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Strategic Plan for the Cab Technology Integration Laboratory

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Development
and Technology
Washington, DC 20590

July 2019

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13. ABSTRACT (Maximum 200 words)

This strategic plan establishes a path to realizing the Cab Technology Integration Laboratory (CTIL) program's vision of advancing railroad safety by using human-in-the loop simulation and modeling research to improve locomotive crew performance. Well-positioned in Cambridge, MA, at the Volpe National Transportation Systems Center, the CTIL can be used by stakeholders across the rail domain to explore human performance.

This plan is a living document that provides the framework for program managers to think strategically about the goals that help them achieve that aim. It contains actionable objectives which were derived from rail stakeholder input.

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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)

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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)

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METRIC TO ENGLISH

LENGTH (APPROXIMATE)

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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)

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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)

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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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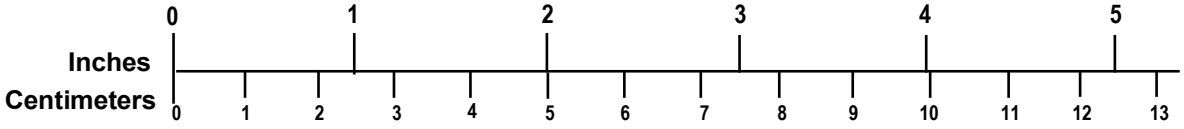

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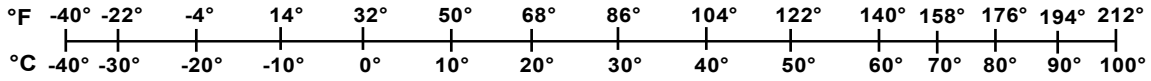

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Contents

Tables

Executive Summary

The strategic plan for the Cab Technology Integration Laboratory (CTIL) establishes a path to realizing the program's vision of advancing railroad safety by using human in-the-loop simulation and modeling research to improve locomotive crew performance. This developing document provides a framework for program managers to think strategically and outlines actions that fulfill strategic goals.

The CTIL is a locomotive cab simulator dedicated to researching safety issues associated with crew operating behavior, locomotive operating procedures, and the ergonomics of the crew interface with locomotive controls, displays and automation. The laboratory was built in 2010 after a 3-year planning and acquisition process, which involved consulting similar programs in other modes, conferring with human factors experts, and exploring needs with rail domain stakeholders.

Collaborative research efforts with industry and academia are ongoing today, with the CTIL playing a crucial part in human factors research in multiple projects that can inform new locomotive operating protocols for railroads and new versions of cab user interfaces, particularly where automation is concerned. The Federal Railroad Administration's (FRA) Office of Research, Development and Technology (RD&T) recognizes that these shared experiences between rail stakeholders are critical to success and wish to continue these collaborative relationships.

The desire for continued collaboration, along with a list of recommendations for success from the Transportation Research Board (TRB) in 2015, became the impetus for this strategic plan. The plan's goals and objectives follow two key themes: (1) industry communication and collaboration, and (2) enhanced program capability and research support. The themes emerged through engaging stakeholders in focus groups, individual interviews, and research-prioritizing activities.

The CTIL strategic plan is consistent with the U.S. Secretary of Transportation Elaine L. Chao's goals to improve safety and lead in transportation innovation and technology (particularly in automation), and it supports those goals in a manner that does not contribute to the rail industry's regulatory burden.

1. Introduction

This document describes the vision, mission, goals and attainable objectives supporting the Federal Railroad Administration's (FRA) Office of Research, Development and Technology's (RD&T) automation and human factors research program utilizing the Cab Technology Integration Laboratory (CTIL). The CTIL strategic plan is consistent with U.S. Secretary of Transportation Elaine L. Chao's goals to improve safety, lead in transportation innovation and technology, particularly where the implementation of automation is concerned, and it supports those goals in a manner that does not contribute to the rail industry's regulatory burden.

1.1 Document Purpose and Use

The CTIL strategic plan establishes a path to realizing the program's vision and mission. It is a living document that guides research efforts and outlines actions to fulfill strategic goals. It can be adjusted easily to reflect the evolving needs of its stakeholders. Also, further stakeholder engagement may reveal information requiring shifts in strategy.

Each year, the objectives in this document will be prioritized and as much will be addressed as possible based on the availability of funds. Given that long-term planning requires periodic self-assessment, this plan will be periodically updated with new objectives. Staff will then develop an updated plan which again will include stakeholder input.

1.2 Program Need

Locomotive cabs have evolved considerably from early models that were controlled only with basic handles, levers and analog gauges. While many of those features remain, today's locomotives also include a variety of electronic and mechanical systems that allow trains to perform complex operations and operate more safely and efficiently than their decades-old counterparts.

While locomotive human-machine interfaces have changed with the advent of locomotive systems, the cab environment still exemplifies a lack in human-centered approach design and evaluation. For instance, the process of adding software user interfaces (UI) continues to be problematic; these new displays increase attentional demand, threaten to take up finite cab space, and have ergonomic and functional impacts depending on their placement. A human-centered approach demonstrated by studies performed in the CTIL, would improve human performance in these areas by aligning designs with user capabilities and limitations.

Research from this facility aims to advance the design of the human-machine interface, improve human performance, and help to reduce risk of human error (Federal Railroad Administration, 2011).

1.3 Program History

The CTIL program's inception in 2005 addressed an FRA-identified need for a safe environment for analyzing human performance, and was aligned with a United States Department of Transportation (DOT)-wide strategic plan to address human error across all transportation domains. The program set two initial objectives: (1) being able to make safety assessments related to human performance on cab controls and displays, and (2) to demonstrate

experimentally-derived workstation configurations that exercised the human-centered approach to design (Federal Railroad Administration, 2011).

From 2007 to 2008, FRA planned for the successful development of the CTIL by consulting other government programs addressing similar needs in other domains, conferring with human factors experts to determine candidate measurement tools, and gathering input from rail industry stakeholders. Learning lessons from the successes and failures of similar programs enabled FRA to start its laboratory with an aim toward success.

The CTIL's construction was completed in late 2009 and was delivered to Volpe in March 2010. FRA has updated the hardware and software on multiple occasions between 2010 and 2019. Table 1 describes the upgrades and the improvements that each upgrade afforded the CTIL.

Table 1. Functional upgrades made to the CTIL

Year	Upgrade	Improvement
2013	Changed core simulation software to CORYS Matrix	Reduce scenario production time; align software platform with Class I railroads; increase software stability; improve graphics
2015	Added simulated General Electric (GE) Trip Optimizer (TO)	Position the CTIL to conduct human performance studies using fuel conservation automation tools
2016	Added new eye-tracking equipment	Improve data collection for long simulation runs through greater mobility and lighter weight optics
2016	Added simulated Electronic Train Management System (ETMS)	Position the CTIL to conduct human performance studies using ETMS (a type of positive train control system frequently used in freight operations)
2017	Added Vizard virtual reality software	Enable researchers to utilize virtual reality displays in experiments
2019	Added modified ACS64 console	Improve ability to simulate passenger operations by utilizing a passenger-style console. (This passenger console can be switched out with the CTIL's freight console, as needed.)
2019	Added simulated Advanced Civil Speed Enforcement System (ACSES) II	Position the CTIL to conduct human performance studies using ACSES II (a type of positive train control primarily used in passenger operations)

Year	Upgrade	Improvement
2019	Added NE Corridor track from Wilmington, DE, to Penn Station in New York, NY	Provides additional track options for use in passenger and freight experiments

Since 2010, the CTIL program has demonstrated the laboratory's unique value through coordinating, supporting and conducting research across multiple projects. A sample of these include projects follow:

- **Examining the role of distraction and attentional errors:** Veolia Transdev, together with George Mason University and Volpe, conducted a two-phase study aimed at understanding and then reducing engineer distraction. Researchers used knowledge of key distraction issues gained in the CTIL during the first phase to design a training program intended to reduce engineer distraction. This training module was tested in the CTIL during the second phase (Parasuraman, 2012). Veolia implemented its attention training program in 2013, directly leading to the National Transportation Safety Board (NTSB) closing a Safety Recommendation (National Transportation Safety Board, 2009).
- **Human factors evaluation of an experimental engineer crewstation:** FRA commissioned QinetiQ North America Technology Solutions Group to design and construct an experimental prototype crewstation and to demonstrate an alternative crewstation concept and design approach. Volpe conducted a human factors evaluation of the experimental crewstation to find areas where it may provide or deny a human factors' benefit when compared to the Association of American Railroads (AAR) 105 control stand. This evaluation included standards comparisons, usability testing in CTIL with locomotive engineers, and assessment using CTIL's anthropometric modeling tools.
- **Modeling human-automation function allocation effectiveness in rail:** GE teamed with Massachusetts Institute of Technology (MIT) to build a hierarchical task model of the TO software, and used it to inform a potential future iteration of it. GE collaborated with several Class I freight railroads to bring in TO-experienced engineers to validate the model and test the next-generation TO concept using the CTIL. This research provides a methodology to design and evaluate new roles for humans and automation systems.
- **Development and evaluation of a moving map display for rail applications:** Researchers at MIT developed a real-time moving map display to support engineer situation awareness. The design was informed by a cognitive task analysis, and was tested using rail engineers in the CTIL.

1.4 Program Management Structure

Table 2 describes the people and groups responsible for the CTIL.

Table 2. CTIL roles and responsibilities

Role	Responsibility	Represented By
FRA RD&T Division Chief	Oversees all programs in division	Starr Kidda
FRA RD&T Program Manager	Manages project activities; oversees strategic decisions; finalizes research agenda	Michael Jones
Visiting Researchers	Conduct research	Volpe, railroads, vendors, academia
Technical & Research Support	Maintains the CTIL; facilitates operation (e.g., scenario design, data collection)	Volpe
Program Support	Assists FRA with program management; particularly on-site	Volpe

Approval to use the laboratory is not dependent upon being funded through FRA; stakeholders can use outside sources of research funding, including their own, and there are no fees associated with CTIL use.

1.5 Key Factors

Historically, researchers performing work in the CTIL have collaborated with each other to help their projects succeed. Veolia Transdev created a video describing their work in attention and demonstrated their study onsite to local and national Brotherhood of Locomotive Engineers and Trainmen (BLET) representatives, showing their work's value, gathering input and facilitating recruitment; UMass Amherst collaborated with MIT to use their moving map to examine attentional impacts of Positive Train Control (PTC) on engineers; Class I freight railroads took an interest in GE's research and provided qualified engineers from across the country to participate; Volpe conducted outreach and established partnerships resulting in new research by leading CTIL demonstrations for government and outside stakeholders alike.

FRA RD&T considers these collaborative endeavors critical to program success. The CTIL program seeks to approach collaboration and outreach strategically through creation and execution of the strategic plan.

In 2015, the Transportation Research Board (TRB) reviewed the entire RD&T program at the request of FRA, including the CTIL, and found some similar potential avenues to success at the program level. Their recommendations for the CTIL included creation of a strategic plan to guide the program toward its vision, fostering external collaboration to focus research, and

refining communications strategies to make the program and its intent better known to potential users (Transportation Research Board, 2015).

1.6 Key Program Stakeholders

A key to program improvement is engagement with stakeholders. Their support is important to accurately inform the direction of changes in the locomotive controls, displays, procedures and operations. Table 3 shows the CTIL program stakeholders and their roles from a high-level perspective.

Table 3. The CTIL program's stakeholders and roles

Stakeholder	Role in the CTIL Program
FRA	Fund the CTIL and its upkeep; solicit stakeholder feedback; fund and oversee the CTIL's research; promotion and outreach
CORYS Thunder, Inc.	Created the CTIL's simulation and modeling software
Volpe	Provide program and researcher support
Railroad industry e.g., carriers, manufacturers, AAR, ASLRRA	Provide input about needs; act as participant recruitment partners
Labor unions	Provide input about needs; act as participant recruitment partners
Researchers e.g., Volpe, QinetiQ, universities	Conduct research using the CTIL (both government-funded and independently-funded)
Vendors (e.g., GE, NYAB, Wabtec, Alstom, Veolia)	Participate as research partners and in implementing results; provide input about needs

The strategic plan includes strategies for exposing stakeholders to the CTIL and its value as a tool for improving safety, learning stakeholder human factors needs, and to guide the laboratory's research agenda.

1.7 Strategic Planning Process Description

The primary input to the strategic plan was a set of themes generated by representatives from key CTIL stakeholder groups ("Representative Stakeholders"). An independent third party collected this information in two phases:

- They used direct communication (focus groups and individual interviews in person and by phone) to collect data on key CTIL success factors and barriers. Analysis of the Representative Stakeholder input produced themes including communications, collaboration, policy support, and program improvement for the CTIL. The FRA RD&T and Volpe used the themes and comments to identify strategic goals and develop attainable objectives for the plan.
- They queried the Representative Stakeholders to rank the relative importance of various potential research topics.

The results of these activities are reflected in the goals and objectives of the strategic plan. The FRA RD&T has also used the research topic rankings to inform the CTIL research agenda.

2. Vision and Mission

The CTIL's vision and mission guide the laboratory's goals and objectives.

2.1 Vision

Advance railroad safety by using human-in-the loop simulation and modeling research to improve locomotive crew performance.

2.2 Mission

- Bring together government, industry, and academia to conduct human performance research using human-in-the-loop simulation.
- Perform research in a simulated rail cab environment that examines the safety risks of new technologies and the boundaries of operator capability and performance.
- Address human performance problems that are connected to the current and future needs of railroad human operators in the interest of public safety.

3. Strategic Components, Goals, and Objectives

Two strategic components surround fulfillment of the CTIL's mission and vision: (1) industry communication and collaboration and (2) enhanced program capability and support.

This section provides goals and supporting objectives, derived primarily from stakeholder input, and organized by strategic component. Each objective contains an *Attainment* attribute that describes a specific tangible action that would demonstrate achievement of the objective.

3.1 Industry Communication and Collaboration

The value of using simulation to study human factors in rail is only just becoming known to some stakeholders. The CTIL's managers will work to increase the lab's utilization and raise its impact on safety by employing a variety of engagement methods to reach its stakeholders and by educating stakeholders in the value of simulation research. Likewise, the CTIL managers want to learn more from industry about their needs and how the laboratory can address them. In doing so, program managers can align the laboratory's research agenda to support areas most important to the industry.

3.1.1 Goal 1: Create a CTIL Research Agenda that Reflects Stakeholder Needs

Ultimately, there are finite resources for any laboratory to conduct research. To maximize the effectiveness of these resources, the CTIL's program management will create a research agenda that is informed by an understanding of the industry's users, organizations (and relationships within and across them), technologies, and operating environment. Research planning will include stakeholders to ensure its applicability and completeness. This information can also be used to inform RD&T's 5-year strategic plan.

3.1.1.1 Objective 1.1: Establish CTIL Stakeholder Research Advisory Meetings

Stakeholder research advisory meetings bring stakeholders together with FRA researchers to define and frame cab human factors safety problems that need research. These meetings will be important in helping the CTIL to fulfill its mission by:

- Identifying research areas and safety problems that are both important to the industry and addressable using the laboratory's facilities.
- Identifying areas where the CTIL could be upgraded and its research processes could be improved.
- Providing a communication pathway for stakeholders to learn about the CTIL program's decision-making process. For example, the CTIL program management can share decisions about its research agenda at advisory meetings so that stakeholders understand the reasoning behind it and provide reactions and guidance.
- Providing a forum for gaining insight on which areas are ones of overlapping interest (e.g., two railroads with a similar need might be willing to jointly provide subjects for a study that addresses it) and which ones are controversial (e.g., a railroad wants to conduct a study but unions find the direction to be concerning).

Attainment

- Implement CTIL stakeholder advisory meetings (intended annually)
- Use high-importance research topics from the stakeholder advisory group to inform the CTIL's research agenda

3.1.2 Goal 2: Expand and Enhance the CTIL's Marketing and Communications

The Representative Stakeholders indicated that some of their colleagues do not know that the CTIL exists; this indicates that past marketing efforts (such as hosting videos on RD&T's website), while useful, have not reached the entirety of the program's intended stakeholder audience. The program must find and follow the right avenues for promoting the CTIL. This is not an easy task; succeeding in this goal will require educating stakeholders in areas including the process of partnering with government entities to perform research, the availability of funding, and the support system for designing studies and running the simulator.

The CTIL program can increase lab utilization and impact by educating stakeholders about using simulation to address human factors issues. It will do this by initiating discussions about its research and by timely dissemination of its findings.

3.1.2.1 Objective 2.1: Develop a Communications Plan

For the CTIL to have a wide reach in each stakeholder community, RD&T needs to find the right means to increase awareness of the lab and its utility. The specific means of communication will be planned, implemented, and regularly examined to determine effectiveness and make adjustments accordingly. Outreach methods may include other objectives detailed later in this document, such as presentations at conferences and webinars.

Attainment

- Assess communication needs to help identify the most effective means to communicate with each stakeholder group.
- Formalize a marketing and communications plan that can be periodically examined and adjusted.

3.1.2.2 Objective 2.2: Build a Website to Promote Awareness of the CTIL

A website provides a clear pathway to communicate with potential stakeholders, show off research, and demonstrate capabilities. Additionally, it provides many opportunities to understand stakeholder interest, such as the number of unique site visits, the ways visitors arrived there, and tracking downloaded materials.

Attainment

- Make a website that is public-facing and reachable both by using the FRA site navigation tools and through public search engines.
- Examine site and page visits as an initial benchmark for understanding whether the site is being used, and which elements generate interest.

3.1.2.3 Objective 2.3: Disseminate the CTIL's Research Through Webinars

Webinars are live presentations that are conducted over the Internet. This format is also particularly useful because it can be interactive; FRA can get live feedback about its CTIL research that can be used to drive further work.

CTIL webinars may describe upcoming, ongoing, or recently completed research, allowing potential partners to learn about the CTIL's utility in specific areas from stakeholders who are already using the laboratory. In doing, FRA can increase the impact of work performed in the CTIL by providing rapid updates to targeted audiences. Additionally, RD&T may run promotional webinars aimed at a wider audience, in which presenters discuss a variety of the CTIL's research.

Webinar impact may also be bolstered by providing slides and/or recorded webinars for replay through the CTIL website and creating a distribution list of people interested in attending webinars (and working to expand it).

Attainment

- Conduct webinars with current and potential research partners.
- Make webinar slides available through the CTIL website.

3.1.2.4 Objective 2.4: Encourage Presenting and Publication of CTIL Work

Presenting research findings at conferences, industry meetings, and other professional forums helps expand the list of potential CTIL research partners, and encourages the exchange of ideas between stakeholders. Additionally, extending outreach to a wide variety of professional forums can encourage out-of-the-box thinking by reaching experts that are not normally associated with rail human factors research.

Given that design and technology can move quickly, it is important to release the CTIL's research in a timely manner and to reach as many people as possible. FRA already requires researchers to submit Technical Reports that FRA publishes; however, more can be done towards these ends. The CTIL program can encourage researchers to publish findings in a variety of fashions, such as in journals and trade publications.

Attainment

- Encourage research partners to present their work at a professional forum and/or publish findings beyond a government report.
- Track when research is presented at conferences or published that is related to the work performed in the CTIL.

3.2 Enhanced Program Capability and Support

Volpe will continue to identify and provide support that makes work easier for stakeholders who may be new to human factors research, and/or have limited railroad domain expertise. The CTIL's technology also needs to change with evolving research needs so that it continues to be a useful research tool.

3.2.1 Goal 3: Further Improve the Quality of the CTIL's Facilities and Operations

Continued implementation of emerging train cab technologies can maintain and improve the breadth of research that can be done in the CTIL. The program must also stay attuned to the quality of its processes, such as ones for onboarding potential researchers, developing research plans, building simulator scenarios, maintaining equipment, and experiment-day logistics. This process of monitoring and adjustment will be driven by information from stakeholders.

3.2.1.1 Objective 3.1: Gather Feedback from Outgoing Researchers on How to Improve the CTIL

The CTIL program will get accurate direction for improving the laboratory by asking its research partners about the laboratory's performance and capabilities. A Volpe staff member unaffiliated with the CTIL program will meet with one or more representatives from each project after its conclusion to discuss the labs strengths and where it can be further improved.

Attainment

- Develop and implement a procedure for holding exit meetings with outgoing researchers as they finish projects in the CTIL.
- The Volpe support team will review input provided during these meetings together with FRA on a yearly basis.

3.2.1.2 Objective 3.2: Periodically Review the CTIL's Research Capabilities

It is critical that the technical capabilities of the CTIL facilitate relevant research and minimize the possibility of any bugs or other technical issues that might interfere with work. The CTIL program will also review industry technological needs to determine the benefits of system upgrades, and perform regular maintenance of the laboratory.

Attainment

- Maintain a list of potential CTIL upgrades, based on input from stakeholders.
- Maintain a list of outstanding issues with hardware and software, if any, which were not able to be adjusted during projects, and determine whether further action is needed by FRA to facilitate their resolution.
- Use the list of upgrades and outstanding issues to prioritize upgrading the CTIL.

3.2.1.3 Objective 3.3: Implement a Database of Potential Participants to Facilitate Participant Recruitment

Stakeholders' decisions whether to conduct research in the CTIL revolves in part around their ability to find engineers and conductors qualified to participate. It can be a challenge to recruit engineers, particularly where very specific engineer characteristics or experience is needed for a given study. Therefore, the CTIL program must find pathways to facilitate subject recruitment. We have identified two ways to do this.

The first way is that we will ask participants in current CTIL studies if they would be interested in learning about participation opportunities for future studies. This method has the advantage of being inexpensive to implement so it will be doable even with budget constraints.

A second and more ambitious approach would be to develop a database of potential volunteers, ideally with some with flexibility to visit the CTIL. Inclusion in the database will be completely voluntary, and may include managers and retired engineers who are differently encumbered than active full-time engineers. The database may include information about potential subjects that researchers can use to filter results. Examples of participant information include experience with automation systems (such as energy management and PTC), type of service (freight, passenger), current position (engineer, conductor, manager, retiree, etc.) and distance from the CTIL facility (in travel time by car).

Attainment

- Develop a list of previous CTIL participants interested in learning more about upcoming research with the possibility of volunteering again.
- Develop a database of retired engineers willing to be contacted about possible research participation (to be updated as resources allow).

4. Overview of Planned Actions

Table 4 provides an overview of all the attainment items that will be done en route to accomplishing the goals and objectives laid out in this plan and who will do each action. As previously mentioned, FRA's funding availability will impact the pace of activity for Volpe tasks and any tasked to contractors. Therefore, FRA will prioritize the attainment items based on funding levels and any other relevant program considerations and address them in that order.

Table 4. Summary of planned actions and actors

Objective Number	Attainment Item	Planned Actor
1.1	Implement stakeholder advisory meetings	Volpe; FRA contractors
1.1	Use high-importance research topics from the stakeholder advisory group to inform the CTIL's research agenda.	FRA
2.1	Assess communication needs to help identify the most effective means to communicate with each stakeholder group.	TBD
2.1	Formalize a marketing and communications plan that can be periodically examined and adjusted.	TBD
2.2	Make a website that is public-facing and reachable both by using the FRA site navigation tools and through public search engines.	Volpe
2.2	Examine site and page visits as an initial benchmark for understanding whether the site is being used, and which elements generate interest.	Volpe and FRA
2.3	Conduct webinars with current and potential research partners.	FRA
2.3	Make webinar slides available through the CTIL website.	FRA
2.4	Encourage research partners to present their work at a professional forum and/or publish findings beyond a government report.	FRA
2.4	Track when research is presented at conferences or published that is related to the work performed in the CTIL.	FRA
3.1	Develop and implement a procedure for holding exit meetings with outgoing researchers as they finish projects in the CTIL.	Volpe
3.1	The Volpe support team will review input provided during these meetings together with FRA on a yearly basis.	Volpe/FRA
3.2	Maintain a list of potential CTIL upgrades, based on input from stakeholders.	Volpe
3.2	Maintain a list of outstanding issues with hardware and software, if any, which were not able to be adjusted during projects, and	Volpe

Objective Number	Attainment Item	Planned Actor
	determine whether further action is needed by FRA to facilitate their resolution.	
3.2	Use the list of upgrades and outstanding issues to prioritize upgrading the CTIL.	FRA
3.3	Develop a list of previous CTIL participants interested in learning more about upcoming research with the possibility of volunteering again.	TBD
3.3	Develop a database of retired engineers willing to be contacted about possible research participation (to be updated as resources allow).	TBD

5. Summary

The CTIL managers will follow stakeholder input and improve the program by focusing on goals in two key areas: (1) further improving communications and collaboration with industry, and (2) enhancing our program's capability and the support provided. By continuing to explore improvement in these areas, the CTIL managers can focus strategic planning to meet evolving stakeholder needs.

The CTIL managers will use the combination of fulfilling this strategic plan's goals and continued strategic reflection and adjustment to stay focused on the laboratory's vision: advancing railroad safety by using human-in-the loop simulation and modeling research to address locomotive crew performance. In doing so, the CTIL program will continue to support the DOT goals of improving safety and leading in transportation innovation and technology.

6. References

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Abbreviations and Acronyms

Abbreviations/ Acronyms	Term
ACSES	Advanced Civil Speed Enforcement System
ASLRRA	American Short Line and Regional Railroad Association
AAR	Association of American Railroads
BLET	Brotherhood of Locomotive Engineers and Trainmen
CTIL	Cab Technology Integration Laboratory
ETMS	Electronic Train Management System
FRA	Federal Railroad Administration
GE	General Electric
MBCR	Massachusetts Bay Commuter Railroad
MIT	Massachusetts Institute of Technology
NTSB	National Transportation Safety Board
NYAB	New York Air Brake
PTC	Positive Train Control
RD&T	Research, Development and Technology
TRB	Transportation Research Board
TO	Trip Optimizer
UMA	University of Massachusetts Amherst
DOT	United States Department of Transportation
UI	User Interface
Volpe	Volpe National Transportation Systems Center