



OFFICE OF RESEARCH & DEVELOPMENT

2012 R&D
REVIEW

Research and Development Strategic Direction and Delivery



U.S. Department
of Transportation

Federal Railroad
Administration

JOHN TUNNA

Director

Office of Research and Development
Office of Railroad Policy and Development

Outline

- FRA and Office of R&D organization
- Fit with D.O.T. strategic goals
- Workforce development
- Freight and high-speed passenger rail
- Facilities and equipment
- Budgeting and delivery
- Evaluation
- Outreach

Two Primary FRA Offices

- Office of Railroad Safety – Robert Lauby (Acting Associate Administrator for Safety/Chief Safety Officer)
 - Rulemaking and enforcement
 - Rail Safety Improvement Act (2008)
- Office of Railroad Policy and Development – Paul Nissenbaum, Associate Administrator
 - Obligation and oversight of grants and loans (Amtrak, RRIF, HSIPR, TIGER, etc.)
 - National Rail Plan
 - Passenger Rail Investment and Improvement Act (2008)
 - Research and Development

Office of Research and Development



Office of Research and Development
Director, Dr. John Tunna



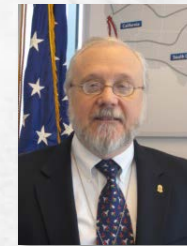
Equipment and Operating Practices Division
Chief, Kevin Kesler
(5 Staff Members)



Train Control & Communications Division
Chief, Sam Alibrahim
(5 Staff Members)



Track Research Division
Chief, Gary Carr
(6 Staff Members)



Human Factors Research Division
Chief, Dr. Tom Raslear
(2 Staff Members)

Other Government Partners

- **We work closely with the Research & Innovative Technology Administration (RITA)**
 - Member of Research, Development and Technology Planning Team where best practice is shared
 - Participate in Intelligent Transportation Systems project, which will include infrastructure to vehicle communications at grade crossings
- **and, where justified, directly with other Agencies and Departments**
 - Memorandum of agreement with Federal Transit Administration for the use of the Transportation Technology Center near Pueblo, CO
 - Common definition of hazards where FRA and Pipeline & Hazardous Material Safety Administration intersect
 - Locomotive efficiency and fuel studies with the Department of Energy



Research and Development Programs

- Core program addresses the Department of Transportation's goals of
 - Safety
 - Economic competitiveness
 - State of good repair
 - Livable communities
 - Environmental sustainability
- High-speed rail program investigates enabling technologies



Safety Goal

“Improve public health, safety, and security by reducing transportation-related fatalities and injuries” – D.O.T.

Scope of responsibility includes:

- Freight and passenger operations over the “general system”
 - Class I, regionals and short lines, intercity, commuter (not transit)
- Railroad employees
 - On duty injuries and fatalities; occupational illnesses and health
- Rail passengers on trains and in station areas
- Members of the public living and working near the railroad
 - Highway-rail grade crossing safety (motor vehicle and pedestrian) and trespass prevention

Rail security is primarily the responsibility of the industry and Department of Homeland Security’s (DHS) Transportation Security Administration (TSA)

Safety Averages - 1974 to 2009

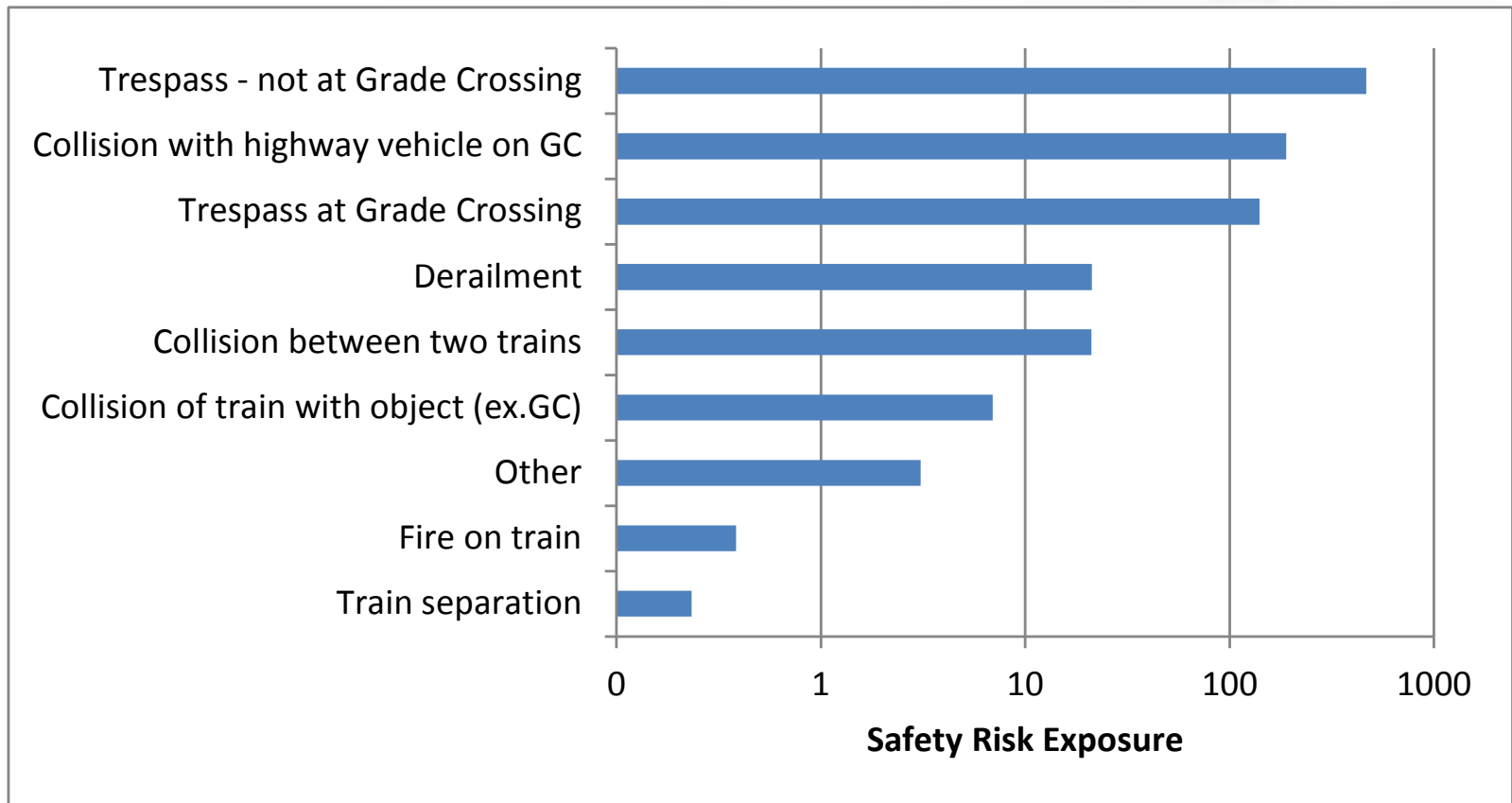
Accident/Incident Category	Average Reportable Incidents per Year	Average Fatalities per Year
Grade Crossings	6,107	594
Trespassers	n/a	468
Miscellaneous (excluding grade crossings)	500	7.6
Human Factors	1,252	7.0
Track	1,575	1.5
Equipment	687	1.0
Signaling	31	0.1

External Factors

- Recent regulations
- New technology
- Changes in working practices
- Increases in traffic volume, axle load and speed
- Increased passenger traffic
- Changes in type of commodity

Safety Risk Model

A model of harm



Core Research Program Areas

Program Areas	Risk Factors				
	Trespass	Grade Crossing	Derailment	Train Collision	All Other Safety Hazards
Railroad Systems Issues					X
Human Factors	X	X	X	X	X
Track & Structures			X		X
Track & Train Interaction			X		
Facilities & Equipment	X	X	X	X	X
Rolling Stock & Components			X	X	X
Hazardous Materials			X		X
Train Occupant Protection		X	X	X	X
Train Control & Communications	X	X		X	
Grade Crossings & Trespass	X	X			

State of Good Repair Goal

“Ensure the U.S. proactively maintains its critical transportation infrastructure in a state of good repair.” – D.O.T.

Some FRA R&D topics

- Rail corridor inspection and assessment equipment
 - Improve performance, reliability and efficiency
- Understanding the life cycle of railroad assets
 - Determine defect initiation and growth rates



Economic Competitiveness Goal

“Foster transportation policies and investments that serve the traveling public and freight movement, and bring lasting economic and social benefit to the Nation.” – D.O.T.

Some FRA R&D topics

- Methods for increasing and optimizing system capacity
- Foster development of domestic equipment manufacturing and testing facilities
- Promote development of new technology to improve system performance and resilience



Livable Communities Goal

“Foster livable communities through place-based policies and investments that increase transportation choices and access to transportation services.”

– D.O.T.

Some FRA R&D topics:

- Reduced noise and vibration from railroad operations
- Improved access to railroad transportation for special needs populations and individuals with disabilities

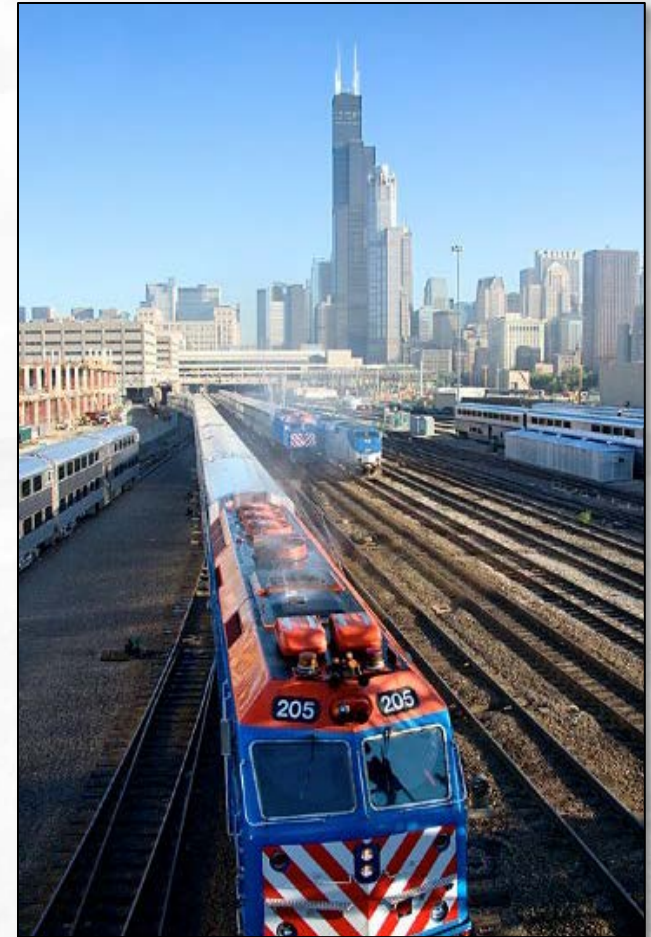


Environmental Sustainability Goal

“Advance environmentally sustainable policies and investments that reduce carbon and other harmful emissions from transportation sources.” – D.O.T.

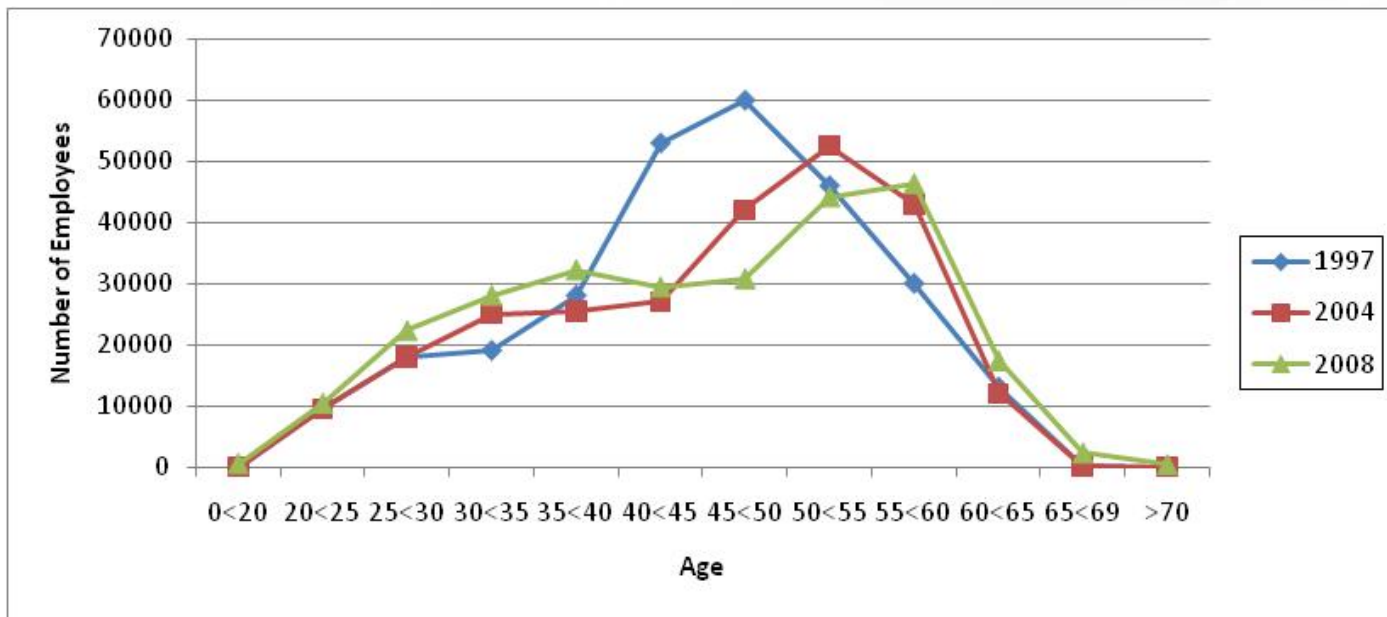
Some FRA projects:

- Use of alternative fuels and battery powered locomotives
- Improved fuel efficiency of rail equipment
- Reduced locomotive diesel emissions



Workforce Development

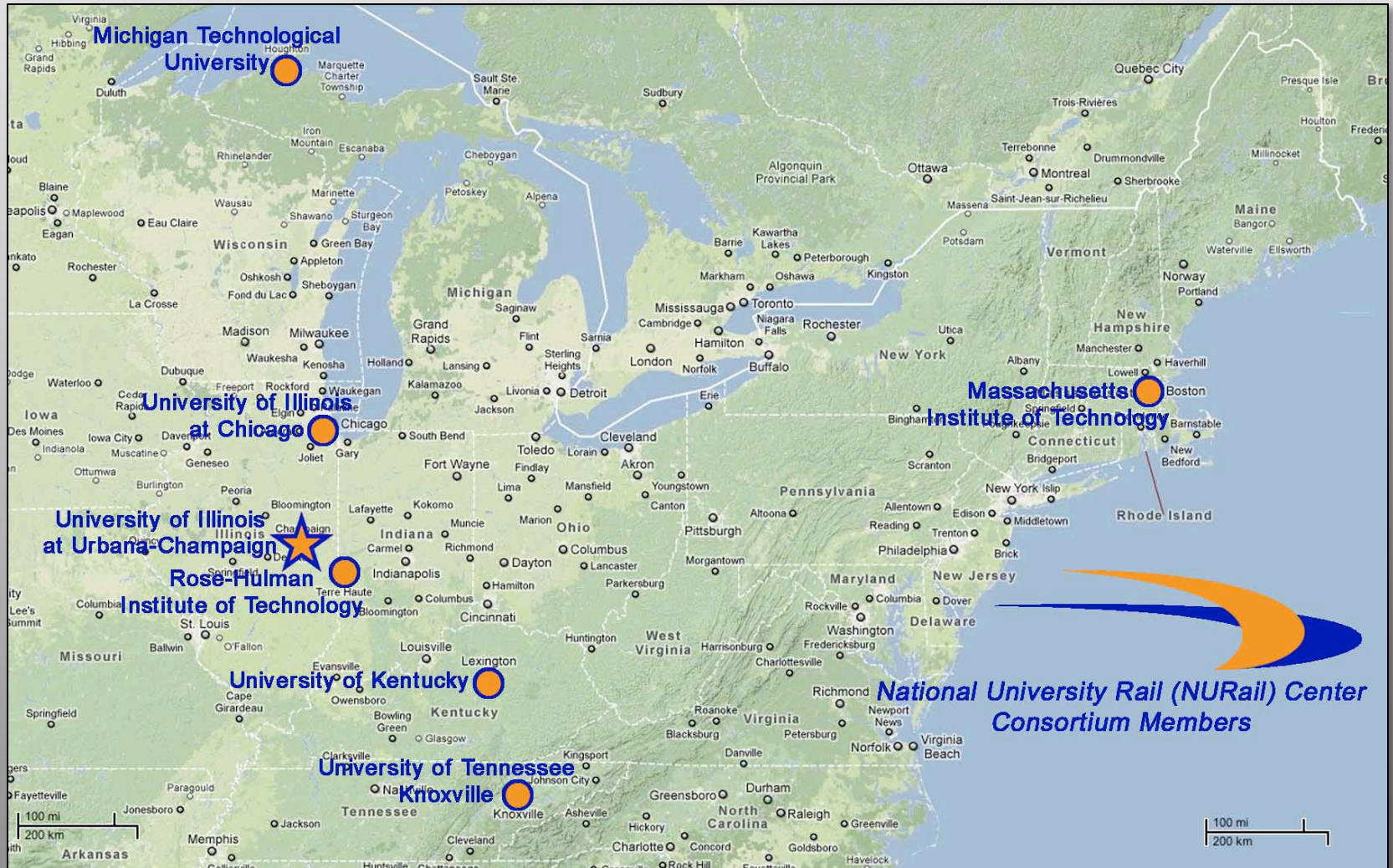
- Need to ensure a steady stream of qualified entrants to the industry
- Input provided to D.O.T.'s workforce development plan
- Plan more involvement with schools and universities



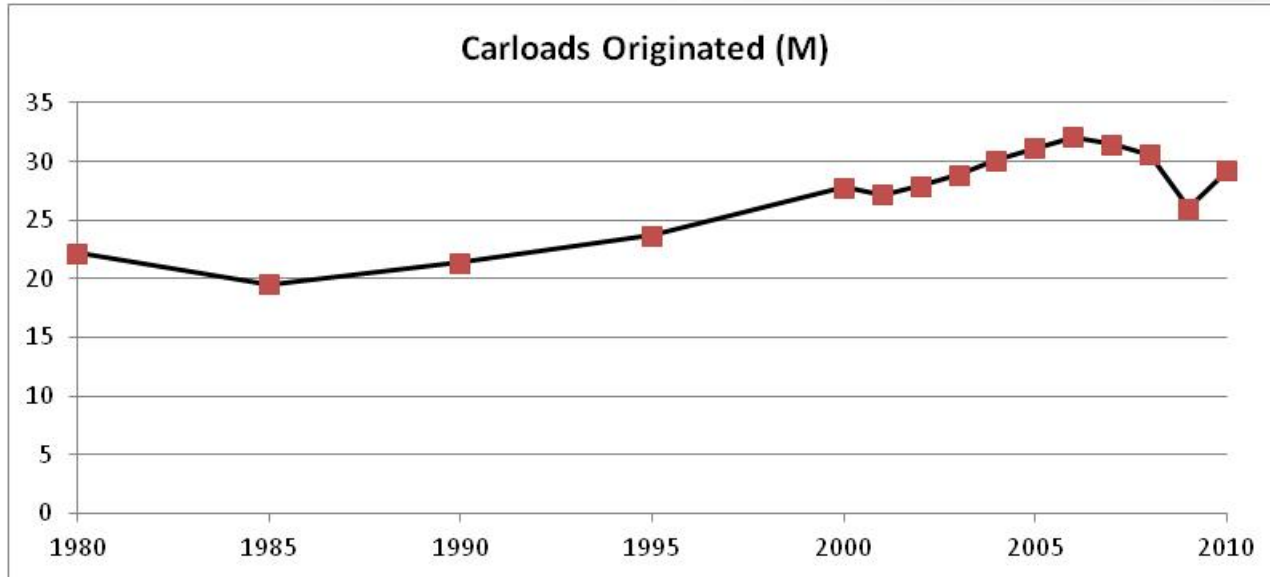
Railroad Employee Age Distribution Shift, 1997-2008

NURail Center Partners

- University of Illinois at Urbana-Champaign
- University of Illinois at Chicago
- Massachusetts Institute of Technology
- Michigan Technological University
- University of Kentucky
- University of Tennessee, Knoxville
- Rose-Hulman Institute of Technology



Freight Rail Trends



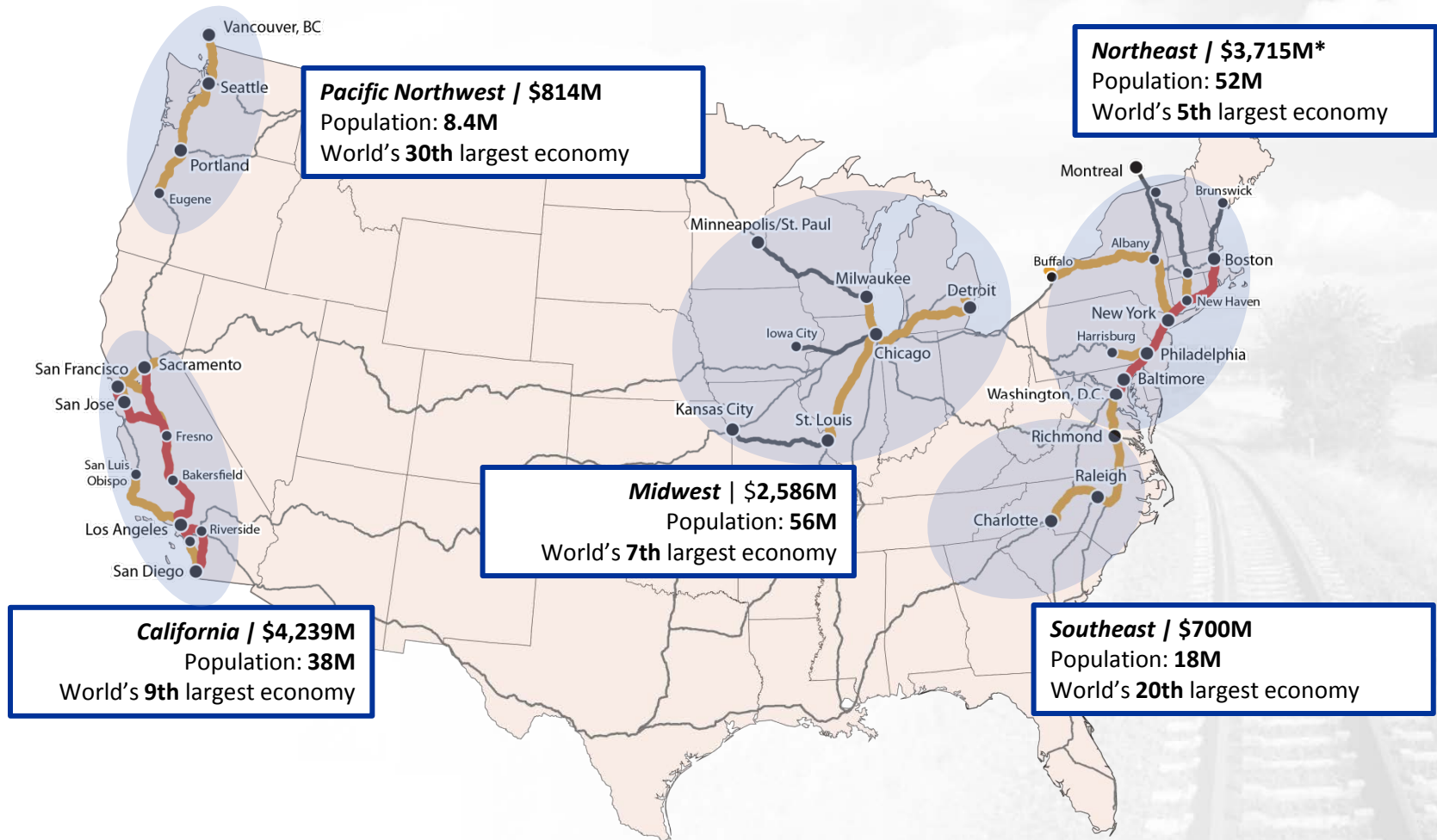
- 40% of freight ton-miles are shipped by rail
- Annual growth of 3% expected
- Coal – steady
- Chemical – modest growth
- Intermodal – growing
- Strategy is to collaborate with the Association of American Railroads

High-Speed Intercity Passenger Rail (HSIPR)

	Emerging/Feeder	Regional	Core Express
Speed (mph)	Up to 90	91 to 125	126 +
FRA Track Class	5	6 and 7	8 and 9
Track	Shared	Shared or dedicated	Dedicated
Grade Crossings	Standard	Enhanced	None
Route Length (miles)	~100	100 to 500	200 to 600

Source: National Rail Plan – Moving Forward, D.O.T. September 2010

High-Speed Intercity Passenger Rail Mega-Regions



HSIPR Program Highlights

- **95%** of the nearly **\$10.1 billion** allocated to the HSIPR Program across funding sources (ARRA, FY2009, FY2010) has been obligated
- **Over 30** projects totaling **\$2.3 billion** are under construction or set to break ground
- More than **5,000** jobs have already been created
- The FRA proposes investing \$53 billion over the next six years in high-speed and intercity passenger rail to provide 80 percent of Americans with access to the intercity passenger rail network within 25 years

High-speed and Intercity Passenger Rail Research Priorities



Track & structures

- Autonomous and efficient inspection
- Materials and construction
- Improved turnout performance
- Corridor hardening
- Modeling and simulation software



Equipment

- 125 mph non-electric locomotive
- 126+ mph passenger equipment
- Vehicle weight and unsprung mass reduction
- High-speed truck – passenger and freight
- Train occupant protection



Train control

- Grade crossing protection
- Capacity improvements
- Interoperable wireless communications
- Positive Train Control (PTC) integration and enhancements



Human Factors

- Interface with controls and displays
- Cab environment
- Employee training for new technology and operations

High-speed R&D Program Status

- **Direct Awards and Grants (6) - \$3.4M**
 - Volpe Center safety research, regulatory support
 - High-Speed Rail (HSR) standards, testing strategy, Next Generation Equipment Committee support
- **Broad Agency Announcement (26 awards) - \$11.6M**
 - Track and Structures, Human Factors, Equipment, Train Control
 - Relatively short duration projects with clearly defined deliverables
 - 2 projects complete

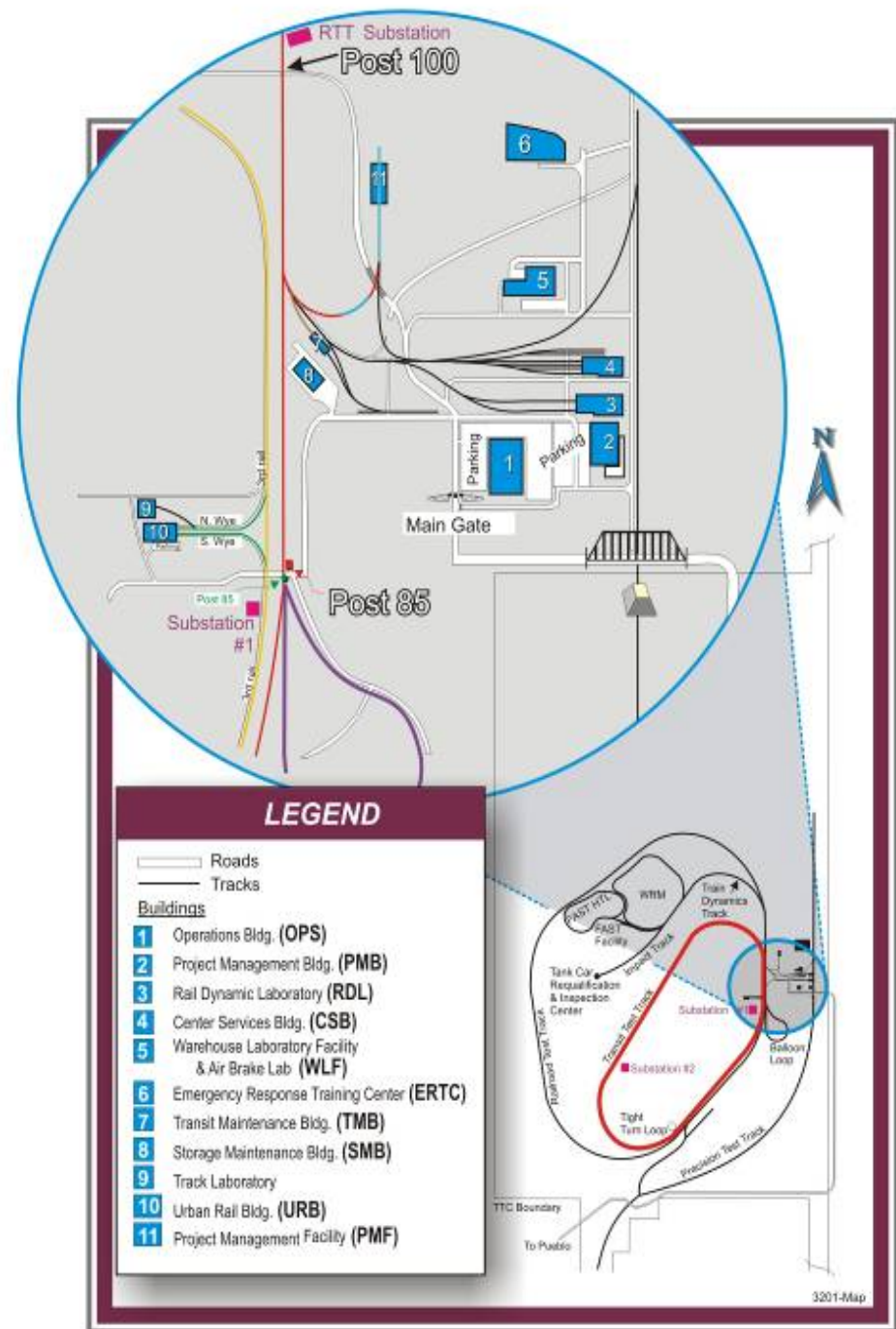
High-Speed R&D Highlight – Concrete Ties

- **Performance-derived specifications**
(UIUC, CXT, BNSF, UP, Amtrak)
- **Pre-stress/transfer length optimization**
(Kansas State University, CXT)
- **Inspection technologies**
(ENSCO, Amtrak)
- **Advanced concrete formulations** (Silica Fume Assoc., UIUC)



FRA's Transportation Technology Center

- 52 square miles near Pueblo, CO
- ~50 miles of test track
- Max. testing speed – 165 mph
- Laboratories and workshops
- Association of American Railroads has been the Care, Custody and Control contractor since 1982
- Transportation Technology Center, Inc. took over in 1998



Equipment

R-4



DOTX-218



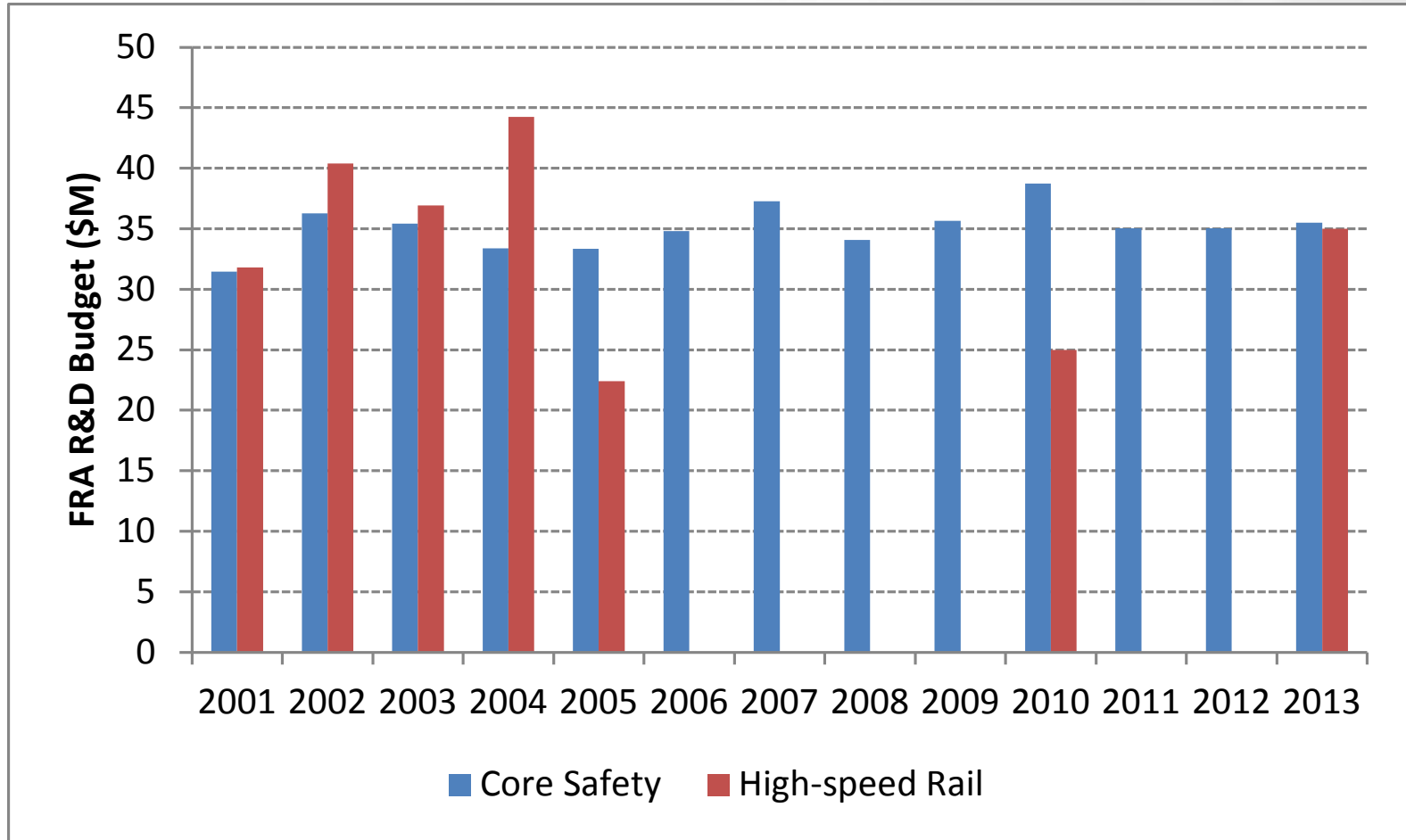
DOTX-216



CTIL



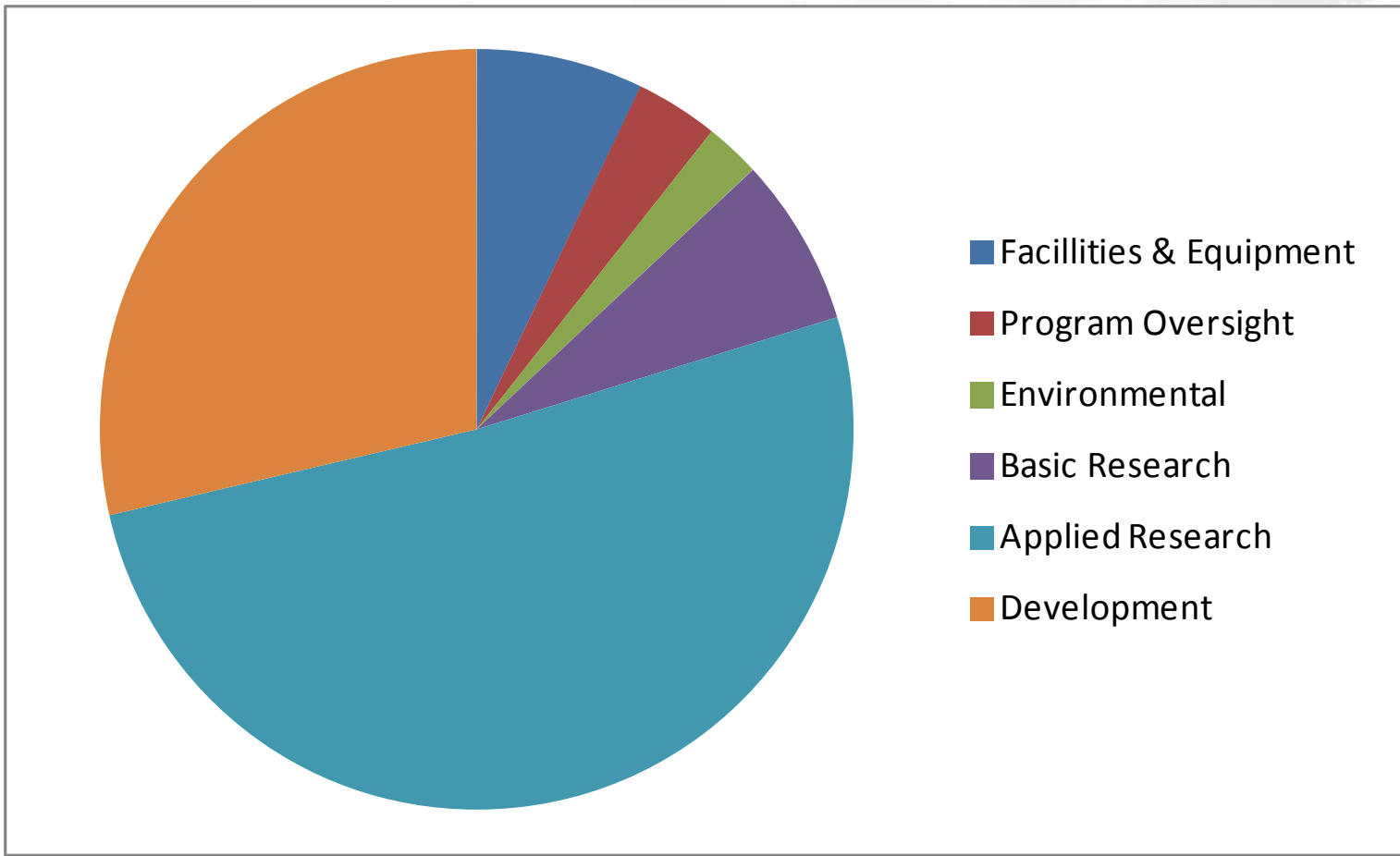
R&D Budget History



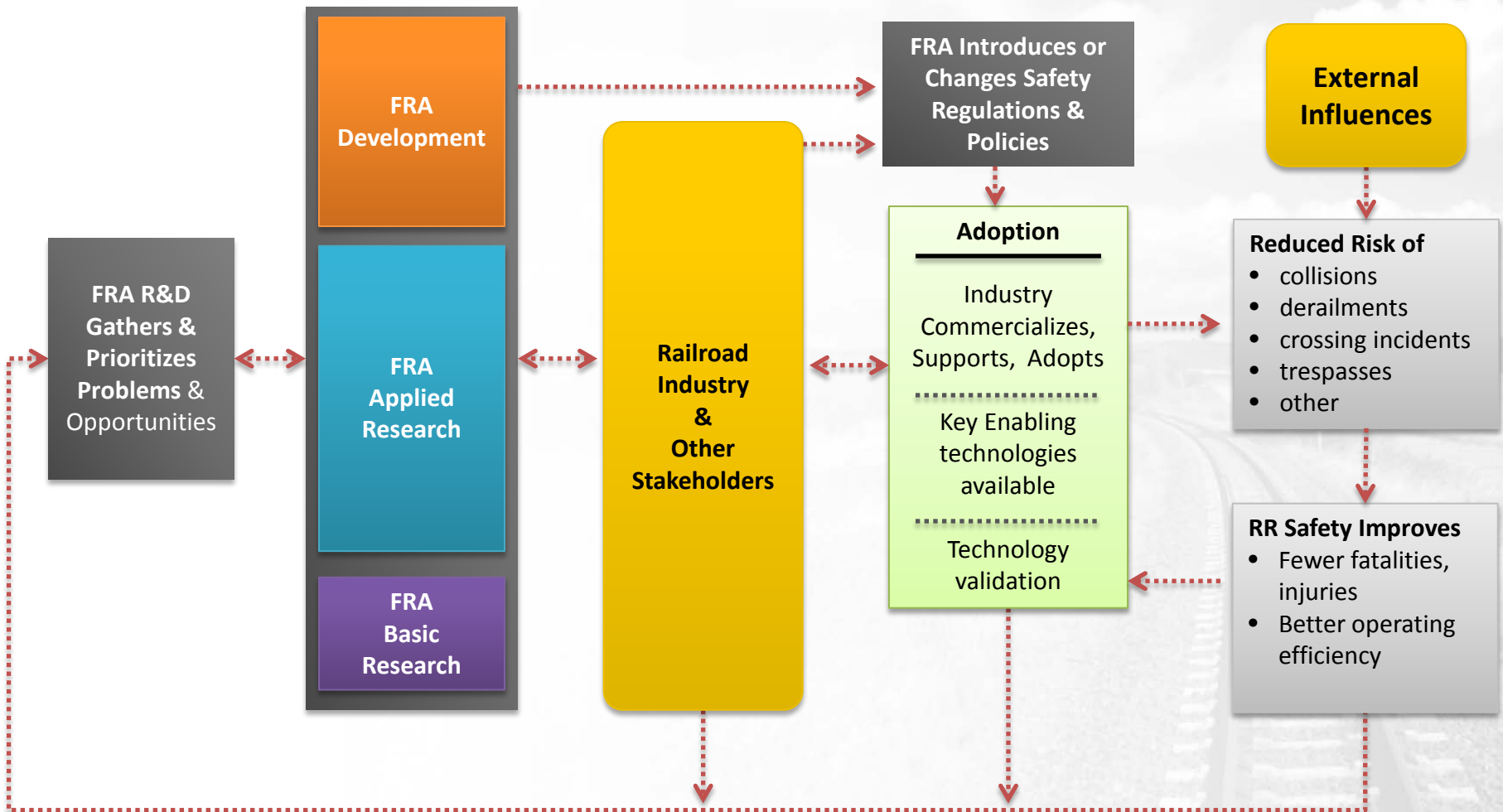
2001 to 2012 – Enacted (adjusted for Consumer Price Index)

2013 - Requested

R&D Funding Strategy

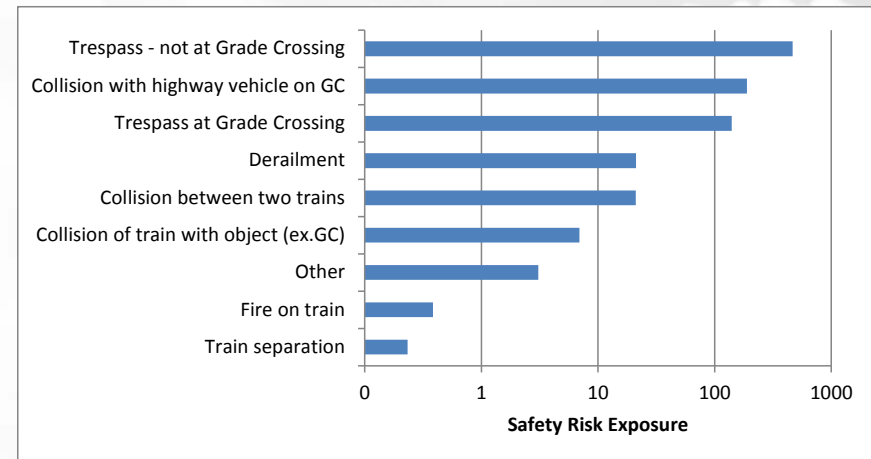


R&D Logic Model



Identifying Research Needs

- Safety Risk Model
- Customers and stakeholders
 - Office of Railroad Safety (RRS)
 - Association of American Railroads (AAR)
 - Suppliers
 - Universities
 - National Transportation Safety Board (NTSB)
- Industry associations
 - American Railway Engineering and Maintenance-of-Way Association (AREMA)
 - American society of Mechanical Engineers (ASME)
 - American Public Transportation Association (APTA)



Procurement

- Competitively awarded contracts
- Partnerships and cooperative agreements
- Grants
- Small Business Innovative Research (SBIR) - Congress mandates 2.5% of budget
- Broad Agency Announcements
- Transportation Research Board
 - National Cooperative Rail Research Program
 - Innovations Deserving Exploratory Analysis (IDEA) Program



Principal Contracts

- Interagency Agreements with John A. Volpe National Transportation Systems Center (Volpe)
- Care, Custody and Control contract with Transportation Technology Center, Inc. (TTCI)
 - A zero value contract requiring a minimum annual investment of \$2.6 M from the contractor
- Operation, Maintenance, Instrumentation and Analysis (OMIA) contract with ENSCO
 - R&D's test cars and road-rail vehicle
- Indefinite Delivery - Indefinite Quantity (IDIQ) contracts
 - 5 to support human factors research
 - 5 to support rolling stock research

Example Research Project

Derailment at Eunice, LA in May 2000

- 33 freight cars derailed; 15 contained hazardous materials resulting in explosions and a fire
- ~3,500 people were evacuated from the area
- Total damages exceeded \$35 million
- NTSB concluded that the cause of the accident was the failure of a set of joint bars that had remained in service with undetected and uncorrected defects



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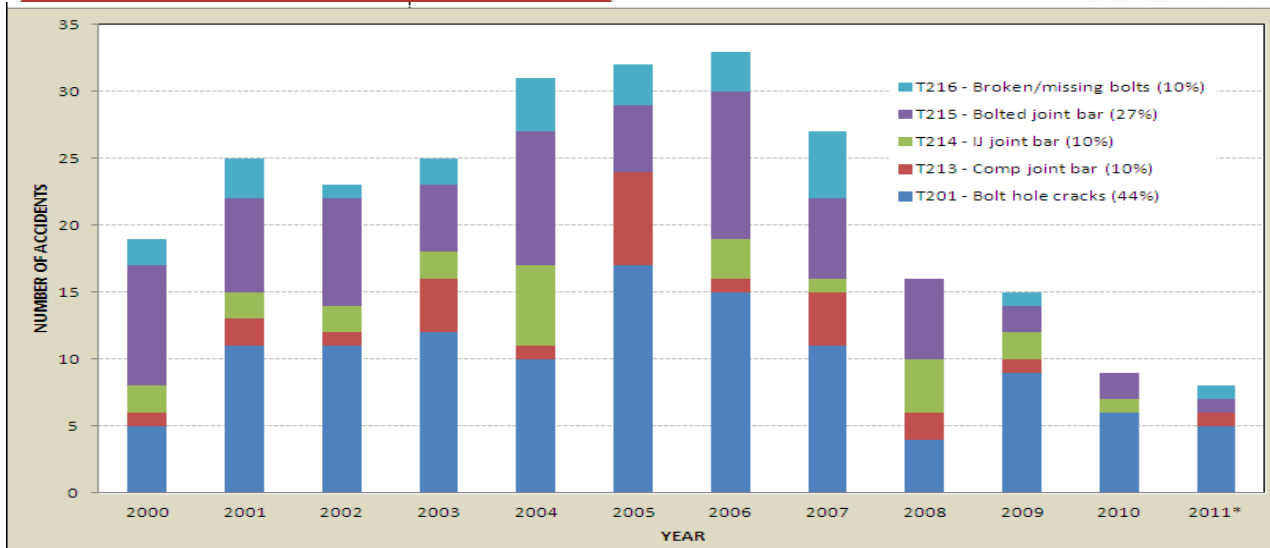


Inspection Services

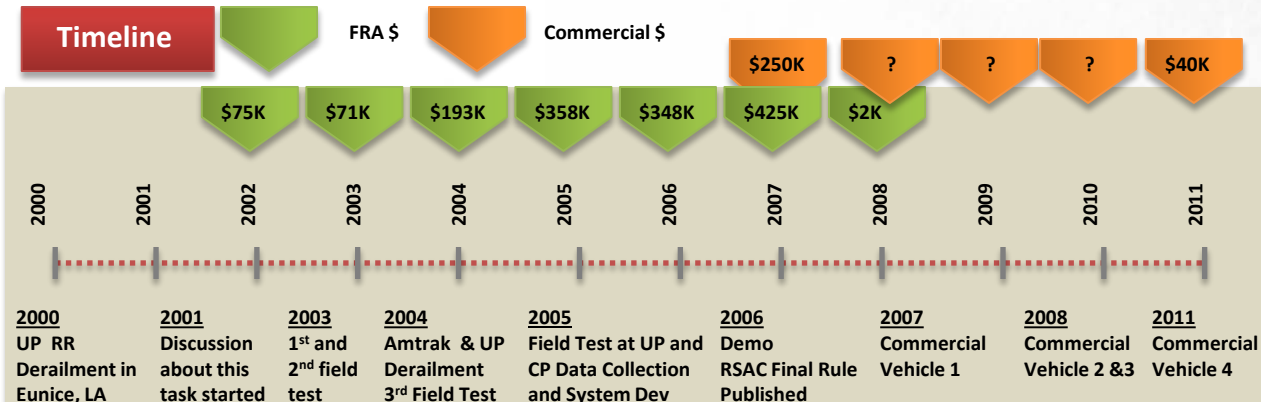
Joint Bar Inspection System

Joint Bar related accidents per year

Source: FRA Office of Safety
*Partial data available only



Timeline



Technology readiness level

TRL 9

TRL 8

TRL 7

TRL 6

TRL 5

TRL 4

TRL 3

TRL 2

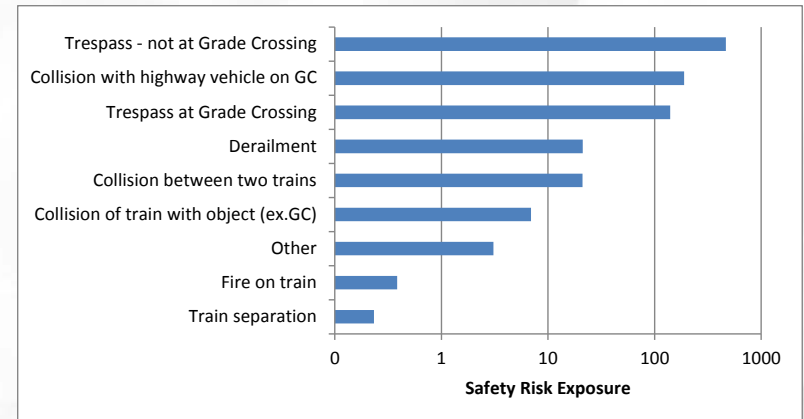
TRL 1

Actual application of the technology in its final form and under operational conditions, such as those encountered in operational test and evaluation. In almost all cases, this is the end of the last “bug fixing” aspects of true system development.

FRA Total Funding: \$1.3 M

Performance Measures

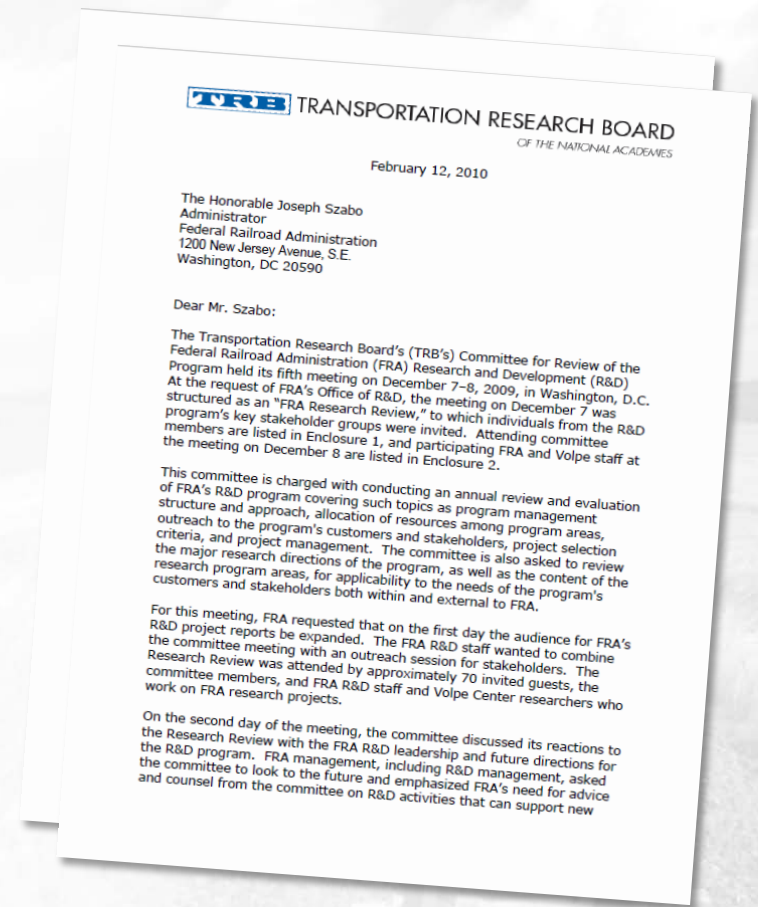
- Our goal is to reduce safety risk
- By doing so we expect there will be a reduction in actual accidents and harm
- Safety Risk Model will be used to
 - Calculate safety metrics e.g.
 - Passenger – equivalent fatalities per billion passenger train kilometers
 - Workforce – equivalent fatalities per million worker hours
 - Risk exposure for a typical traveler or worker
 - Monitor safety risk over time



Transportation Research Board (TRB)

External Evaluation

- Annual review and evaluation of FRA's R&D program
- Covers program management, allocation of resources among program areas, outreach to customers and stakeholders, project selection criteria, and project management
- Also provides direction to the FRA R&D program, and comments on the substance of the research program areas
- A copy of the 2011 letter report is at http://www.fra.dot.gov/downloads/TRB_frard_March_2011.pdf



Outreach

- Research Result Summaries – 4-page reports that describe significant R&D projects milestones or outcomes
- Research Reports – complete records of research projects providing details of methodology and results
- Available on FRA's, RITA's and TRB's websites
- Annual, 2-day R&D review
- University speaking engagements

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