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Office of Research, Development & Technology
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FRA RD&T Overview

Transportation Research Board
Committee for Review of the Federal Railroad Administration's R&D Program
Washington, DC ● May 14-15, 2019

U.S. Department of Transportation
Federal Railroad Administration

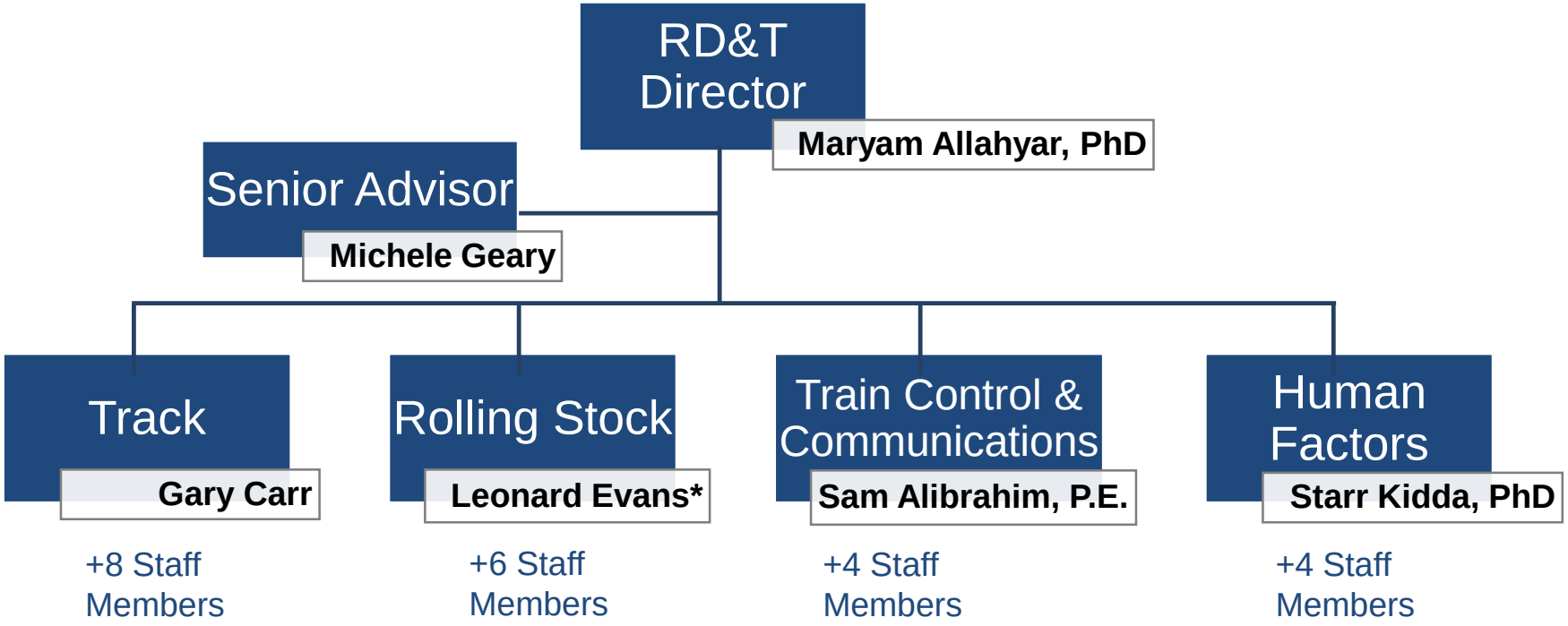
Agenda

- RD&T Mission
- FRA's Office of Research, Development & Technology (RD&T)
- RD&T Budget
- 5 year Strategic Plan
- Project Prioritization
- Technology Transfer (T2)

FRA's RD&T Mission

To ensure the safe, efficient, and reliable movement of people and goods by rail through applied research.

FRA's Office of Research, Development & Technology (RD&T)



* June 1, 2019

RD&T Research Areas Overview

Track Research

- Focus: To develop technologies to improve track inspection and monitoring
- Track and infrastructure failure is the major leading cause of train derailments in the U.S.
- Another common cause of derailment is incorrect interaction between moving vehicles and the track.

Rolling Stock Research

- Focus: To prevent derailments, equipment failure, and undesired emergency brake applications
- Other integral research areas are risk assessment and mitigation, along with support for safety assurance.

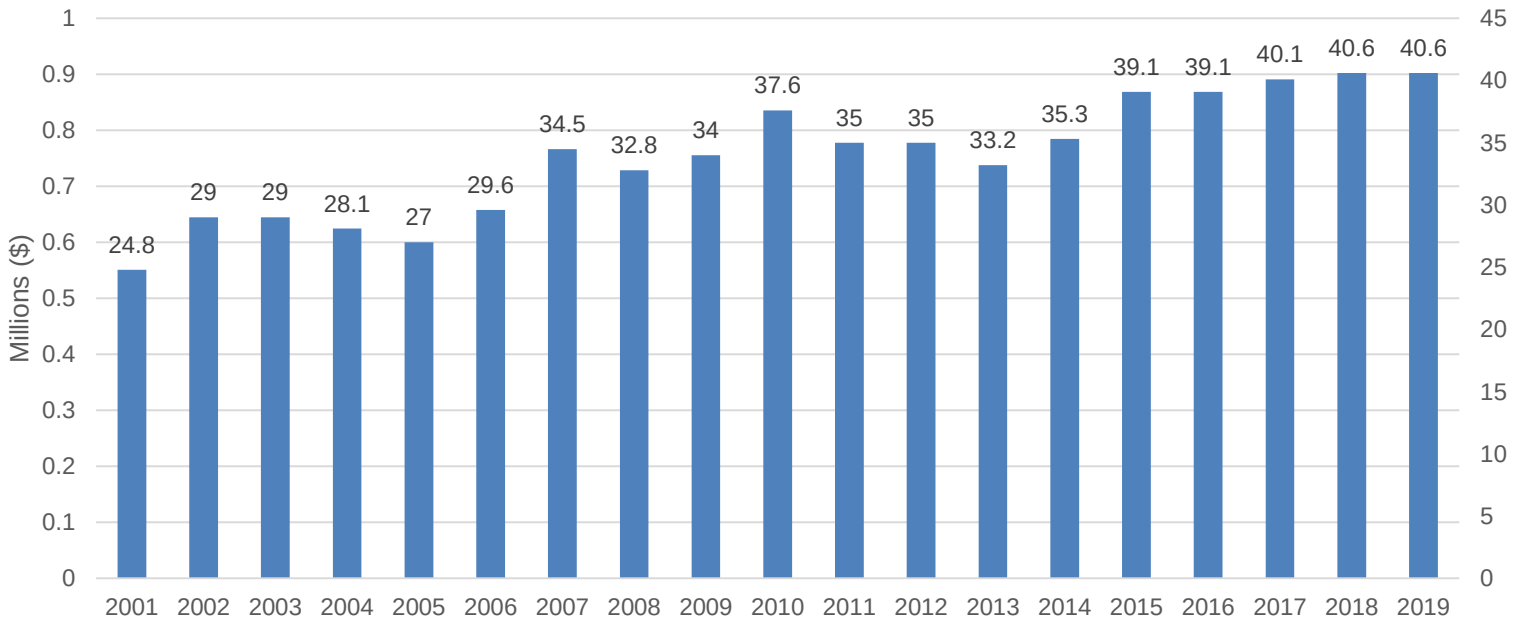
Train Control & Communications

- Focus: To develop Intelligent Railroad Systems
- Systems will incorporate new sensor, computer, and digital communications technologies into train control, braking systems, grade crossings, and defect detection; also will be integrated into planning and scheduling systems.

Human Factors

- Focus: To conduct research into automation, fatigue, distraction and ergonomics
- Also conduct pilot trials to improve safety and organizational culture in railroad organizations.
- Human errors account for more than 1/3 of train accidents in the U.S. railroad industry.

R&D Budget History



2001 to 2019 - Enacted

Funding Summary: Program Budget by Program Goal

RD&T Program Name	FY19 Pres. Budget ($000)	SAFETY ($000)	INFRA-STRUCTURE ($000)	INNOVATION ($000)	ACCOUNT-ABILITY ($000)
Railroad Systems Issues	$4,871*	$4,871*			
Track Research	$9,179	$9,179			
Rolling Stock	$10,322*	$10,322*			
Train Control & Communication	$8,086	$8,086			
Human Factors	$6,042*	$6,042*			
Totals	**$38,500****	**$38,500****			

*Amounts include earmarks for Short Line Safety Institute ($2,500) in Human Factors, Safe Transportation of Energy Products ($2,000) in Rolling Stock and Research with Universities on Intelligent Railroad Systems ($1,000) in Railroad Systems Issues.

* *The total amount does not include $2,100 for facilities per instructions for the report. The total amount includes earmarks. All carryover amounts are included in the Project Spend Plan.

5 YEAR STRATEGIC PLAN

OFFICE OF RESEARCH DEVELOPMENT & TECHNOLOGY

FRA OFFICE OF RAILROAD POLICY & DEVELOPMENT

Strategies Matrix

DOT Goal	DOT Strategic Objective	RD&T Strategy
1. Safety	Systemic Safety Approach	• Use data to understand safety risk in railway system • Collaborate with public and private partners to identify safety risk • Prioritize research to ensure the best outcome • Address safety risk in rural areas • Clarify RD&T's role as research leaders in DOT and the railroad industry
2. Infrastructure	Project Delivery, Planning, Environment, Funding and Finance	• Provide tools to ensure Federal investments achieve safety improvements
	Life Cycle and Preventive Maintenance	• Maintain RD&T facilities and equipment in a state of good repair

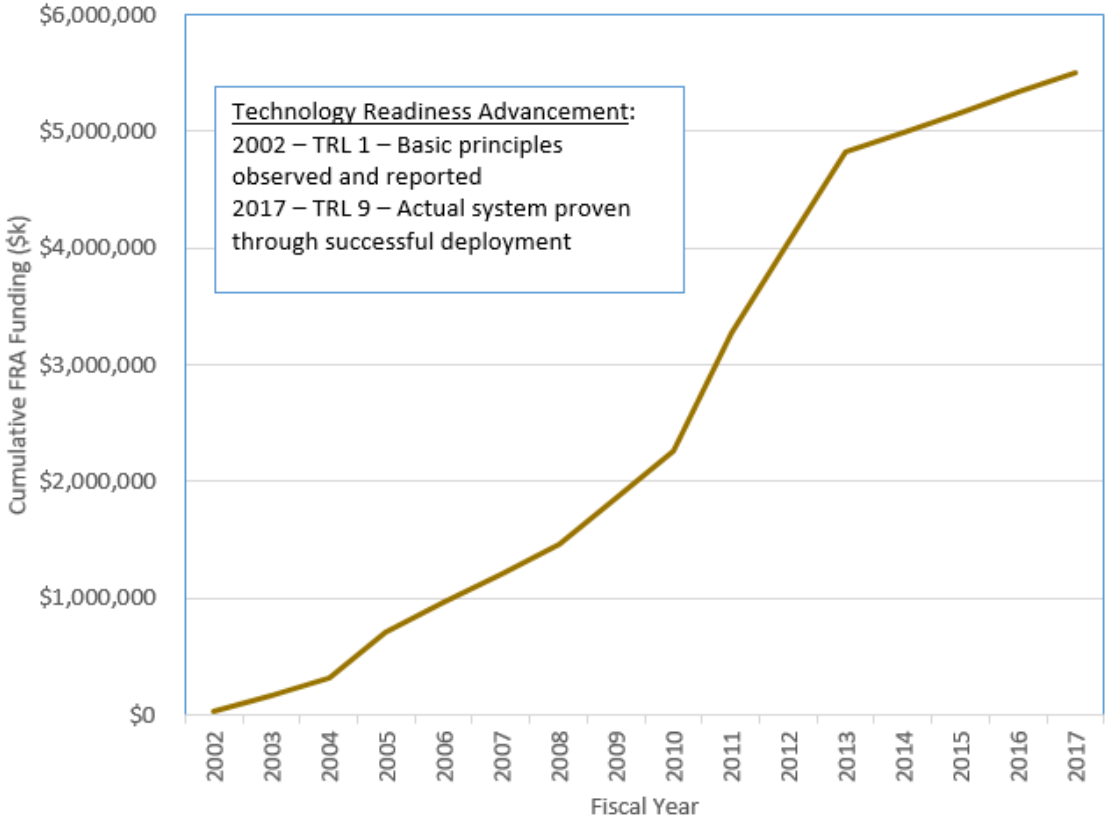
Strategies Matrix - Continued

DOT Goal	DOT Strategic Objective	RD&T Strategy
3. Innovation	Development of Innovation	• Collaborate with DOT research and development partners • Innovate in partnership with the railroad industry • Address safety concerns related to data and cybersecurity
	Deployment of Innovation	• Ensure the safe integration of new technology with railroad operations • Strengthen the technology transfer process
4. Accountability	Regulatory Reform	• Participate in reforming regulations
	Mission Efficiency and Support	• Increase staff knowledge and industry awareness • Ensure prudent financial management and procurement • Improve operational efficiency of the Transportation Technology Center

Research Type 1: Introducing New Technology

e.g. Autonomous Track Geometry Monitoring System (ATGMS)

ATGMS – *which enables railroads to efficiently gather data on track condition* - is a good example of how RD&T's investment and partnership with industry delivered accelerated information sharing and technology transfer to achieve safety goals.



Research Type 2: Supporting Regulatory Reform

e.g. Revised regulations for crashworthiness of passenger rail vehicles

This recent rule establishes modern, performance-based safety standards for passenger trains. RD&T performed research and full-scale testing to revise regulations for crashworthiness of rail vehicles and improve safety in collisions and derailments. Without investing in safety research, FRA would lack contextual data or information to define such safety requirements. This rule is expected to save more than **$475 million** in net regulatory costs.

Human Factors

Focus: Addresses accidents caused by human error, which is the most common cause of railroad accidents.

Core Research Priorities

- Fatigue
- Human Automation Interaction
- Grade-Crossing Safety
- Trespass/Suicide Prevention
- Monitoring and Support to Short Line Safety Institute (SLSI)

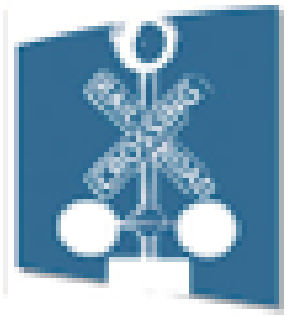
Goals: Safety, Infrastructure, Innovation, and Accountability

Train Control and Communication

Focus: Reducing train collisions with other trains and with objects at highway-rail grade crossings.

Core Research Priorities

- PTC Performance Monitoring and Reporting
- Next Generation PTC Technologies
- Intelligent Transportation Systems (ITS)
- Artificial Intelligence (AI) and Computer Learning (CL)



Goals: Safety, Infrastructure, Innovation, and Accountability

Track Research

Focus: Develops track inspection technologies; computer modeling capabilities; expands the use of autonomous inspection methods and develops new techniques for monitoring difficult to detect safety issues.

Core Research Priorities

- Autonomous Inspection Technologies
- Artificial Intelligence-Based Risk Analysis
- Safety Assurance Performance Measures
- Rail Safety Simulations and Testing
- Advanced Defect Detection Measures
- TTC Research Facility Maintenance and Enhancement

Goals: Safety, Infrastructure, Innovation, and Accountability

Rolling Stock

Focus: Examines the structural integrity of trains to increase the safety of passengers and reduce releases of hazardous materials. Targets the causes of derailment due to rolling stock component failures and poor train handling.

Core Research Priorities

- Automated Inspection Technologies and Techniques
- Improved Materials and Component Designs for Rolling Stock Components
- Energy and Environmental Sustainability
- Occupant Protection Enhancements
- Improving the Safety of Hazardous Materials Transportation

Goals: Safety, Infrastructure, Innovation, and Accountability

Emerging Technology

Technology	Description	Research Area(s)	Strategy
Unmanned Aerial Vehicle (UAV)	A UAV is an aircraft piloted by remote control or onboard computers.	Track	Evaluate how UAV may be applied in the railroad industry and determine if it can replace or enhance existing measurement and inspection technologies.
Artificial Intelligence (AI)	Artificial intelligence (AI) is human behaviors demonstrated by machines.	Track Train Control & Communications	Evaluate how AI may be applied in the railroad industry and determine if there are unintended safety risks.
Augmented Reality (AR) and Virtual Reality (VR)	Virtual reality engineering includes the use of 3D modelling tools and visualization techniques as part of the design process.	Human Factors	Determine how AR and VR could help to train conductors and drivers and improve health and safety.
Machine Learning	Machine learning gives computers the ability to learn without being explicitly programmed.	Human Factors Track Rolling Stock	Determine how machine learning could ensure timely maintenance.
Positive Train Control (PTC)	Positive Train Control (PTC) is an advanced system designed to automatically stop a train before certain accidents occur.	Train Control & Communications	Monitor the development of future generations of PTC to determine if there are any unintended safety risks.

PROJECT PRIORITIZATION

OFFICE OF RESEARCH DEVELOPMENT & TECHNOLOGY
FRA OFFICE OF RAILROAD POLICY & DEVELOPMENT

Summary

- Genesis of RD&T project ranking/rating process
  - Transportation Research Board RD&T Review Committee
  - Primary recommendations
  - Initial approaches

- Migration to Decision Lens yielded many benefits
  - Simultaneous multi-user capability
  - Web-based – no need to be on DOT network
  - Ability to integrate input from leadership and staff

History of Transportation Research Board Reviews

DATE	ACTIVITY
1998-2001	Conceived for review of R&D programs
2002-2005	Re-scoped as “Committee for Review of the FRA Research, Development, and Demonstration Programs”
2005-2007	Renewed (additional term)
2007	1st & 2nd meetings of new Committee (FRA HQ and TTCI, Pueblo)
2010	6th meeting, letter report 03/2011
2012	Letter report, 05/2012
2015	TRB Special Report 316 (2015) describing review of “case studies”
2019	Renewed (new term, new members)

Origins of RD&T Project Prioritization

- "Blue Ribbon" Committee comprised of experts from academia, Class I railroads, passenger railroads, labor unions and consultants
- Currently meets every 2-3 years (next meeting: May 14, 2019)
- Primary recommendation from initial reviews identified need for RD&T to develop a rational process for selecting R&D projects given limited funding
- FRA developed prototype process with available tools/technology
- Subsequent reviews suggested improvements to that process
- Continued improvement/added functionality not possible with extant software
- Migration to more robust solution necessary

What is Decision Lens

- Web-based software solution allows:
  - Collaborative decision-making
  - Planning
  - Prioritization
  - Resource Allocation
  - Optimization
- Many Federal clients:
  - FAA
  - NIH
  - DoD
  - DHS….and many more

Decision Lens is the leader in strategic planning for government, providing easy-to-use software solutions to take the guesswork out of mission critical enterprise planning, financial, IT and performance-related decisions.
https://www.decisionlens.com

Rating/Ranking Prerequisites

- Need:
  - Candidate projects (considered as “alternatives”)
  - Evaluation criteria (important characteristics a project must possess)
  - Priorities (which characteristics have greatest weight)

TECHNOLOGY TRANSFER (T2)

OFFICE OF RESEARCH DEVELOPMENT & TECHNOLOGY

FRA OFFICE OF RAILROAD POLICY & DEVELOPMENT

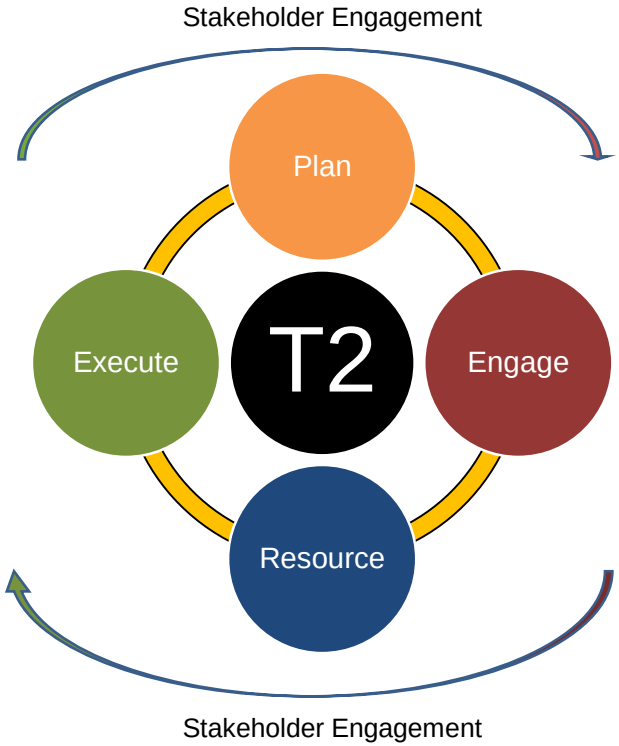
Technology Transfer (T2)

T2 needs, adoption and requirements drives research.
In 2020, RD&T will continue to create program level T2 plans for each division and their program areas. T2 plans include:

- Technology Readiness Level (TRL) Assessment
- Resource Strategy
- Risk Assessment
- Communications Strategy
- Integration Strategy

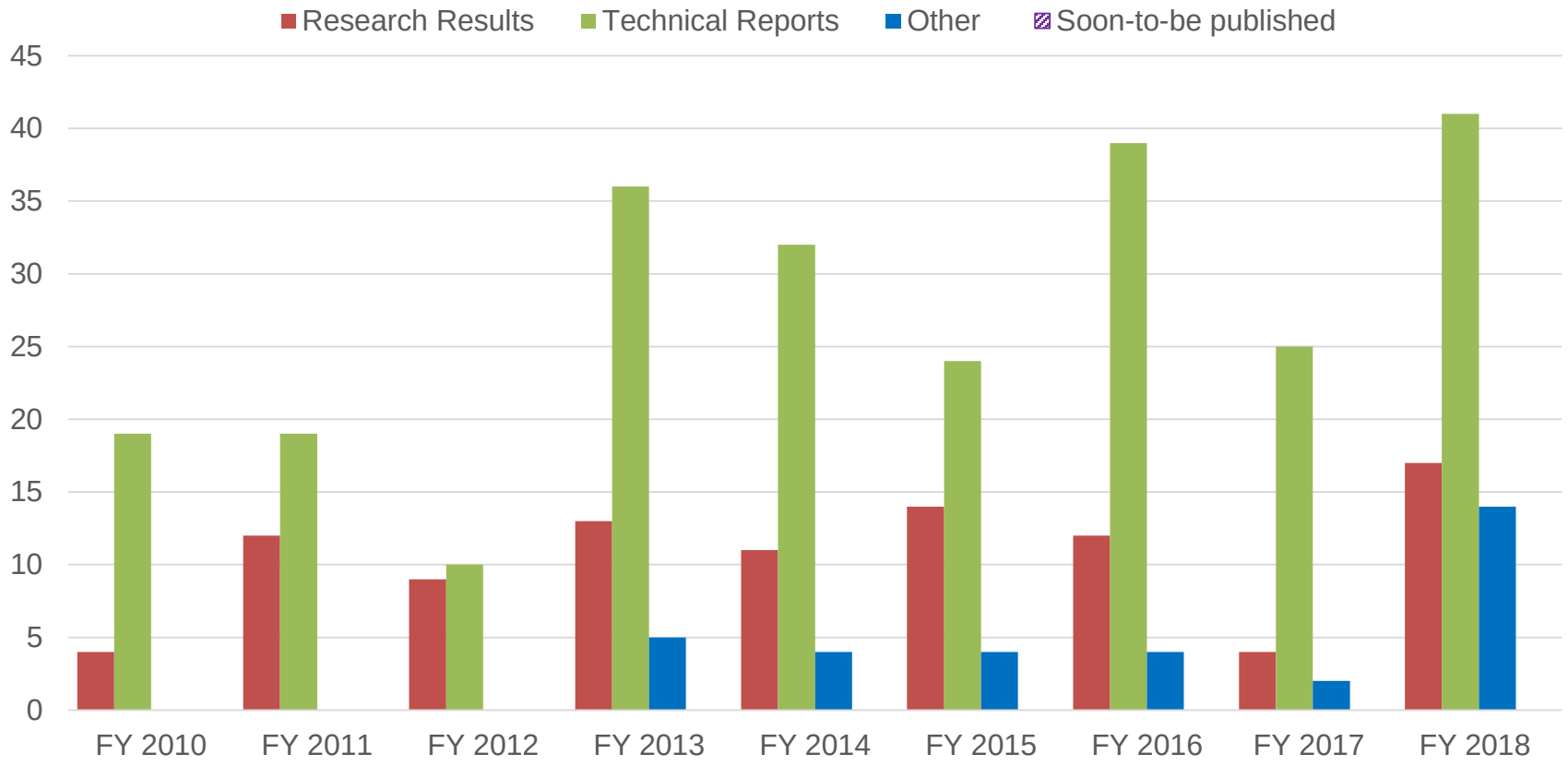
RD&T T2 related spend plans will be approximately $550K in FY2020. T2 implementation costs include:

- Stakeholder Engagement
  - Industry Conferences, Meetings, Presentations/Demonstrations (e.g., international suicide conference and Union of International Railways Grade Crossing Awareness Day)
  - Workshops, Committees and Summits
  - Community of Practice Meetings
- Communications
  - Support for publications and reports



RD&T Publications on eLibrary

(www.fra.dot.gov)



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