VISION

To be the provider of choice for advancing railway safety and technology

MISSION

To provide our customers highly effective and efficient railway research, consulting, testing, system engineering, inspections, training, and technical support for standards in a safe manner, ensuring the highest level of integrity while providing our employees a challenging and sustainable work environment.
The Federal Railroad Administration (FRA) is committed to partnering with Transportation Technology Center, Inc. to maintain and improve the facilities at the Transportation Technology Center (TTC) in Pueblo, Colorado, and to enhance the use of those facilities for transportation research, development, security, training, and test activities. FRA encourages broad use of TTC facilities by other government agencies and the private sector.
The vision of Transportation Technology Center, Inc. (TTCI) is to advance the safety and technology of the rail industry. From research to training our nation’s first responders, our focus in 2014 was to make the vision a reality.

In research performed on behalf of the North American rail industry, we were able to proudly celebrate completing 4-billion ton miles at our Facility for Accelerated Service Testing (FAST) in 2014. In service since 1976, FAST has allowed us to understand the expected performance of everything from new types of rail to 100-year-old bridge spans. We look forward to achieving our next billion ton miles.

In addition to industry-sponsored work, TTCI serves individual clients within the rail industry. With 48 miles of active track, enabling us to achieve speeds of up to 165 mph, 2014 proved to be a big year for testing new and innovative power at Pueblo. From General Electric’s Tier 4 locomotives to BNSF’s dual-fuel locomotive technology, TTCI was happy to provide a revenue-service type environment for the testing of these units.

Not all of TTCI’s clients hail from North America. TTCI is a global organization, serving the needs of customers around the world. We sold Trackside Acoustic Detector Systems (TADS) on three continents and used our consulting expertise in China and South America.

No doubt TTCI is a unique facility, and we look forward each year for the opportunity to show off our test facilities and capabilities. TTCI hosted many tours in 2014 ranging in scope from elected officials to our Class I railroads. Among the dignitaries we welcomed to tour our site were U.S. Senator Michael Bennet, former FRA Administrator Joe Szabo, NTSB Member Robert Sumwalt, NS President Jim Squires and members of his staff, as well as CN Chief Operating Officer Jim Vena and members of his staff.

But, of all of our accomplishments in 2014, I think the work we performed to train our nation’s first responders is the one I am proud of most. In February 2014, TTCI was tasked with the challenge of training 1,500 first responders by the end of the year in hazardous materials response techniques for crude oil incidents. In just four months, the team changed the flat expanse of cactus and buffalo grass on the north end of the site into a 19-car crude oil derailment. We began training in July 2014, and I am very pleased to report that we succeeded in this challenge and trained 1,504 first responders in 2014.

Finally, I want to take this opportunity to personally acknowledge the noteworthy career of one of TTCI’s leaders, Mr. Robert Florom, who elected to retire in 2014. As Vice President of Engineering and Quality Services, Bob mentored most of the current engineering organization. So on behalf of TTCI, I wish him the best in his retirement and want to say: Bob, you made a difference.
Major freight railroads fund SERTC to provide CBR training to first responders

TTCI’s Security Emergency Response Training Center (SERTC) provided crude by rail (CBR) incident response training in 2014 to more than 1,500 first responders, representing the nation’s major freight railroads.

The training provides skills needed by today’s first responders to safely mitigate incidents involving the transport of crude oil by rail.

SERTC developed the training program, which was funded by the railroads, and created the curriculum that includes classroom instruction, boil-over demonstrations, and participation in multiple hands-on, crude oil live-fire scenarios at its 19-car train derailment located on the training campus.

The 24-hour CBR course provides first responders with critical decision-making information and advanced firefighting techniques that prepares them for any incident involving crude oil.

British Columbia Fire Chief Ken McClure said it best: “The crude by rail emergency response course was the best course I have ever attended in my 30 years of being a firefighter. As a Chief Officer of a progressive fire rescue service, I found the strategies and tactics put forth by the instructors of TTTI to be the most beneficial. The demonstration of water introduced to a very small amount of crude oil on fire was spectacular to say the least.”

A 4-hour module, covering many aspects of CBR, was also added to all of SERTC’s existing rail-related courses, including Tank Car Specialist and Hazardous Materials Technician.

For outreach, SERTC developed a 4-hour CBR web-based training program that serves as an awareness level program, giving participants basic understanding of issues when responding to crude oil incidents shipped by rail.

The railroads will continue their commitment to the training of first responders in 2015 by continuing to support additional training initiatives.
Total tonnage accumulated at the Facility for Accelerated Service Testing (FAST) since the Heavy Axle Load Test Program began in 1976 exceeded 4-billion gross tons in 2014. Three billion of those tons were accumulated with 315,000-pound gross rail load (GRL) cars after car weights were increased from 263,000 pounds GRL in 1988. Of note, FAST tonnage of 174 million gross tons set a record, exceeding the previous yearly high of 165 MGT.

Several new tests were also started. TTCI’s track crew installed latest generation premium rails from six suppliers in January at FAST for evaluation. Performance metrics include wear, service failures, and rolling contact fatigue (RCF). Differences in wear rates and RCF development are beginning to develop.

Ten electric-flash railhead repair welds were installed in March. This is the second generation of this type of weld and was intended to address weld batter and stress concentration issues identified during testing of first generation welds. One of the welds failed after 85 MGT, and several others developed defects at tonnages between 85 and 150 MGT. Investigation into the premature causes of the weld failures is underway.

Testing of a 65-foot riveted steel span built in 1954, with a Cooper rating of E-46, started in January. The test train at FAST applies E-57 loading for the length of the span. Testing at FAST provides information on the fatigue lives of bridges that experience loading that exceeds their design capacity. Deflections measured under the test train have been close to calculated deflections, and there have been no component failures or problems.

TTCI continues to test and evaluate new and improved track components and maintenance procedures under an accelerated service environment at FAST. The facility is also used to evaluate new technologies such as machine vision inspection of vehicles, field evaluation of improved wheel steels, and next generation prototype truck suspension systems.
GE tests new locomotives series

GE Transportation took full advantage of the facilities at Transportation Technology Center in 2014 to perform validation testing of its new Evolution Series Tier 4 locomotives.

To comply with the Tier 4 emissions standard set forth by the U.S. EPA and at the same time meet customer requirements for performance and economy, GE has invested over $400 million in developing its Evolution Locomotive platform. Before field trials with customers, GE needed to perform validation testing, and TTCI proved to be the perfect facility for these demanding tests.

Early in 2014, GE tested two Evolution Series Tier 4 locomotives for several weeks prior to sending them to railroad customers for formal field evaluation. The test locomotives ran for over 10,000 miles in operations simulating heavy haul and intermodal service. GE identified issues typically found at the prototype stage, resolved them, and green-lighted the units for field testing with customers on the general system.

"TTCI support personnel worked seamlessly with the GE engineers to achieve the test goals, with safety as the foremost priority. TTCI provided exemplary service, enabling GE to meet its commitment to deliver the advanced new Evolution Series Tier 4, scheduled for full production in 2015," said GE Program Manager Mike Anderson.
TTCI and Nippon Sharyo worked together in 2014 to run a new design of diesel multiple units (DMU) through a battery of extensive static and on-track testing at Nippon Sharyo’s manufacturing facility and at Transportation Technology Center.

These trains will be used by Metrolinx for their new “UP Express” service connecting downtown Toronto with Pearson International Airport quickly and reliably, with amenities and services designed with the traveler in mind.

The DMUs will also provide clean, efficient movement of commuters as Sonoma-Marin Area Rail Transit (SMART) restores service to an area devoid of trains for nearly 50 years.

Nippon Sharyo and TTCI personnel worked collaboratively to assess safety features and ride quality. These state-of-the-art Tier IV compliant diesel units were tested up to 105 mph, a speed that exceeds normal operating practices, and with a full range of loading weights to verify their suitability for revenue service.

Nippon Sharyo was selected by Toronto’s Metrolinx and by SMART to create a new generation of rail vehicles that will provide improved reliability, efficiency, and mobility for travelers in southern Ontario and northern California.
An economic analysis was performed in 2014 by an outside contractor to estimate annual savings associated with the implementation of improved friction control management systems (FCMS) in North America from 1994 to 2014.

The analysis showed that using these systems reduced fuel consumption and rail replacement. Use of top-of-rail friction control (TORFC) is estimated to reduce fuel consumption by approximately 4 percent. Implementation of TORFC together with improved gage face lubrication is estimated to increase rail life by 25 percent. Reducing rail replacement also reduces train delays caused by replacement work.

The annual benefit of improved FCMS is estimated at $82 million, or $1.2 billion in total since 1994. Of this total, the portion attributable to AAR research is $216 million. Based on these values, the benefit cost ratio of this research is calculated to be 8.5, and the return on investment is 57 percent.

According to the post-audit analysis, the AAR’s Strategic Research Initiatives Program has helped accelerate adoption of improved FCMS by at least 3 years, and, in some cases, much longer.

Implementation of TORFC has also contributed to increased wheel life and reduced accidents. However, these benefits were not included in the analysis.

The high impact wheels (HIW) attribute to approximately $400 million of annual wheel replacement costs in North America. As a result, TTCI developed a conceptual design for an improved freight car truck (IFCT) in 2014, with improved wheel life and improved loaded car hunting as the major drivers for the design.

TTCI has directly associated HIWs with high steering forces in sharper curves and has proposed a design using softer adapter pads that allow the wheelsets to align more radially in the curve and reduce these forces.

The empty and loaded car hunting stability threshold is maintained through the use of frame braces or spring planks.

Further work in 2015 includes quantifying the wheel damage threshold using the new rolling contact fatigue simulator, evaluating the durability of IFCT components, particularly that of the adapter pads, and proposing a performance-based specification to AAR.
2014 Tours and Visitors

Norfolk Southern President James Squires and his executive team

Canadian National Jim Vena – Chief Operating-Officer and Executive Vice President

National Transportation Safety Board Members

Mike Rush AAR Environment Lawyers

Joseph C. Szabo Federal Railroad Administrator

U.S. Senator Michael Bennet
With the help of two host railroads, TTCI has monitored a number of experiments at two mega sites in 2014, including maintenance and remediation methods implemented to address track components subjected to rolling contact fatigue of rails and transition performance at bridge approaches.

Implementation of improved and new designs at the mega sites included half-frame concrete ties, next generation insulated joints, elastic rail fastening systems on open deck bridge, and advanced frog systems, all of which demonstrated improved performance over their conventional counterparts in reduced track degradation and better dynamic responses measured under heavy axle load (HAL) train operations.

The Association of American Railroads and Federal Railroad Administration have jointly funded the HAL revenue service testing program since 2005. One of the main objectives of the program has been to determine the effects of HAL traffic on track infrastructure by supplementing test activities performed at the Facility for Accelerated Service Testing with a wider range of track, operation, and climatic conditions.

**Locomotive wheel climb at switch-point protectors**

TTCI’s investigation in 2014 into the incidences of locomotive wheel climb at switch-point protectors showed that the contact geometry that is created between a locomotive wheel with a large chamfer on the field corner of the rim and the worn plane on the entry flare of a switch point protector can serve as a ramp to aid wheel climb.

Large chamfers on locomotive wheels are often the result of wheel rim width that exceeds the design width of the reprofiling cutter head or poor lateral alignment between the wheel and the cutter head.

The brake test rack is made up of all the piping and pneumatic components found on 150 common railroad cars.

Initial studies have shown some common characteristics will develop depending on the size of the leak and its relative location in the train. Further testing will work toward refining understanding of these characteristics in order to provide the industry with information that can reduce dwell times.

TTCI has also been working with industry members to develop tests that can be used at intermediate terminals to quickly and effectively address cars identified by wheel temperature detectors. By targeting specific components during the inspection, workers are able to identify components that can quickly be repaired to keep the train moving on time.

Under AAR’s strategic initiative for air brakes, TTCI investigated cold-weather effects on brake systems and studied how the data from wheel temperature detectors can improve reliability of cars in service.

Observations in revenue service in 2014 showed researchers how decreasing temperatures can change the behavior of a qualified collection of cars. With that knowledge, researchers can use TTC’s 150-car brake test rack to induce leaks of known sizes in various locations throughout a consist and evaluate their effects.

Brake research

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TTCI efforts in development of fiber-optic distributed acoustic sensing technology with a focus on broken rail, flat wheel, and train location detection continued strongly in 2014.

TTCI worked with the Federal Railroad Administration, CSX Transportation, Inc, and Fotech Solutions, Ltd., a supplier of fiber optic sensing, to advance the capabilities of this technology for railroad use. This technology continues to exhibit revolutionary potential for the detection of many different events of interest by a single system that can also support communications.

Efforts in 2014 have focused on developing and refining detection and alarming algorithms for flat wheel and broken rail detection.

TTCI also studied the feasibility of using fiber-optic distributed acoustic sensing technology for train location, track discrimination, and roll-out detection. Testing in 2015 will focus on continuing to refine algorithms, detecting additional types of defects, testing the development of the railroad-hardened hardware system, and assessing feasibility for use in critical railroad applications.
C&TC introduces supporting technologies for PTC

TTCI’s Communications and Train Control Business Unit continues to focus on solving critical issues associated with Positive Train Control (PTC) deployment and introducing supporting technologies.

Project highlights in 2014 included testing of mitigation techniques for radio interference issues between dissimilar PTC systems operating concurrently in the Northeast Corridor, continuing designs for PTC radio networks in major urban areas and enhancement of the PTC Test Bed at TTC.

Following the success with freight operations, TTCI escalated efforts on PTC braking enforcement algorithm research for passenger and commuter operations.

New technologies that will provide enhanced functionality for PTC, including positive train location, fiber optic sensing, and employee-in-charge portable remote terminal, were advanced in 2014, with increased support from railroads and suppliers.

BNSF Railway utilized a variety of tracks and support facilities at TTC in 2014 to conduct development and durability test programs on the latest dual-fuel LNG locomotive technology systems offered by EMD and GE.

Both programs used legacy LNG tenders as the fuel supply for twin high horsepower locomotive. Each program used initial development time with the test programs culminating in multi-week operations as part of the test train at FAST.

The two systems operated for over 10,000 miles in FAST operations. These efforts allowed technology development to continue until FRA provided authorization for revenue service testing and operations.

SERTC receives $5-million from NDPC to train first responders

TTCI’s Security and Emergency Response Training Center (SERTC) received a $5-million cooperative agreement in 2014 with the Department of Homeland Security/Federal Emergency Management Agency, National Training and Education Division and partnership with the National Domestic Preparedness Consortium (NDPC).

The agreement is being used to train over 1,700 first responders in concert with NDPC’s mission “to enhance the preparedness of federal, state, local, and tribal emergency responders/first receivers and teams, including non-governmental organizations and the private sector, to reduce the Nation’s vulnerability to incidents involving weapons of mass destruction, terrorism, and all high hazard-consequence events by developing, delivering, and assessing plans, training, technical assistance, and exercises.”

First responders are receiving knowledge in the classroom from the most experienced instructors in the field and transferring that knowledge by performing real-life situation scenarios on real life equipment, which includes three mock derailment scenes established on the SERTC campus.


Other classes added in 2014 to SERTC’S NDPC offerings were Crude by Rail, as well as Surface Transportation Emergency Planning and Security for Senior Officials, Passenger and Mass Transit, and Freight.
In 2014, TTCI identified and documented all of the requirements for qualification and acceptance testing of passenger rail vehicles before their deployment into U.S. service for the Federal Transit Administration. This work was completed to provide the industry with a compiled list of tests.

Multiple sources were used to identify the tests that could be performed: recommended practices of the American Public Transportation Administration, testing requirements of the Federal Railroad Administration, Request for Proposals, and international specifications, such as International Standards Organization and European Standards.

The compiled list is published on TTCI’s website at http://fta.aar.com/.

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Full-scale impact tests improve puncture resistance of tank cars

In work sponsored by the Federal Railroad Administration in 2014, TTCI is conducting full-scale impact tests to improve the impact behavior and puncture resistance of railroad tank cars.

Results of the tests and following analyses provide the technical basis for rule-making on enhanced and alternative performance standards for tank cars and review of new and innovative designs that are developed by the industry and other countries.

Ultimately, the results of this research will be used by the Government regulatory agencies in the United States and Canada to establish performance-based testing requirements and to develop methods to evaluate the crashworthiness and structural integrity of different tank car designs.

New track anomaly test section constructed at TTC

In cooperation with FRA constructed a concrete slab track test section in the Railroad Test Track in 2014, which allows for installation of both vertical and lateral irregularities in the normal track alignment.

The accuracy and precision of the measurement systems tested across the test section can be compared to the installed anomalies. The test section is designed for allowance of testing of track geometry systems at speeds up to 125 mph with a top speed of 165 mph, when the track is set for completely normal operation. The length of the test section is 500 feet with the ability to double that length in the future. The ability to adjust track geometry in this manner is unique to TTC.

While originally intended for high-speed track geometry system calibration, the test section is useful for testing any track geometry system. In addition to the intended use, vehicle testing can also be performed using known perturbations installed in the test track. The full capabilities of this test section are waiting to be explored.
In 2014, TTCI successfully implemented Trackside Acoustic Detection System (TADS®) technology in China’s high speed rail system. For over 10 years, TTCI has been working with Harbin VEIC Technology in China to apply TTCI-developed TADS technology in China’s huge and expanding rail system. Over 85 of these systems have been installed and soon that number will near 100 or more. TTCI’s President Lisa Stabler spoke about how the North American rail industry has improved safety, reliability, and efficiency through integration of wayside detection into day-to-day operations, resulting in reductions in both derailments and service interruptions. Exchanges at these trade shows benefit not only TTCI in understanding the needs of customers but the industry at large by providing a platform where new technology and products can be shared.

TTCI’s global reach

In 2014, TTCI’s global reach leads to participation in industry trade shows throughout the year. In 2014, TTCI participated in InnoTrans, an international platform for buyers and sellers of passenger and freight transport technology. Held in Berlin every two years, it is one of the most highly attended trade shows in the world by the railway community.

During the same time, TTCI’s marketing team participated in a seminar on condition monitoring technologies sponsored by voestalpine Signaling, where several speakers from Europe and TTCI discussed the benefits of using condition and performance monitoring systems.

TTCI provided technical consulting services to other customers in China as well in 2014, providing professional support in technical areas of vehicle characterization and testing, special trackwork, and inspection technologies.

Rail advances in China

The initial focus was on freight train operations and now is extended to passenger trains, including the high speed electric multiple units. Continued implementation of TADS technology in China’s vast high speed rail network is expected in 2015.

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One part of TTCI’s commitment to the rail industry in 2014 was to offer a class to help first responders unable to travel to Pueblo to attend crude by rail (CBR) training. Fortunately, due to the crude by rail safety initiative by the North American Class I railroads, TTCI was able to utilize the CBR training facility and course work at the Security and Emergency Response Training Center as the basis for a web-based training course. Approximately 2,800 people signed up and took the course in 2014. Three more web-based training courses will be offered in 2015 and will be designed for customer convenience and flexibility.
New era of TTCI software development

TTCI began a new era of advancements in railroad dynamics modeling software in 2014. And to support this effort, TTCI formally established a software development department. The new department is focused on deploying advancements in both technical capabilities and user interactions with TTCI’s software products.

TTCI and our customers are already realizing the benefits of the department in the form of enhancements initiated to NUCARS®, TOES™, STARCO™, MultiVu, and several other products key to TTCI’s core business functions.

Looking toward the future, TTCI will use a combination of modern development practices and high caliber developers to advance industry software tools.

TTCI’s Hazardous Materials Compliance and Training division is comprised of two branches that work in concert: The Security and Emergency Training Center (SERTC) provides comprehensive classroom and hands-on hazardous materials training to the railroad industry and first responder community, both nationally and internationally. The Bureau of Explosives (BOE) provides valuable products and services that promote compliance with federal hazardous materials regulations and industry safety standards.

SERTC has increased participant numbers during 2014 by 60 percent over 2013. This increase is due in part by SERTC’s latest course, Crude by Rail (CBR) Emergency Response, which was attended by more than 1,500 first responders from the major freight railroads.

Firefighting courses in hazardous materials and flammable liquids were attended by over 2,700 first responders from the seven Class I railroads.

BOE field inspectors continued plant inspections, technical inspections, and quality-assurance audits of tank car facilities. This included formerly registered facilities that chose to become certified facilities in 2014 as part of the six-year implementation plan established by the AAR.

BOE continued supporting AAR with database updates and hosting the 27th Annual AAR/BOE Hazardous Materials Seminar, which was attended by approximately 340 inspectors and industry personnel.

This year’s seminar featured a keynote presentation by Greg Fox of BNSF as well many well attended educational sessions and exhibits of the latest products and services were offered by leaders in the hazardous materials and emergency response industry.
TTCI introduced a web-based database and software interface tool in 2014 that allows users of the Trackside Acoustic Detection System (TADS®) to review their data, aid in the maintenance of their vehicle fleet, listen to the acoustic emissions of a given roller bearing, and monitor the output and health of their TADS equipment.

The Customer Bearing Analysis System (CBAS™) is currently in use in the United Kingdom and Australia and is expected to expand to other markets in 2015.

Customers continue to provide feedback to improve the database.

The existing AAR Certification Program serves the North American rail industry well and facilitates the purchase and maintenance of equipment that can be manufactured by suppliers throughout the world for use in interchange traffic within North America. Until this year, no program existed for products intended for use outside of North America.

AAR and TTCI are offering selected portions of the existing M-1003 certification (compliance) process to railroad product and service providers when their intent is to supply the product outside of the North American market. The new publication, AAR Compliance Standard 5000, is available at www.aar.org.

The AAR M-1003 Quality Program was initiated in 1985 with one component (roller bearing) and two auditors. Due to its great success, the program has now grown to cover 123 components. Nearly 50 auditors are utilized. Currently over 700 suppliers participate worldwide. This program covers quality assurance requirements and is over and above the technical standards (requirements) for the covered components. The new AAR Compliance Program now offers the same rigid standards for the remainder of the globe.
In 2014, TTCI’s Eco-Friendly Resource Team continued pursuing sustainability for TTC by examining power consumption on site and investigating ways to reduce the demand on nonrenewable resources.

The third annual UPCYCLE competition was held during TTCI’s annual health fair, reminding employees to not only recycle but to reuse. This year’s winner of the competition took home a Kindle Fire.

With about a half-million of employee work hours, the Safety Resource Team announced a lost time frequency rate of 0.39 in 2014. Sixty-two corrective actions were completed around the site totaling 344 points surpassing TTC’s goal of 325. Completed corrective actions included the installation of equipment guarding around pumps and motors located in the Component Test Laboratory to eliminate the risk created by the rotating shafts. A second corrective action eliminated the hazard of an employee reaching up and coming in contact with the fan blades by installing guards on the hydraulic pump enclosures located in the Rail Dynamics Laboratory.

This year’s health fair offered employees professional medical advice, nutritional information, flu shots, and other professional advice on maintaining a healthy lifestyle.

TTCI’s Risk Management Team addressed two key areas in 2014: IT security and fixed asset inventory integrity.

Security consultants performed a vulnerability assessment of our electronic communications processes, both internal and external. TTCI now has the capability to conduct self-administered audits on its network.

TTCI’s accounting team led a major site-wide effort and improved procedures for TTCI’s management of its physical assets. Consultation with local law enforcement presented a number of initiatives to improve site security, and Human Resources managed a significant effort to assess and improve compliance with federal and state employment practices and regulations.

Transfer of knowledge to TTCI’s newer workforce has been a continuous effort by the Quality Resource Team (QRT) in 2014.

Sessions from basic computer skills to highly specific data analysis and modeling have been presented by TTCI veteran experts.

Customer satisfaction, process improvement, and the development of an easily accessible training database have been a focus of QRT and will continue in 2015.

Camaraderie events, such as the annual Picnic on the Green, and off-site activities, such as bowling and classes in pottery making, continue to bring team members together throughout the year.

TTCI also conducted staff training and refresher courses in 2014 on diversity training, workplace harassment, and antitrust and Foreign Corrupt Practices Act compliance.