Semih KALAY

Semih Kalay is Senior Vice President, Technology, Transportation Technology Center, Inc. (TTCI), a wholly owned subsidiary of the Association of American Railroads. (AAR). He has 36 years of experience in railway research and research management. He has managed and participated in a broad spectrum of research studies concerning railway vehicle and track performance and maintenance.

Mr. Kalay’s current responsibilities include overall management of the North American Strategic Research program. Mr. Kalay currently is the North American member of the World Congress in Railway Research (WCRR) Organizing Committee. He also serves on the IHHA Board, representing USA.

Mr. Kalay has authored more than 200 professional articles, technical reports, presented several hundred speeches at professional forums nation-wide and internationally. He lives in Colorado Springs with his wife Grace.
AAR Strategic Research Highlights
Presentation Outline

♦ TTCI and North American Railways
♦ Strategic Research Overview
## The US Freight Railroad Industry 2012

<table>
<thead>
<tr>
<th>Type of Railroad</th>
<th>Number</th>
<th>Miles Operated</th>
<th>Employees</th>
<th>Freight Revenue ($ Billions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I</td>
<td>7</td>
<td>95,391</td>
<td>163,464</td>
<td>$69.9</td>
</tr>
<tr>
<td>Non Class*</td>
<td>561</td>
<td>43,188</td>
<td>17,317</td>
<td>$4</td>
</tr>
<tr>
<td>Total</td>
<td>568</td>
<td>138,579</td>
<td>180,781</td>
<td>$73.9</td>
</tr>
</tbody>
</table>
Thank you!
AAR Governance

Board of Directors

- Safety & Operations Management Committee
- Policy & Advocacy Management Committee

Standards, Operations, Safety & Security Committees
- Policy & Communications Committees

AAR staff support the work of the committees through direct committee support, communications and lobbying
Railinc is the IT subsidiary of the AAR

AAR
Washington, DC

TTCI
Pueblo, CO
Research & Development

Railinc
Cary, NC
Information Technology
TTC and TTCI: Two Different Things

TTC: The Facility

TTCI: The Company

A Small Business Enterprise

- Wholly owned subsidiary of the Association of American Railroads
- Headquartered at TTC
- Operated by an on-site management team
- Guided by an independent Board of Directors

U.S. Department of Transportation
Federal Railroad Administration
Basic Facts about TTC and TTCI

Transportation Technology Center

♦ 52 Square miles
♦ Land is owned by the State of Colorado and leased to the FRA
♦ 48 miles of track
♦ Laboratory equipment capable of testing full size rail cars
♦ Training center with life size props

Transportation Technology Center, Incorporated

♦ 270 Employees
♦ 100 Researchers
♦ 22 Test / Laboratory Engineers
♦ 52 Standards Engineers / Inspectors / Trainers
♦ 65 Operations Personnel
♦ 31 Administrative Staff

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Strategic Research Program addresses current and future strategic issues relating to the North American Rail Industry.

The Research Objectives are:

- **Improve Safety**
  - Reduce track and equipment-related derailments through technology development

- **Improve Reliability**
  - Reduce or eliminate line-of-road failures

- **Improve Efficiency**
  - Productivity and cost reductions
2013 AAR Strategic Research Program

- **Wheel/rail interface management**
  - Wheel/rail interface maintenance
  - Root causes of rolling contact fatigue
- **Improved car performance**
  - Integrated Freight Car Truck
  - Dynamic load environment
- **Vehicle/track performance**
  - Effects of superelevation on VTI
- **Heavy axle load implementation**
  - FAST/HAL Operations
  - HAL revenue service monitoring
  - Track structure for HAL coal lines
  - Very Heavy Axle Loads
- **Improved braking systems**
  - Improved brake system performance
- **Train condition monitoring**
  - Technology driven train inspection
  - Automated cracked wheel detection
- **Track integrity monitoring**
  - Phased Array rail flaw inspection
  - Rail Stress management
  - Automated Track Inspection
- **Improved car components and materials**
  - Strategies to prevent wheel failure
  - High performance car coupling systems
  - Optimize HBD scanning
- **Special trackwork**
  - Improved special trackwork designs and materials
  - HAL effects on rail joints
- **Bridge research**
  - Bridge life extension
  - Advanced bridge designs and materials
- **Improved track components**
  - Improved rail welding
  - Improved rail performance
- **Improved performance track**
  - Improved tie/fastener system performance
- **New technology implementation**
  - Equipment health monitoring technology
  - Equipment and track technology implementation

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Rail Flaw Inspection

♦ Problem:
  ● Under high-tonnage HAL lines
  ● Increased defects on older rails
  ● More frequent inspections needed
  ● Potentially greater effects of undetected
  ● Defects masked by surface defects/RCF

♦ Technology Solutions
  ● Improvements to existing UT technologies
  ● Laser-based inspection and phased array UT systems
Phased Array Rail Flaw Detection

- Electronic scanning (rastering) possible without moving probe, beam steering and beam focusing possible
- Increased control of beam characteristics
- Simultaneous inspection with multitude of angles using one probe
- Can better inspect complex geometries or areas with limited access

Linear

- Focusing and beam steering in the primary probe axis

2D Matrix

- Focusing and beam steering in all directions

Piezoelectric Elements
Probe Layout — One LPA and Three MPA

Railhead (top view)  Probes in Roller Search Unit

54 el LPA

25 el x 5 el MPA

25 el x 5 el MPA

25 el x 5 el MPA
Phased Array Rail Flaw Detection

Linear Probe Coverage

Matrix Probe Coverage
Custom Roller Search Unit — a familiar configuration
Cracked Wheel Detection System Implementation

♦ Inspection Coverage
  ● Complete revolution of rim
    ▲ Tread exposed using flange bearing track
    ▲ Head sensors are pushed in and up to contact wheel
    ▲ Head moves with wheel for about 15 feet
Vehicle Health Monitoring Systems:
Next Generation Cracked Wheel Detection Systems

♦ Wheel-related Derailments Still a Major Concern
♦ Current Cracked Wheel Detection Systems are Very Complex & Maintenance Intensive: Prevented Many Derailments
♦ More Cost-effective, Less Complex Systems Needed
♦ TTCI Research Underway to Accelerate Development & Implementation of New Systems
Technology Driven Train Inspection
Fully Automated Train Scanning System

Fully Automated Train Scanning System:

♦ Imagining capabilities demonstrated by ASAIS and AISC prompted complete car imaging

♦ Ongoing applications include:
  ● Car underbody
    ▲ Truck component details
    ▲ Coupler securement/draft pocket inspection
    ▲ Brake rigging details
  ● Top and side views
    ▲ Shifted / imbalanced loads
    ▲ Unsecured lading
    ▲ Top chord condition
  ● Security applications
    ▲ Tank car inspection
    ▲ Foreign object detection

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Technology Driven Train Inspection
FATSS
Revenue Service Results at Gallup, NM

- 7 coupler pin securement defects November–December, 2013
Wayside Detector Management System

Carrier Wayside System

Raw Data

Equipment Identification

AEI

Carriers

Out of Stress State Condition

Car Owners

Stress State Condition

InteRRIS®

Via Industry Systems

Industry Systems
Wayside Detector Distribution

02/02/2014

Based on USGS DLG 1:2,500,000, Geographic Projection, DD.
2014 (c), Transportation Technology Center, Inc.
FAST/Heavy Axle Load Implementation:
- Test and evaluate new and untried components before they are implemented in revenue service
- Mitigate adverse effects of HAL

HAL Operations
- 16,000-tonne train with 110 cars
- Newer and more fuel efficient locomotives (3 SD70 locos)
- Operations under computer control
- Accumulated 140 MGT in 2013
Thermite Weld HAZ Treatment, Alloy-Head Thermite Welds

Improved Track Strength

Optimized Stiffness/Steering Turnout

Ties (wood, plastic, concrete) and Fasteners

Concrete Bridges

Premium Rails

Intermediate Rails

Improved Track Strength

Alloy-Head Thermite Welds, EF Railhead Repair Welds

Steel Bridge

Concrete Bridges

HTL 2.7 Miles

State-of-the-Art Turnout, w/Movable-Point Frog

Major Experiments at FAST

Flange Bearing Turnout Frog

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On Behalf of TTCI and AAR
Thank You!