

SUPPORTING JUSTIFICATION – Part A
Head-Up Display Study; OMB No. 2130-NEW
Form Number FRA F 6180.170 (a); FRA F 5180.170 (b)

Summary of Submission

- This information collection request is a new submission. The proposed experiment is intended to study railroad engineers to gain insight into the extent and nature of distraction among these workers by the in-cab radio, and whether a Head-Up Display & digital communications could help in mitigating this distraction.
- The estimated total number of burden hours requested for this submission is **200 hours**.
- The estimated total number of participants whose abilities will be tested is **40**.

* The required 60-day Notice was published in the Federal Register on November 2, 2016. See 81 FR 76411. FRA received three comments in response to this Notice.

1. Circumstances that make collection of the information necessary.

The Federal Railroad Administration's (FRA) Office of Research and Development has the opportunity to investigate innovative technologies that may be helpful in the railway context, and explore potential aids to problems on the railroad. One such emerging problem is radio distraction. In this context, radio distraction is distraction caused by communicating, manipulating, or listening to the dispatch radio while operating the locomotive. Anecdotal evidence from multiple train engineers indicates that the radio is the most distracting technology in the cab. In addition, others in the industry indicate that radio distraction is known to be, or suspected to be, an important contributing factor in miscommunication, distraction, and increased workload.

FRA is proposing an exploratory study which will focus on railroad engineer performance. Preliminary research suggests that the dispatch radio communications may have significant effects on crew workload and performance, the communications themselves becoming a source of distraction. There are generally two categories of dispatcher-engineer communications. Some require immediate action and are provided in the usual manner (over the radio). These are referred to as urgent messages. However, others do not require immediate action and could be digitally transmitted at some later point in time, either as text or speech, and retrieved whenever the engineer's workload had decreased. It is these non-urgent messages upon which we want to focus.

Specifically, we will combine the digital transmission of radio communications and head-up display (HUD) technologies to help the engineer maintain attention on the forward track during high workload situations where normally a non-urgent radio communication could prove problematic. This digital transmission of radio communications as text is referred to as data link in aviation. There, data link has been used successfully for communications between pilots and air traffic control (ATC). This technology can solve some of the problems of radio communication, such as poor transmission quality and interruption of ongoing work (leading to distraction), etc., (Masquelier, 2004) by digitally transmitting the messages, storing them as text, and then making it possible for pilots to retrieve them at whatever point in time is most safe. The messages could also be provided aurally via synthetic speech.

One of the benefits of providing non-urgent messages by text rather than voice radio is that the messages were found to be better remembered by pilots, possibly because the visual modality (text) is less transient than the auditory modality and therefore less likely to take a toll on working memory (Lee, Kurlik, & Dainoff, 2013) (Morrow & Rodvold, 1998). In addition, pilots were more accurate when reading back ATC messages that were sent as text (Helleberg & Wickens, 2003). Related to synthetic speech, previous studies have shown that the addition of synthetic speech may have several benefits such as less head-down time, lower workload, and improved memory of clearances (Lennertz, 2012).

We will apply aviation's method of digital transmission to rail when the message is not an urgent one. There will be two data-link-like systems combined with the HUD. One is similar to aviation where the information conventionally provided over voice radio is now turned into text, to be displayed on an in-cab screen which the engineer can retrieve at any point in time after the message is sent, allowing the engineer to postpone reading of the message during high workload conditions. The engineer is alerted on the HUD that a non-urgent message has arrived.

A second will be a novel, using of text-to-speech technology, where the information conventionally provided over the voice radio is now turned into digitized speech for the engineer to hear. Again, the engineer can retrieve the dispatcher's message at any point in time after the message is sent. And again, the engineer is alerted of the arrival of a non-urgent message on the HUD.

In summary, FRA seeks to develop an understanding of how the dispatch radio communications could potentially lead to human-performance degradation in the railroad engineer, and if a Head-Up Display (HUD) combined with digital transmission of radio communications would be an alternative and superior technology to communicating non-urgent information usually conveyed over the dispatch radio.

In order to take effective and efficient action to minimize the risk of radio distraction in the railroad industry, FRA requires information to test the hypothesis that the radio impacts distraction and workload and time spent looking at the forward railway, and whether there is a technology that can be implemented to reduce that distraction. At present, this information is unknown. With this submission, FRA is requesting permission to acquire the needed knowledge.

2. **How, by whom, and for what purpose the information is to be used.**

This is a new collection of information, and is entirely voluntary.

Primary users will be staff within FRA's Research and Development office who will have access to summarized data in an effort to inform a research agenda in support of minimizing the amount of radio distraction and the risks associated with such use. We can also use this formative research to show that there is an alternative technology to communicate information otherwise given over the radio.

The purpose of this data collection effort is to learn about radio distraction, how it affects human performance, and how can we leverage innovative technologies to reduce those distractions. FRA will be collecting quantitative information to evaluate engineers' abilities.

The purpose of this research study is not to make recommendations or regulations. It is to explore the feasibility of and the human performance effects of new cab technologies.

3. **Extent of automated information collection.**

All of the information collected for the simulator experiment is done automatically, either as output of the train's behavior (e.g., velocity) or engineer's behavior (e.g., eye glance location), and involves only recipients who have volunteered to participate.

4. **Efforts to identify duplication.**

To FRA's knowledge, this is the first data collection effort of its kind looking at radio distraction along with incorporating a Head-Up display and digital transmission of radio communications to reduce that distraction.

FRA is aware of the existing research on distraction in other transportation modes, but thorough literature reviews have revealed no data focusing on the railroad industry or cab radio distraction. The existing data on radio distraction in the railroad industry is limited

to information related to specific railroad accidents involving radio distraction and does not involve the use of Head-Up displays. Thus, similar data is not available from any other source.

5. **Efforts to minimize the burden on small businesses.**

Respondents will be individual railroad engineers who voluntarily participate in the study. Individuals invited to participate in the simulator study will be identified through the relevant railroad labor unions. Some individuals who participate in the study may be employed by small businesses but this data collection will not directly impact small businesses. Therefore, the burden to small businesses should be negligible.

6. **Impact of less frequent collection of information.**

If the proposed information collection activities are not conducted, FRA will lose a unique opportunity to study and explore the human performance implications of radio communications on essential segment of railroad employees, namely railroad engineers, who play a critical part in the day-to-day safe operation of trains. Without this proposed collection of information, FRA will be unable to investigate alternative technologies that may reduce this radio distraction.

7. **Special circumstances.**

The simulator study contains no special circumstances. Simulator study participation is entirely voluntary.

All requirements are in compliance with this section.

8. **Compliance with 5 CFR 1320.8.**

As noted in the Summary on page 1 and as required by the Paperwork Reduction Act of 1995, FRA published a notice in the Federal Register on November 2, 2016, soliciting comment on the proposed data collection. *See* 81 FR 76411. FRA received three (3) comments in response to this notice.

Comments were received from The Brotherhood of Locomotive Engineers and Trainmen (BLET), The SMART Transportation Division, and The Association of American Railroads. FRA has contacted all organizations to address any comments and concerns, and will be working with the above organizations to help facilitate the research study. All organizations were open to participation in the design and/or execution of the study.

BLET's Summary of Recommendations/Concerns:

- BLET is supportive of FRA's efforts to study distraction, and suggests getting feedback from locomotive engineers as a method to gauge the degree of distraction that exists within the locomotive cab.
- The FRA study limited to the craft of a locomotive engineer.
- FRA study is not addressing other sources of distraction, such as Trip Optimizer or Leader. BLET encourages FRA to follow up with a study that captures TO or LEADER like experiences in conjunction with the other potential distractors.

FRA responses:

- FRA will continuously seek feedback from multiple locomotive engineers throughout the course of the study, including but not limited to: the design of the study, execution of the study, and the analysis of the results.
- FRA will consider conducting a follow-on study related to cab distraction and its impact on crew-interaction.
- FRA acknowledges that this study will not address any potentially distracting effects from the above-mentioned technologies. FRA has conducted prior studies with Trip Optimizer and can look into other sources of distraction. Christian Holt in the Office of Railroad Safety is available for contact regarding efforts relating to TO/Leader systems.

SMART's Summary of Recommendations/Concerns:

- The HUD will be another electronic device that takes crew members' eyes off the tracks.
- Alternative ways of dealing with in-cab distractions are crew size rules, limiting access by others to radio channels that trains use, limiting use of defect detectors, investigating distractive effects of Leader and Trip Optimizer, and increasing oversight of PTC.

FRA responses:

- The Head-Up Display (HUD) is a mechanism to keep the engineer's eyes on the track. The information is overlaid onto the windshield, negating the need for the engineer to look down for the information he/she needs. Instead, the engineer will be able to keep his or her eyes on the forward track.
- FRA R&D will look to initiate future studies into other in-cab distractions. In the meantime, SMART's concerns were forwarded to Christian Holt in the Office of Railroad Safety, and he has been working with the railroads to review their Locomotive Engineer Certification programs to insure the programs acknowledge training on new technology to include TO/LEADER-type systems, if utilized. These programs must address how the railroad responds to changes such as the introduction of new technology, new operating rule books, or significant changes in operations including alteration of the territory over which engineers are authorized to operate. FRA has and will do further onboard observation inspections regarding TO/LEADER interaction.

AAR's Summary of Recommendations/Concerns:

- AAR recommends that their member railroads be including as active participants in the design and execution of the study.

FRA Response:

- FRA communicated with AAR after receiving their written response to the 60-day Federal Register Notice. FRA welcomes the participation of the member railroads and believes their expertise can contribute to the validity of the study results.

9. Payments or gifts to respondents.

As is consistent with normal experimental practice, we will provide monetary payment for participation in the research program in order to compensate participants for their time. A \$400 compensation will be provided to respondents associated with this proposed collection of information. This is in compensation for their time and travel costs for participating in the study and as wage compensation for wages lost as a result of taking the time to participate in the study.

10. Assurance of confidentiality.

FRA fully complies with all laws pertaining to confidentiality, including the Privacy Act of 1974. Thus, information obtained or acquired by FRA in this proposed study will be used exclusively for statistical purposes or, in this case, to compile data to describe the human performance effects of the radio. Additionally, no individual responses will be released and data will only be reported as group means or aggregate summaries. Participants will be advised before commencing that information is confidential.

11. Justification for any questions of a sensitive nature.

Respondents will not be asked questions about attitudes, religious beliefs, or other matters that would be considered private or of a sensitive nature and unrelated to this project. Participation in this proposed study by railroad engineers is completely voluntary. Thus, only those consenting to participate in the study will do so.

12. Estimate of burden hours for information collected.

Form No.	Respondent universe	Total annual responses	Average time per response (hours)	Total annual burden hours
Form FRA F 6180.168 —Simulator Study	40 Engineers	40	5	200

13. Estimate of total annual costs to respondents.

There will be no additional cost burden to respondents beyond any customary and usual expenses associated with private practices. There will be no need for respondents to keep any records associated with this data collection effort.

14. Estimate of Cost to Federal Government.

Resources	Total
Volpe Technical Scientist	\$75,000
Volpe Simulator Manager	\$30,000
MIT Engineer	\$45,000
Compensation to Participants	\$16,000
Travel	\$2,000
Total	
\$168,000	

15. Explanation of program changes and adjustments.

These are new information collection requirements for a one-time study. The total burden that FRA is requesting approval for is 200 hours and 40 responses. By definition, this entire submission is a program change.

There are no additional costs to respondents outside of the estimated burden provided in the answer to question number 12 above.

16. Publication of results of data collection.

As noted above, this is a proposed new collection of information. FRA is requesting a total burden of 200 hours and 40 responses. By definition, the entire collection of information is a program change.

The results of this study will be presented in a FRA technical report. A summary of the results may also be presented at technical meetings such as the annual meeting of the Transportation Research Board. FRA will be publishing the study independent of whatever results are obtained. The planned project schedule, shown below, assumes that the FRA will receive OMB approval for the study by February 2018 and that the pilot

study will be completed by that time.

Activity	Date
Preparation	August 2016-August 2017
Simulator Study	Feb 2018-Jun 2018
Data Analysis	Mar 2018 – Jul 2018
Preliminary Result Briefing	Aug 2018
Final Briefing	Dec 2018
Draft Final Report	June 2018-Nov 2018
Publication of Final Report	December 2018

17. Approval for not displaying the expiration date for OMB approval.

Once OMB approval is received, the FRA will publish the approval number for these information collection requirements in the Federal Register.

18. Exception to certification statement.

No exceptions are taken at this time.