Whereas some preferred electronic over paper communications or vice versa, some preferred both or were undecided.
- Additional correlations indicated that differences in ICT use and preferences were related to demographic characteristics including age and education level. Newer, younger, and more educated railroaders may be best-reached by technology-based communications.
- Given the significant differences between those who completed the survey on paper and those who completed it online, using only one method of outreach may not be sufficient to reach the full railroad population. FRA may wish to consider the needs and preferences of these distinct groups when creating and distributing safety-related messaging.
- The survey results provide qualitative data about the RGHS website for FRA's consideration.

5.1 Recommendations for Additional Research

Although this study focused on TY&E railroaders, similar future research could be expanded to include workers in other railroad crafts, or conducted again for TY&E workers as part of a series tracking workforce change. Experience gained during the OMB PRA approval process for this study provides lessons learned for both Volpe and FRA.

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Appendix A.
Finalized Questionnaire

This appendix includes the questionnaire that respondents received in the two survey packet mailings. The research team did not make any changes to the questionnaire between the mailings.

OMB Control No. 2130-0624

Your unique code:

Information and Communications Technology (ICT) Survey

Instructions

a. There are three sections on this questionnaire. The first and third set of questions ask about you and your ICT preferences. The second set asks about the Railroaders' Guide to Healthy Sleep *website to learn how much you know about and have used this ICT resource.*

b. Please read each item carefully, and select your response by completely filling in the square(s) using a black or blue pen. (Most questions allow only one response. However, in a few places more than one response is allowed, and will be stated as such.)

Section A: Your ICT Preferences

1. Please select all the ways that you connect to the Internet/the Web. *(Select one or more.)*

- ☐ Dial-up modem
- ☐ DSL
- ☐ Cable modem
- ☐ Fiber-optic
- ☐ Mobile (phone, tablet, hotspot)
- ☐ Satellite
- ☐ I don't know
- ☐ I don't access the Internet
- ☐ Other

If Other, please specify:

2. How many hours per week, on average, do you typically use computer technology at home for work or personal use? *(Hours=hrs.)*

	I don't use this	1-4 hrs.	5-9 hrs.	10-15 hrs.	>15 hrs.
Desktop or Laptop computer (Mac, Dell, HP, etc.)	☐	☐	☐	☐	☐
Tablet (iPad, Kindle Fire, Surface Pro, etc.)	☐	☐	☐	☐	☐
Smartphone (iPhone, Samsung, Blackberry, etc.)	☐	☐	☐	☐	☐
Smartwatch (Apple Watch, Samsung Watch, etc.)	☐	☐	☐	☐	☐
Smart TV or Speaker (Samsung, Alexa, Google, etc.)	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐

If Other, please specify:

3. How often do you use these information sources?

Printed Materials

	Never	Rarely	Sometimes	Frequently
Newspapers, Print (New York Times, Wall Street Journal, USA Today, a local paper, etc.)	☐	☐	☐	☐
Magazines, Print (Progressive Railroading, Railway Age, Sports Illustrated, Reader's Digest, etc.)	☐	☐	☐	☐
Newsletters, Print (union, community, hobby, etc.)	☐	☐	☐	☐
Postings (flyer, poster, informational fact-sheet, hand-out, etc.)	☐	☐	☐	☐
Other	☐	☐	☐	☐

If Other, please specify: ☐

Online or Electronic Materials

	Never	Rarely	Sometimes	Frequently
Newspapers, Online (nytimes.com, latimes.com, etc.)	☐	☐	☐	☐
Magazines, Online (thedailybeast.com, trn.trains.com, etc.)	☐	☐	☐	☐
Email distribution lists (listservs, e.g., local union lists, etc.)	☐	☐	☐	☐
Internet websites (cnn.com, webmd.com, progressiverailroading .com, railwayage.com, etc.)	☐	☐	☐	☐
RSS feeds (stock market, news sites, carrier feed, etc.)	☐	☐	☐	☐
Videos (youtube.com, etc.)	☐	☐	☐	☐
Podcasts (letstalktrains.com, etc.)	☐	☐	☐	☐
Blog sites (gizmodo.com, mashable.com, tmz.com, etc.)	☐	☐	☐	☐
Online communities (NextDoor, Facebook, Twitter, Instagram, LinkedIn, etc.)	☐	☐	☐	☐
Mobile device communications (text message, voicemail, Whatsapp, etc.)	☐	☐	☐	☐
Other	☐	☐	☐	☐

If Other, please specify: ☐

4. Which option best describes your agreement with these statements?

	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
I prefer to receive information electronically (using a computer, tablet, smartphone, text, etc.).	☐	☐	☐	☐	☐
I prefer to receive information printed on paper.	☐	☐	☐	☐	☐

5. How confident are you in performing these technology-related tasks?

	Not at all confident	Slightly confident	Somewhat confident	Moderately confident	Extremely confident
Using an Internet search engine (Google, Bing, Yahoo, etc.) to find information.	☐	☐	☐	☐	☐
Subscribing to blogs, newsfeeds, and other news-related online services.	☐	☐	☐	☐	☐
Using online community sites (NextDoor, Facebook, Twitter, Instagram, LinkedIn, etc.).	☐	☐	☐	☐	☐
Completing video-based training on the Internet.	☐	☐	☐	☐	☐

Section B: Your Use of the *Railroaders' Guide to Healthy Sleep* Website

6. Have you heard of the *Railroaders' Guide to Healthy Sleep* website?

☐ Yes — Continue to next question

☐ No — Skip to Question 16

7. How did you learn about the website? *(Select one or more.)*

☐ Union (website, officer, regional meeting, etc.)

☐ Federal Railroad Administration (FRA website, representative, etc.)

☐ Carrier (intranet/employee portal, website, representative, etc.)

☐ I don't know

☐ Other

If Other, please specify: ☐

Please share any additional details about how you learned of the website:

☐

8. When is the last time you visited the website?

☐ Within the last week

☐ More than a week ago, but within the last month

☐ More than a month ago, but within the last 6 months

☐ More than 6 months ago, but within the last year

☐ More than a year ago

☐ I have never visited, but I have heard of it — Skip to Question 16

9. How often do you visit the website?

- ☐ Once a week, or more
- ☐ Once a month or so
- ☐ Twice a year or so
- ☐ Once a year or so
- ☐ I don't visit the website regularly

10. Have you completed the *Anonymous Sleep Disorders Screening Tool* on the website?

- ☐ Yes — Continue to next question
- ☐ No — Skip to Question 13
- ☐ I don't know what that is — Skip to Question 13

11. Did the results from the *Tool* recommend that you see your healthcare provider for possible sleep disorder(s)?

- ☐ Yes — Continue to next question
- ☐ No — Skip to Question 13
- ☐ Prefer not to answer — Continue to next question
- ☐ I didn't understand the results — Continue to next question

12. Did you see a healthcare provider for a possible sleep disorder, based on the *Tool's* recommendation?

- ☐ Yes
- ☐ No
- ☐ Prefer not to answer
- ☐ I didn't understand the results

13. Did you find what you were looking for on the *Railroaders' Guide to Healthy Sleep* website?

- ☐ Yes
- ☐ No
- ☐ I was just browsing

Please share any additional details, like what you were looking to find on the website:

14. What steps or actions, if any, did you take after visiting the website?

15. What would make the website more useful to railroaders, like you?

Section C: About You *These questions allow us to group responses for analysis and will not be used to identify any individual.*

16. How many years have you worked in the railroad industry? *(If less than a year, round up to 1.)*

☐☐

17. In which operations do you work?

☐ Freight — Continue to next question

☐ Passenger or Commuter — Skip to Question 19

18. What type of freight work do you currently do? (*Select only one, then skip to Question 20.*)

☐ Extraboard
☐ Hostling
☐ Local/Road switcher
☐ Pool
☐ Yard
☐ Other

If Other, please specify: _____

19. Which type of passenger work do you currently do? (*Select only one.*)

☐ Extraboard
☐ Hostling
☐ Pool
☐ Yard
☐ Other

If Other, please specify: _____

20. What is your current craft, at the time of this survey? (*Select only one.*)

☐ Brakeman
☐ Conductor
☐ Hostler
☐ Locomotive engineer
☐ Trainee
☐ Yard foreman/Switchman*
☐ Other

If Other, please specify: _____

*If you selected "Yard foreman/Switchman" above, are you an RCL operator?

☐ Yes
☐ No

21. What is your sex?

- ☐ Male
- ☐ Female

22. What is the highest level of education you have completed?

- ☐ Junior high school
- ☐ Some high school
- ☐ GED
- ☐ High school graduate
- ☐ Some college
- ☐ Associate degree
- ☐ Bachelor's degree
- ☐ Master's degree
- ☐ Doctoral degree

23. Have you attended a railroad trade school (e.g., MODOC)?

- ☐ Yes
- ☐ No

24. What is your age?

☐☐

25. Are you of Hispanic, Latino, or Spanish origin? *(Please answer both question 25 and 26. For this questionnaire, Hispanic, Latino, and Spanish origins are not races.)*

- ☐ Yes, I am of Hispanic, Latino, or Spanish origin
- ☐ No, I am not of Hispanic, Latino, or Spanish origin

26. What is your race? *(Select one or more.)*

- ☐ American Indian or Alaska Native
- ☐ Asian
- ☐ Black or African American
- ☐ Native Hawaiian or Other Pacific Islander
- ☐ White

Thank you for your time!

Appendix B.
Survey Mailing Materials

This appendix contains the text of the survey mailing materials used in administration, either preceding, following, or accompanying the questionnaire in Appendix A.

This appendix includes the text that the team included in the following:

- **Pre-mailing announcement letter** (preceded survey packet mailings)
- **Cover letter: first mailing** (part of survey packet)
- **Cover letter: second mailing** (part of survey packet)
- **Consent form** (part of survey packet)
- **Reminder postcards** (followed first survey packet mailing)

Note that the mailed versions of both the cover letters and the announcement letter included the signatures of the two labor union presidents and both union logos.

Announcement Letter

Hello Brothers and Sisters:

In about a week, you will receive a questionnaire as part of a survey being conducted by the U.S. Department of Transportation Volpe National Transportation Systems Center (Volpe). As your union leadership, we jointly support this effort because we believe it will help us to better serve you, our members.

The purpose of this survey is to learn more about Information and Communications Technology (ICT), which relates to the technology and tools that railroaders, like you, use to share, gather and communicate information. Our goal is to understand how best to communicate important safety-related information to you and across the railroad industry.

We are collaborating with the Volpe team to reach you for this survey. Participation is voluntary and means only completing the questionnaire. Unique codes for each questionnaire will be assigned randomly to participants to keep responses strictly confidential.

No identifiable information is being requested of you or otherwise collected. No data will identify any individual. If results of this survey are reported, only grouped summary information will be presented.

Please make time to complete the ICT questionnaire when you receive it, in about a week.

Thank you for your time. Your participation is important to this effort!

In solidarity,

Dennis R. Pierce	Jeremy R. Ferguson
National President, BLET	President, SMART-Transportation Division

Cover Letter: First Mailing

Hello Brothers and Sisters:

You are one of more than 2,000 active train, yard, and engine railroaders who are receiving the attached questionnaire as part of a survey being conducted by the U.S. Department of Transportation Volpe National Transportation Systems Center (Volpe).

As your union leadership, we jointly support this effort because we believe it will help us to better serve you, our members. With this survey, we aim to learn more about the following from railroaders, like you:

- Information and Communications Technology (ICT) preferences and uses.
- Awareness and use of the *Railroaders' Guide to Healthy Sleep website*, an ICT resource.
- How best to use ICT to communicate important safety-related information to you and the railroad industry-at-large.

You have been assigned a unique code for your questionnaire responses. Please read and complete the attached Participant Consent Form before you start the questionnaire. It describes how Volpe will protect any information you share. The questionnaire should take approximately 20 minutes to complete. *If you no longer consider yourself an "active" railroader, please disregard this and any future survey mailings.*

Please participate in one of the following ways:

1. **Fill out the attached questionnaire** and mail it, along with your completed Participant Consent Form, in the included **postage-paid** envelope.
2. **OR,** go to ICT Survey 2020 (note: address is case sensitive), and enter your unique code below to **fill out the online questionnaire**.

Your unique code: [ADHERE CODE LABEL HERE]

Please complete the questionnaire by _____ so that your responses will be included.

Thank you for your time, and we greatly appreciate your participation!

In solidarity,

Dennis R. Pierce
National President, BLET

Jeremy R. Ferguson
President, SMART-Transportation Division

Cover Letter: Second Mailing

Hello Brothers and Sisters:

About a month ago, you and more than 2,000 other active train, yard, and engine railroaders received the attached questionnaire as part of a survey being conducted by the U.S. Department of Transportation Volpe National Transportation Systems Center (Volpe). This is a final reminder that the survey will close soon: **all responses must be received by July 30, 2020**. Please find enclosed another copy of the questionnaire, in case you have misplaced your original version.

As your union leadership, we jointly support this effort because we believe it will help us to better serve you, our members. With this survey, we aim to learn more about the following from railroaders, like you:

- Information and Communications Technology (ICT) use and preferences.
- Awareness and use of the *Railroaders' Guide to Healthy Sleep* website, an ICT resource.
- How best to use ICT to communicate important safety-related information to you and the railroad industry-at-large.

You have been assigned a unique code for your questionnaire responses. Please read and complete the attached Participant Consent Form before you start the questionnaire. It describes how Volpe will protect any information you share. The questionnaire should take approximately 20 minutes to complete. *If you no longer consider yourself an "active" railroader, please disregard this survey mailing.*

There are two ways you can participate. **Please choose one**.

1. **Fill out the attached questionnaire and Participant Consent Form**, and mail them back in the included **postage-paid** envelope.
2. **OR**, go to ICT Survey 2020 (note: address is case sensitive), and enter your unique code below to **fill out the online questionnaire**.

Your unique code: [ADHERE CODE LABEL HERE]

Please complete the questionnaire by **July 30, 2020** so that your responses will be included.

Thank you for your time, and we greatly appreciate your participation!

In solidarity,

Dennis R. Pierce
National President, BLET

Jeremy R. Ferguson
President, SMART-Transportation Division

Consent Form

Information and Communications Technology Survey Participant Consent Form

Purpose

In collaboration with your Union, the attached questionnaire is part of a survey being conducted by the U.S. Department of Transportation Volpe National Transportation Systems Center (Volpe).

You are invited to participate and help us learn more about the technology tools that you and other railroaders use to share, gather, and communicate information. The goal of this Information and Communications Technology (ICT) survey, in collaboration with your Union, is to understand how best to communicate important safety-related information to you, and across the railroad industry.

This survey has been approved by your Union's leadership and is sponsored by the Office of Research, Development, and Technology of the Federal Railroad Administration.

Procedures

Participation means only completing the attached questionnaire, which should take approximately 20 minutes to complete, whether online or on paper. You are one of more than 2,000 active train, yard, and engine railroaders who have been asked to participate in this survey. *If you no longer consider yourself an "active" railroader, we ask that you decline to participate.*

Benefits and Potential Risks

There is no direct benefit to you from completing this questionnaire. However, your participation will help your Union and the railroad industry-at-large better understand ICT use and preferences to best communicate with railroaders, like you.

As with all research, there is a minimal possible risk of breach in confidentiality of data collected. We are committed to taking as many precautions as possible to minimize this risk.

Confidentiality

A unique code has been assigned to you. Using codes, rather than names, assists us in keeping responses confidential and de-identified from participants. The code allows each questionnaire to be tracked so only those who have not yet responded will receive reminders. All online and paper responses will be kept confidential and maintained in a secure location.

No identifiable information is being requested of you or otherwise collected. No data will identify any individual. If results of this survey are reported, only grouped summary information will be presented. The list of participants and corresponding codes will be kept in a secure location, separate from responses, and will be destroyed when the survey is completed.

Rights

Your participation in this survey is voluntary. You have the right to decline to participate, skip any items, or discontinue your participation at any point.

Questions

If you have any questions or would like additional information about this survey, please contact Dr. Heidi Howarth, the Volpe project lead, at heidi.howarth@dot.gov or 617-494-2522.

Please indicate below your consent to participate. If you are completing this questionnaire on paper, please return this sheet with the questionnaire.

"I understand the above information. I consent to participate in the ICT survey."

(Fill in the square that applies) ☐Yes ☐ No

Appendix C.
Communications Materials

This appendix contains examples of materials that the team developed for the labor unions to support the communications and outreach strategy.

These materials include:

- **Draft press release shared with labor union partners**
- **FAQ sheet for union officers**
- **Examples of draft social media posts shared with labor union partners**

Note that the team encouraged the labor unions to adjust these messages as needed to suit their membership. The social media posts included in this appendix is a subset of the full list and exemplifies the strategy of providing messaging to encourage study participation throughout the survey administration period.

Draft Press Release Shared with Labor Union Partners

[BLET/SMART-TD] Announces Launch of Information and Communications Technology Survey

Cleveland, OH – [The BLET/SMART-TD], in partnership with [SMART-TD/BLET] and the U.S. Department of Transportation (U.S. DOT) Volpe National Transportation Systems Center (Volpe), is launching a survey in mid-May to learn more about Information and Communications Technology (ICT), which relates to the technology and tools that railroaders use to share, gather and communicate information. The purpose of the survey is to understand how best to communicate important safety-related information to union members and across the railroad industry.

The ICT survey, approved by both BLET and SMART-TD leadership, is being sent to a randomly selected sample of active train, yard, and engine railroaders. Everyone included in this sample is strongly encouraged to respond.

"We support this effort because we believe it will help us to better serve our members. We are collaborating with the Volpe team to reach our members for this survey. Please make time to complete the ICT questionnaire if you receive it," explained [Dennis R. Pierce, BLET National President/Jeremy R. Ferguson, SMART-Transportation Division President].

Participation is voluntary and means only completing the questionnaire, which should take no more than 20 minutes. Unique codes for each questionnaire are assigned randomly to participants to keep responses strictly confidential.

Interested parties can learn more about the ICT Survey by contacting Dr. Heidi Howarth, the Volpe project lead, at heidi.howarth@dot.gov or 617-494-2522. This project is sponsored by the Office of Research, Development, and Technology of the Federal Railroad Administration.

The U.S. DOT established Volpe in 1970 to serve as a federal resource positioned to provide world-renowned, multidisciplinary, multimodal transportation expertise on behalf of U.S. DOT's operating administrations, the Office of the Secretary, and external organizations.

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FAQ Sheet for Union Officers

ANNOUNCING THE ICT SURVEY 2020!

The BLET and the SMART-TD have approved the Information and Communications Technology (ICT) survey being conducted by the U.S. DOT Volpe National Transportation Systems Center (Volpe) that will help determine how best to communicate important safety-related information to union members and across the railroad industry.

The ICT survey is being sent to a randomly selected sample of active train, yard, and engine (TY&E) railroaders as a paper questionnaire with an online option. It asks about ICT preferences (the technology and tools that railroaders use to share, gather and communicate information) and awareness of the *Railroaders' Guide to Healthy Sleep* website, an ICT resource.

Your participation is important to your union!

How do I, or my sisters and brothers participate?
You must be invited to participate. Union members, who are active TY&E railroaders, have been randomly selected for participation from across both unions. Those members will receive a letter announcing their opportunity to participate, and then about a week later, a survey packet will arrive. Railroaders who receive the survey can complete it online OR use the paper questionnaire and mail it back in the postage-paid envelope. Please note your union collaborated on all aspects of these mailings, although envelopes have a Volpe return address.

Do I have to participate?
No, BUT your participation is important for Volpe to receive enough responses to provide helpful information to your union for when they are trying to effectively communicate to you. Participation is voluntary and means only completing the questionnaire, which should take no more than 20 minutes.

If I am randomly selected, what will I receive?
At the end of May, you will first receive a survey announcement letter, followed about a week later by the survey package. If not immediately completed, post-card reminders are planned at 2-week intervals and then another (final) survey package will be sent until the survey is either completed or closed in July.

I've been selected, can I participate online?
Yes! Once you receive the survey package, find your unique code and follow the instructions to access the online questionnaire, which should take no more than 20 minutes.

I want to participate, but will I be protected?
Unique codes for each questionnaire are assigned randomly to participants to keep individual responses de-identified and strictly confidential. Only grouped summary information will be reported.

How can I learn more about this survey?
For information about your union's role in this study, please contact Vince Verna (BLET, Director of Regulatory Affairs) at verna@ble-t.org or 202-624-8776; Jared Cassity (SMART-TD, Alternate National Legislative Director) at jared.cassity@smartunion.org or 202-543-7714. For information about the study, please contact Dr. Heidi Howarth (Volpe) at heidi.howarth@dot.gov or 617-494-2522.

Examples of Draft Social Media Posts Shared With Labor Union Partners

Draft Facebook Posts:
The BLET [SMART-TD], in partnership with SMART-TD [BLET] and the U.S. DOT Volpe Center, is launching a survey to learn more about Information and Communications Technology, or ICT, the technology and tools that railroaders use to share, gather and communicate information. The purpose of the survey is to understand how best to communicate important safety-related information to union members and across the railroad industry. The ICT survey, approved by both BLET and SMART-TD leadership, is being sent to a randomly selected sample of active train, yard, and engine railroaders. Participation is voluntary and means only completing the questionnaire, which should take no more than 20 minutes. Unique codes for each questionnaire are assigned randomly to participants to keep responses strictly confidential. Everyone who receives the survey is strongly encouraged to respond, either online or by mail using the enclosed, postage-paid envelope.

If you were randomly chosen to participate, you will soon receive a survey package in the mail from the U.S. DOT Volpe Center (Volpe). The BLET [SMART-TD] and SMART-TD [BLET] are partnering with Volpe to learn more about Information and Communications Technology, or ICT, the technology and tools that railroaders use to share, gather and communicate information. The purpose of the survey is to understand how best to communicate important safety-related information to union members and across the railroad industry. Participation is voluntary and means only completing the questionnaire you receive, which should take no more than 20 minutes. Unique codes for each questionnaire were assigned randomly to participants to keep responses strictly confidential. Please return it either using the enclosed, postage-paid envelope, or respond online!

If you received a survey packet in the mail from the U.S. DOT Volpe Center (Volpe), but have yet to complete the questionnaire, you have until July [date is TBD] to respond! The BLET [SMART-TD] and SMART-TD [BLET] are partnering with Volpe to learn more about Information and Communications Technology, or ICT, the technology and tools that railroaders use to share, gather and communicate information. The purpose of the survey is to understand how best to communicate important safety-related information to union members and across the railroad industry. Participation is voluntary and means only completing the questionnaire you received, which should take no more than 20 minutes. Unique codes for each questionnaire were assigned randomly to participants to keep responses strictly confidential. Please return it using the enclosed, postage-paid envelope, or respond online! Thank you for your participation!

Draft Tweets:
Soon, you may be invited to participate in a survey conducted by @VolpeUSDOT. #BLET [#SMART-TD] & #SMART-TD [#BLET] jointly support this effort to learn more about Information & Communications Technology (ICT) use among #railroaders. #ICT-Survey-2020

Check your mail for the #ICT-Survey-2020 from @VolpeUSDOT! You can help #BLET [#SMART-TD] & #SMART-TD [#BLET] understand how best to communicate important safety-related information to union members and across the #railroad industry.

Did you receive a survey from @VolpeUSDOT? #BLET [#SMART-TD] & #SMART-TD [#BLET] jointly support this effort to understand how best to communicate important safety-related information to union members and across the #railroad industry. Please complete it today!

Hurry! If you received the #ICT-Survey-2020 from @VolpeUSDOT, you have until July 30 to respond! Your input will help #BLET [#SMART-TD] & #SMART-TD [#BLET] understand how to best communicate important safety-related information to railroaders like you.

Abbreviations and Acronyms

Abbreviations	Explanation
M	Average
BLET	Brotherhood of Locomotive Engineers and Trainmen
CPS	Current Population Survey
FRA	Federal Railroad Administration
FAQs	Frequently Asked Questions
ICTS	Information and Communication Technology Survey
ICT	Information and Communications Technology
SMART-TD	International Association of Sheet Metal, Air, Rail and Transportation Workers-Transportation Division
LoC	Letter of Commitment
M	Mean
N	Number of Survey Respondents
n	Number of Survey Subsample Respondents
N	Population Size
n	Sample Size Needed
PRA	Paperwork Reduction Act
PII	Personally Identifiable Information
PSR	Precision Scheduled Railroading
OMB	Office of Management and Budget
RD&T	Office of Research, Development and Technology
RGHS	*Railroaders' Guide to Healthy Sleep* website
RSS	Really Simple Syndication
RCL	Remote Controlled Locomotive
SD	Standard Deviation
T&E	Train and Engine
TY&E	Train, Yard, and Engine
URL	Uniform Resource Locator
DOT	U.S. Department of Transportation
USPS	U.S. Postal Service
Volpe	Volpe National Transportation Systems Center