

Research to Enhance Rail Network Performance
A Workshop

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Breakout Discussion Reports

Safety

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

Safety

- More nationwide education regarding grade crossing dangers, right-of-way incursions.
- Advance the application of various non-destructive testing for application in the operating environment.
 - The railway work environment is challenging from an ergonomic perspective, and may benefit from application of new technologies and design standards.
 - Safety tradeoffs that arise from modal diversion.
 - Improving crash and crush worthiness of rolling stock: Continue the progress made in better understanding of energy absorption management systems in rolling stocks, in order to make railcars and locomotives more crashworthy.
 - Improve and develop crossing warning flasher illumination and gate illumination.
 - Develop technology-driven “train inspection” tools, sensors, systems, etc.
 - Develop new technologies for broken rail detection and prevention and develop devices to analyze track stresses. In short, further research is required to develop ways of improving track integrity.
 - Quantification of derailment and collision prevention measures.
 - Hazmat network routing and product substitution to reduce risk.
 - To determine economic incentive for public and private investment in enhanced wayside and on-board defect detection systems.
 - Improved data on accidents and accident causes, and more rigorous use of benefit/cost evaluation in setting R&D priorities.
 - Train control systems that incorporate safe operating practices as well as operational experience.
 - Research into individual/public/private role and accountability division of accountability.
 - Human factors research to analyze the impact of employee training, future working skills, recruitment of new generation of RR employees and the requirements for the future, more automated work environment, including the impact of current and future work cycles on operations employees.
 - Implication for railroad industry of transportation of spent nuclear fuel and high level radioactive waste.
 - Trespass research.
 - Evaluate the effectiveness of photo enforcement technology at grade crossings.
 - Positive train control (safety aspects).
 - Automated assisted inspections for track (e.g., machine vision).
 - Performance-based track geometry standards.
 - Development of machine vision technologies to apply generally in the railroad environment.
 - Ability to track hazmat cars and detect any material release—develop device.
 - Research the total cost of postponement of grade crossing separation with goal of accelerating number of grade crossing separations.

Group #1

More nationwide education regarding grade crossing dangers, right-of-way incursions.

DESCRIPTION

More than Operation Lifesaver is required in the effort to educate children and adults on the nuances and dangers of freight and passenger trains

SUBTOPICS

- “Passive crossing” awareness, drivers license test questions enhanced.
- Use of internet to attract younger users, local full page ads with clear messages.
- Awareness that you may not hear the train that kills you.
- Second train coming issues.

TIME FRAME

- Gap in current research: Yes, immediate recommended.
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Experience tells us the public is very unaware of what to do at “Passive-crossbuck only” crossings. Also, many states driver’s handbooks are not well drafted, and railroad questions may not be on the test. Operator Lifesaver is a good effort, but much more can and needs to be done.

Group #1

Advance the application of various non-destructive testing for application in the operating environment.

DESCRIPTION

Adapting existing technology for inspection in realtime mode to identify potential catastrophic defects for both rail and rolling stock.

SUBTOPICS

- High-speed cameras
- Low-level lasers
- Ultrasonic
- Eddy Current (electro magnetic)
- Infrared

TIME FRAME

- Gap in current research
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

- Elimination of derailments and service
- Interruptions as a result of a component
- Failure and/or ineffective maintenance

Group #1

The railway work environment is challenging from an ergonomic perspective, and may benefit from application of new technologies and design standards.

DESCRIPTION

Research in following areas:

1. Ergonomic standards for freight car appliances
2. Loco cab ergonomics from a physical and cognitive perspective
3. Right-of-way crew ergonomics for manual and mechanized tasks
4. Ergonomics for rail passengers as related to ride quality

SUBTOPICS

TIME FRAME

- Gap in current research
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

High cost of employee injuries and a need to attract a more diverse workforce raises the economic and safety impact of addressing these needs.

Group #1

Safety tradeoffs that arise from modal diversion.

DESCRIPTION

For both passenger and freight regulatory requirements can affect mode choice without a full understanding of the actual economic and safety impacts. These requirements affect hardware designs, acquisitions and operations costs that may tilt modal selection.

SUBTOPICS

- Hazmat routing, access to shipper facilities by rail
- Regulatory impacts on mode selection
- General public safety impacts
- Environmental exposure – direct and indirect

TIME FRAME

- Gap in current research: Longstanding.
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Group #1

Improving crash and crush worthiness of rolling stock: Continue the progress made in better understanding of energy absorption management systems in rolling stocks, in order to make railcars and locomotives more crashworthy.

DESCRIPTION

This research is intended to extrapolate on lessons learned in the automotive industry, as well as those from the recent FRA passenger car crash evaluation, to identify critical technologies that can be implemented on high-risk rail cars

SUBTOPICS

- Impact energy management systems
- Composite materials and non-metallic materials
- Detachable couplers
- Energy absorption tanker containers

TIME FRAME

- Gap in current research: 5–10 years.
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Hazardous material spills are a major safety concern to the industry. The vast majority of such spills occur as a result of rail car derailment and puncturing of the container. This research topic will address a broad spectrum of technologies related to crash, starting from better understanding the physics and mechanics of impact energy in trains, to managing that energy in readily deployable systems.

Group #2

Improve and develop crossing warning flasher illumination and gate illumination.

DESCRIPTION

Most crossing warning lights in service today are incandescent based. Burn-out due to open filaments is the primary reason of failure. LED substitutes are available, but have not been widely used for existing warning systems due to the expense required to retrofit older technology. In addition, gate arms could be more effective if the gate arm itself was translucent and lit from the inside (like a fluorescent tube).

SUBTOPICS

- Incandescent versus LED lighting
- Gate arm lighting (what if the entire gate is lit from the inside)

TIME FRAME

- Gap in current research
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Driver behavior depends on conveying a clear precise message.

Group #2

Develop technology-driven “train inspection” tools, sensors, systems, etc.

DESCRIPTION

Use various scanning, communications, and technologies to improve the speed, efficiency and effectiveness of train and railcar inspections. Develop OR tools to optimize placement of wayside detection installations that maximizes cars inspected while minimizing the number of installations given traffic flow of rolling stock on network.

SUBTOPICS

- Hardware development for all inspection tasks
- Integration of data into railroad operation and repair systems
- Optimization model for placement of wayside installations

TIME FRAME:

- Gap in current research
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Group #2

Develop new technologies for broken rail detection and prevention and develop devices to analyze track stresses. In short, further research is required to develop ways of improving track integrity.

DESCRIPTION

Rail breaks, rail pull-aparts, and buckled track continue to be dominant causes of train derailments. Research is needed to further improve rail defect detection technologies and to determine rail stresses such that effective management strategies can be implemented. Rail integrity is also an essential element for the implementation of PTC.

SUBTOPICS

- This research needed is actually a subset of PTC.
- Rail defect detection must be tolerant of compromised rail surface conditions.
- Defects in the entire rail section, including the head web and base, should be detectable.
- Rail stress detection could be incorporated on rail-bound vehicles.

TIME FRAME

- Gap in current research: No effective non-destructive technology exists to determine rail stresses. Rail defect detection technologies are still not fully effective in reducing disruptions due to broken rails.
- 5-year research need: Continue to optimize and refine detection methods.
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

This research is essential for implementing PTC and to reduce the safety, cost, and productivity consequences associated with compromised track integrity. Technologies are required so that railroads can proactively manage track integrity issues.

Group #2

Quantification of derailment and collision prevention measures.

DESCRIPTION

There is an inadequate quantitative understanding of the cause and effect of various measures railroads take to maintain and improve train safety. This project would use statistical and engineering approaches to risk-based allocation of resources so as to most effectively and efficiently improve safety. It would also provide essential input to development of performance-based safety standards.

SUBTOPICS

- Broken rail, joint bar and related, and track buckles.
- Wheel, axle, bearing failure caused
- Train handling and other human-factor caused
- Collisions and related

TIME FRAME

- Gap in current research
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Group #2

Hazmat network routing and product substitution to reduce risk.

DESCRIPTION

This research consists of analyzing the flow of hazmat traffic on the railroad network; determining the risks of the current routings; identifying opportunities to improve routings; improving public safety; performing a trade-off analysis between demand efficiency and improved safety; and determining opportunities for product substitutions to improve safety.

SUBTOPICS

- Assess public demand for rerouting of hazardous materials.
- Trade-off analysis between efficiency and safety.
- Enumerating alternative routing plans and determining optimal constrained routings.
- Feasibility of substitution by less hazardous materials.
- Consider both public safety and environment effects.

TIME FRAME

- Gap in current research
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

There is little scientific research available on hazmat traffic routing. We need to understand the issue better. This research will help us understand the relationship between public safety and hazmat transportation efficiency better.

Group #3

To determine economic incentive for public and private investment in enhanced wayside and on-board defect detection systems.

DESCRIPTION

Develop wayside and on board defect detection systems that predict component (track, locomotive, and car) failure.

SUBTOPICS

- Economic on board track inspection equipment providing daily track inspection
- Communication from wayside and on Board to systems to train control systems.
- Automate equipment inspection systems to eliminate scheduled stops due to mileage
- Reduce FRA regulations that require inspections and allow to support technology safety of operations

TIME FRAME

- Gap in current research
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Predicting bad actor conditions prior to failure will allow rail carriers to schedule repair activity and eliminate catastrophic failure.

Group #3

Improved data on accidents and accident causes, and more rigorous use of benefit/cost evaluation in setting R&D priorities.

DESCRIPTION

FRA's current accident data and reporting system relies on retrospective analysis of accidents, and uses accident cause categories that do not accurately report root cause (e.g. human errors often have underlying causes categories that do not revealed by a simple categorization). FRA is now engaged in initiating a "close call" program that receives confidential reports of close and develops more voluminous accident reporting. This program should be encouraged and strengthened. A particular example of this information is analysis of locomotive camera data. Another example is the need to collect data on the safety and accident exposure of the entire system (passenger accidents in stations) rather than focusing only on the areas that FRA regulates. Based on research involving close call data, locomotive camera data and a review of broader accident experience, FRA should initiate a review of accident data categories and definitions. In addition, FRA should incorporate the improved data into a more detailed (and more frequent) benefit/cost analysis of the priorities for R&D efforts.

SUBTOPICS

- Focus on effective use and analysis of close call data, including a new accident report format
- Enhanced collection and use of locomotive camera data
- Review of accident data categorization to improve root cause identification
- Use of better data through benefit/cost analysis to improve R&D priorities: develop an easily applied methodology for annual application

TIME FRAME

- Gap in current research: Attention needed for close call program data collection and use of locomotive camera data.
- 5-year research need: Redefine accident categories and definitions, and incorporate better benefit/cost analysis in setting safety R&D priorities.
- 20-year research need: Continuing attention to collection of better accident data and accident categorization.

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

In the longer run, the ability to improve safety is only as good as the understanding of the underlying exposures and risks. This is, of course, an iterative process: the problem for FRA is to reduce the rigidity of the current system and to foster evolution in data and information. In addition, FRA's current R&D priorities are related to accident category (track, signals, grade crossings, trespassers, etc.) but they are not clearly related to the risk of damage in each category, and they are not effectively related to the probability of success of the R&D proposed.

Group #3

Train control systems that incorporate safe operating practices as well as operational experience.

DESCRIPTION

Smarter train control practices that incorporate human factor issues (i.e. circadian rhythms), operating practices, grade crossing risk model, equipment design, and track/mechanical detector systems.

SUBTOPICS

- Human factors and safety issues-operation personnel
- Operating practices
- Grade crossing risk model
- Equipment design
- Track and mechanical detectors

TIME FRAME

- Gap in current research
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Group #3

Research into individual/public/private role and accountability division of accountability.

DESCRIPTION

To better define dividing lines between individuals/ public agencies/private entities with respect to overall safety of all railway operations.

SUBTOPICS

- Legal/political/judicial research into public due diligence (& liability)
- Human factor research into role of train length in public negative behavior
- Research into scheduling and train makeup as alternative to long trains.
- Development of restraint alternative to fencing (for trespassing)

TIME FRAME

- Gap in current research
- 5-year research need: For remaining three above.
- 20-year research need: (For political and legal research)

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Waste in targeting precious resources at changing public behavior, more efficiently changed by legal or social means.

Group #3

Human factors research to analyze the impact of employee training, future working skills, recruitment of new generation of RR employees and the requirements for the future, more automated work environment, including the impact of current and future work cycles on operations employees.

DESCRIPTION

The changing workforce demographics, a profound cultural shift and the dramatic changes in technology create this need.

SUBTOPICS

- Updated training and recruitment for the “next” generation
- Include evaluation of “on –the-ground” training for “off the street” employees.
- Evaluation of See Something-Say Something training/campaign for the public and employees
- Analysis of future “cab/office” environment

TIME FRAME

- Gap in current research
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Changing working conditions and an impending succession in many classifications will create a crisis in operations if accommodations are not properly designed.

Group #4

Implication for railroad industry of transportation of spent nuclear fuel and high level radioactive waste.

DESCRIPTION

Within the next two years, significant shipments of SNF and HLW by rail will begin, and may be expected to continue for about 40 years. What does the industry need to consider to handle these materials safely?

SUBTOPICS

- Operating practices (e.g., dedicated trains, guards, etc.)
- Risks to employees (establish exposure levels, dosimetry and other protection, etc.)
- Risks to the public (e.g., security, secrecy of schedules)

TIME FRAME

- Gap in current research
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Current levels of shipments are so infrequent that no specific studies have been conducted. This will change dramatically with opening of permanent repositories at Yucca Mountain and in Utah.

Group #4

Trespass research.

DESCRIPTION

Problem identification, develop more accurate reporting criteria, collaborate with Transport Canada on “hot spot” methodology development. Develop community intervention process for implementation.

SUBTOPICS

- Identify and stratify categories of trespass, e.g., suicide, etc.
- Develop appropriate terminology for trespass
- Root cause of trespass events
- Transfer existing technology to railroad infrastructure
- Develop methodology for determining nationwide “hot spot”
- Use video and sensor technology to trespass detection

TIME FRAME

- Gap in current research: Identify and stratify categories and root causes.
- 5-year research need: Develop countermeasures. Tech trans for technology.
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Reduce highest fatality rate within the railroad industry, trespass.

Group #4

Evaluate the effectiveness of photo enforcement technology at grade crossings.

DESCRIPTION

Evaluate effectiveness and feasibility of applying photo enforcement technology at crossings with both passive and active crossings to deter crossing at risk.

SUBTOPICS

- Public/private partnerships (railroad police?)
- Low cost application for passive crossings
- Pilot at crossings in “hot spot”
- With high accident/near miss frequency

TIME FRAME

- Gap in current research
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Group #4

Positive train control (safety aspects).

DESCRIPTION

PTC seeks to prevent train-to-train collisions, derailments caused by over speeding trains, and to ensure track forces within their work limits are protected from trains operating through the work zone.

SUBTOPICS

- What crew information displays are most effective
- Trade-offs between availability of PTC-based information vs. crew's over-reliance on the system
 - What operating rules should govern incremental implementation of PTC (e.g., migration strategies for mixing “equipped” and nonequipped” trains in a territory)?
 - Benefit assessment of the different safety functions PTC should try to address (prioritize)
 - What to do about “broken rail” protection if conventional signal system (with DC track circuits)

TIME FRAME

- Gap in current research: Lessons learned from existing PTC projects.
- 5-year research need: Solve technical problems identified in gap analysis.
- 20-year research need: Implement PTC nationwide—yards as well.

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

#1 issue on NTSB Top Ten “Most Wanted” list.

Group #4

Automated assisted inspections for track (e.g., machine vision).

DESCRIPTION

Track inspection is suited to automated methods due to the repetitive nature of the process. Technologies such as machine vision should be applied to improve the efficiency and effectiveness of these processes.

SUBTOPICS

- Detection of missing components
- Detection of broken components
- Real time vs. post processing ↔ implications for regulatory changes
- First priority – broken rail detection
- Second priority – switch position detection in “dark” territory

TIME FRAME

- Gap in current research
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Addresses top two causes of train accidents.

Group #5

Performance-based track geometry standards.

DESCRIPTION

Produce performance based track geometry standards (vs.) static standards which can address multiple causes

SUBTOPICS

One subtopic could include the acceleration of multiple deviation derailment causes by equipment type

TIME FRAME

- Gap in current research: Acceleration work underway
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Increase the ability for railroads to increase safety while maintaining or reducing regulation compliance costs.

Could also be expanded to include review of other regulations for additional adoption of performance approach such as rail flaw inspection to facilitate new and more efficient inspection technologies or locomotive equipment to take advantage of more informed inspection and maintenance approaches outside traditional inspection periods.

Group #5

Development of machine vision technologies to apply generally in the railroad environment.

DESCRIPTION

Man / machine interfaces and intermodal interfaces can result in injury. Machine/computer vision can assist in warning / prevention.

SUBTOPICS

Machine vision to:

- Inspect rail cars and trains
- Monitor property
- Monitor grade crossings
- Measure track typology

TIME FRAME

- Gap in current research: Machine vision technologies.
- 5-year research need: Develop technology.
- 20-year research need: Implement technology.

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

There are many situations / circumstances where traditional sensor technologies are ineffective—machine vision technologies can fill these gaps.

Group #5

Ability to track hazmat cars and detect any material release—develop device.

DESCRIPTION

Equip all hazmat cars with device that can be GPS tracked and will send alert if material release happens.

SUBTOPICS

- Motion generators for power requirements
- Study hazmat routing

TIME FRAME

- Gap in current research
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Current ability to track hazmat cars with 100% certainty is not available. Small chemical releases are currently detected only by human interaction.

Group #5

Research the total cost of postponement of grade crossing separation with goal of accelerating number of grade crossing separations.

DESCRIPTION

Determine total cost including amortization of train delay and loss of transportation to the community affected – consider alternative and lower cost techniques of grade separation.

SUBTOPICS

- Best practices from other countries including the costs and engineering techniques
- Development of total cost model
- Inventory of existing crossings
- Limit number of new crossings

TIME FRAME

- Gap in current research
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Safety to public and employees, efficiency, and capacity of rail operations all impacted by this issue

Group #5

Develop PARETO analysis of why people trespass.

DESCRIPTION

Determine leading causes of people using rail rights-of-way so that solutions can be prioritized to reduce incidents

SUBTOPICS

- Yards
- Line-of-road
- Grade-crossings

TIME FRAME

3 years

- Gap in current research: Don't know of any research being done.
- 5-year research need: 1 to 2 million.
- 20-year research need: Initial research may point the of longer term.

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Injury / death record speaks for itself – security issue as well

Group #5

Establish a long-term effort to improve highway-rail grade crossing safety by forming a cross-functional team of major stakeholders.

DESCRIPTION

Establish a joint [FRA/FHWA/railroads/AASHTO/railroad suppliers/railroad labor] highway-rail grade crossing accident reduction team. The team will establish yearly goals for accident reduction, and report progress annually in a one day forum. Efforts will be linked to ITS programs too.

SUBTOPICS

The team will sponsor research/development programs / projects

TIME FRAME

- Gap in current research: Will be investigated in a one year study.
- 5-year research need: 5 to 10 individual focused research investigations on specific accident causes.
- 20-year research need: Develop a focused railroad crossing improvement program and strive for uniform Federal, State, and railroad funding of needed programs that have been identified in the research programs, projects, and forums.

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Injury/death record speaks for itself—security issue as well.

Group #6

Safe commingled operation of noncompliant vehicles.

DESCRIPTION

Research into technology and other means to allow safe operation of noncompliant passenger equipment in mixed (commingled) operation without the need for strict temporal separation.

SUBTOPICS

- Control technology (avoidance)
- Crash energy management design (survivability)
- Grade crossing issues at highway

TIME FRAME

- Gap in current research
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Will allow cost effective implementation of new start passenger services without disrupting freight. Enables lower cost, higher quality, off-the-shelf, European (or other) equipment.

Group #6

Develop automated, communication-based condition monitoring systems for infrastructure and equipment with emphasis on reliability, intelligence, and transparency.

DESCRIPTION

Gathering and integrating infrastructure and equipment condition data at the granular level in order to present it for historic and predictive analytics as well as to operational – dash board displays. Tools will greatly aid scheduled and unscheduled maintenance.

SUBTOPICS

- Develop guidelines for ride safety and quality for passenger and freight equipment to facilitate wider use of autonomous ride meters.
- Autonomous track geometry inspection systems
- Way-side detectors
- On-board monitors

TIME FRAME

- Gap in current research
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Group #6

Identify low-cost improvements to passive warning devices at grade crossing and development of intermediate-level “semi-active” warning device (e.g. solar-powered/self-powered) that does not involve use of track circuits.

DESCRIPTION

- Intermediate system between crossbuck and high cost conventional signal systems involving flashing lights, bells, gates;
- Could include relaying information into automobile or truck;
- Could also warn engineer of vehicle obstruction in crossing

SUBTOPICS

Study effectiveness of deploying highway signage including stop sign and yellow intermediate warning.

TIME FRAME

- Gap in current research
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

- To make better use of improvement funds to better protect more crossings;
- Improves ability of driver to notice crossings and act safely;
- Improves awareness of both locomotive and road vehicle drivers;
- Helps in difficult rural crossings where sight lines are poor.

Group #6

Introduce low-cost collision avoidance technology for trains and maintenance of way equipment.

DESCRIPTION

Provide warning to trains and MOW equipment that are moving toward collision, i.e. opposing move or overtake on same track.

SUBTOPICS

- Location determination (GPS, etc.)
- Wireless communications
- Human warning/ indication
- Track authority limits

TIME FRAME

- Gap in current research
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

- Reduce train to train and train to MOW collision incidents;
- Lower cost solution than PTC.

Group #6

Do a risk-based analysis on tank car safety for handling of hazmat (poison gas, TIH materials) relative to car construction, routes, and handling.

DESCRIPTION

Need to ensure that analysis on tank car safety takes into account all factors “multi-functional” versus just the tank worthiness. Should TIH and poison gas be handled by RRS?

SUBTOPICS

- RR routes—operating around cities increases cost, reduces efficiency
- Security
- Common carries obligation

TIME FRAME

- Gap in current research
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

- Before we design the “perfect” tank car can we prevent 100% of risk?
- Understand the overall handling requirements of the product hauled
- Are there alternatives?

Group #7

How to economically implement PTC: Go to one system that will be interchangeable between RR's (IE) the AAR, MARKER.

DESCRIPTION

Despite all the pilot projects there hasn't been a solid case made for the cost / benefits of PTC

SUBTOPICS

- Interoperability of PTC systems
- Train and track integrity for communications based train control
- Moving track block determination
- Solution for train measurement and braking prediction algorithm

TIME FRAME

- Gap in current research: Each different RR is doing this same thing.
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

PTC is expensive to implement but important to capacity, safety, etc.
Developing an economical implementation plan will allow for its easier adoption.

Group #7

Heavy axle load research.

DESCRIPTION

Mitigation of the adverse effects of heavy axle loads on infrastructure and freight cars. Testing and evaluation of the effects on track components and vehicles at the facility for Accelerated Service (FAST) and in revenue service

SUBTOPICS

- Testing of new and untried track components
- Testing and evaluation of track maintenance procedures
- Evaluation of stress-state mitigation techniques
- Evaluation of vehicle components (wheels, trucks, axles)
- Train automation and control systems

TIME FRAME

- Gap in current research: Evaluation of new and improved vehicle and track components under 315K and 286K cars.
- 5-year research need: HAL research.
- 20-year research need: HAL research—Long-term performance issues.

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

- Safety implications of HAL.
- Need to determine impact of 315K cars under controlled conditions to advise the industry of the benefits and adverse effects.
- Revenue service tests of track components under 286K cars.
- Capacity and Efficiency and economic impact of HAL

Group #7

Automated track inspection.

DESCRIPTION

Research on better methods to detect rail flaws and other rail defects and ensure track integrity to improve safety and efficiency

SUBTOPICS

- Detection of rail flaws and under surface defects
- Ability to predict track geometry degradation
- High speed testing of track
- Track buckling and slide detection—track integrity
- More reliable testing—less false positives and fewer missed defects

TIME FRAME

- Gap in current research
- 5-year research need: All of the above.
- 20-year research need: Continuing refinement of rail inspection.

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Ongoing risk reduction of track-related accidents

Group #7

Trespasser behavior and attention.

DESCRIPTION

More railroads are installing video cams on their locomotives to reduce grade crossing collisions, train accidents, and other incidents. This project would explore this resource systematically to learn about trespassers as well as grade crossing user behavior. A second part would test systems to effectively warn trespasser pedestrians who often don't respond to train whistles.

SUBTOPICS

1. More systematic and complete analysis of locomotive videocam tapes
2. Development and testing of alternative systems to warn trespasser pedestrian on the track (e.g. police sirens)

TIME FRAME

- Gap in current research
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Trespassers account for about half of all rail related fatalities, and about 80% of trespassers killed are struck by trains or other ontrack equipment. Grade crossing uses account for another 35%

Group #7

Human factor accidents.

DESCRIPTION

Accidents in the rail industry caused by the action or inaction of a person employed in the rail industry because of any one of several factors

SUBTOPICS

- Fatigue
- Close calls
- Crew issues
- Investigation of accidents

TIME FRAME

- Gap in current research
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

The greatest cause of reportable accidents is caused by a person. The elimination of these accidents on main lines and yards would save the railroad and the public from accidents which, on main lines, tend to be catastrophic in nature.

Group #8

More effective mining and use of rail safety and related data to support safety research.

DESCRIPTION

1. Mine existing data to identify most cost effective safety improvements.
2. Determine railroad operations and safety data needed to support on-going research and safety cost-benefit analyses.
3. Determine gaps in available data and develop program(s) to fill gaps.

SUBTOPICS

- Identify available research results for cost-effective application
- More detailed accident descriptions
- Industry-wide data on operations by track class, signal system, etc.

TIME FRAME

- Gap in current research
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Present research programs are hampered by lack of this data.

Group #8

Uniform risk assessment methodology.

DESCRIPTION

Increasingly, risk assessment is being used as tool to evaluate new technologies and processes. Overly rigorous methodologies tend to act as a barrier to innovation.

SUBTOPICS

- Evaluation of effectiveness of current technology/process - provide baseline
- Incremental vs. “all or nothing” introduction strategies
- Monitoring during introductory phase to improve data/risk profile
- Survey of use of risk assessment in other industries
- Thorough understanding of external costs and benefits

TIME FRAME

- Gap in current research
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

- Valuable tool/increasing usage
- Perception that R.A. is insensitive to incremental improvement
- Perfection need not be the enemy of progress

Group #8

Do current safety and task-execution training practices meet the needs of both employees and employers?

DESCRIPTION

Access four areas that create an iterative loop:

1. Are the most important safety principles identified and taught?
2. Are the safe task execution principles tied to idea of successful job completion?
3. Do both managers and employees track and use feedback on successful safety and operations?
4. Do we create safer operations and higher employee retention through creation of this positive feedback loop?

SUBTOPICS

- Prescreening of hires
- Setting right expectations
- Rule books must be understandable

TIME FRAME

- Gap in current research: Unknown.
- 5-year research need: See last paragraph below—Huge!
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

- All railroads will have to hire approximately 60% of their train and engine workforce over the next 6 years
- Current projections show that U.S. will be about 10,000,000 workers short by 2010.

Group #8

Comprehensive safety and human factors analysis of the railroad environment.

DESCRIPTION

Identify safety issues and solutions associated with:

- Crew behavior
- Trespasser behavior
- Grade crossing behavior (drivers, pedestrians, bicyclists, etc.)
- Implementation of new technologies (communications, computer-based track warrants, personal equipment for rail employees, etc.)

SUBTOPICS

- Human factors implications of new technologies
- Crew performance (incentives/disincentives)
- Human reactions in and around railroads

TIME FRAME

- Gap in current research
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

The interaction of humans with railroad equipment, operating rules and warning devices continues to be the source of many rail accidents. Implementing certain technological solutions requires changes in mindset and possibly procedures used by employees to carry out their duties. The public also must adjust their actions in response to new warning devices or other systems/procedures implemented by railroads.

Group #8

Implementation of best practices in the railroad industry.

DESCRIPTION

Many technology advances have been made in the last 10 years. How can these technologies and management practices be applied in the rail environment?

SUBTOPICS

- Management
- New materials used in other industries – application to rail industry
 - Smart sensors
 - Longitudinal Force management

TIME FRAME

- Gap in current research: Technology transfer—need broader surveys.
- 5-year research need: Industry materials and technologies that could be adapted to improve safety.
- 20-year research need: Adapt best management practices to implement changes in workforce and technologies.

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Railroads are changing due to ageing workforce, massive changes in new employee attitude, work habits and job satisfaction values.

Group #9

Security and the threat of terrorist activity.

DESCRIPTION

There is a threat of terrorist activity that needs to be prevented, detected, and mitigated to prevent harm to people, property, and the economy.

SUBTOPICS

- Assessment of terrorist threats, methods of attack, targets
- Vulnerability assessment
- Effectiveness of mitigation measures, hardening infrastructure, rolling stock, control systems, computers
 - Response to and recovery from attacks
 - Appropriateness of threat levels
 - Incompatibility between safety and security measures regarding hazmat (signage may alert terrorists to targets of opportunity)
- How protect access to information

TIME FRAME

- Gap in current research
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Group #9

Understanding and mitigating the impact of silos between various groups and organizations that inhibit communications and information exchange.

DESCRIPTION

Dialogue is limited between rail, regulators, communities, law enforcement, safety and others. Research needs to contribute to understanding what contributes to this problem and developing tools, strategies to address it.

SUBTOPICS

- Land use next to railway property
- Communicating re zoning and re-zoning
- How to open communications and develop working tools
- Silos between stakeholders are different from silos between organizations

TIME FRAME

- Gap in current research
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Many problems can be resolved if all groups and organizations were to share knowledge, explain issues, and have an open mind for change.

Group #9

What performance-based standards can be used that will equal or improve on existing prescriptive standards?

DESCRIPTION

As our understanding of the dynamics of railway system operations increases and as our use of measurement and detection technologies improves, the use of performance based standards may often improve the level of safety beyond that provided by existing prescriptive standards.

SUBTOPICS

- Visual track inspection requirements
- Train speeds over unsignalled territory
- Remote control of rolling stock
- Worker fatigue standards
- Use of technology to reduce the costs of roadway worker protection

TIME FRAME

- Gap in current research
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Group #9

Examine human factors as a contributing cause of injuries.

DESCRIPTION

Human factors are the largest cause of derailment and injury. Research on the following sub-topics needs to be conducted as a means to reduce this factor.

SUBTOPICS

- Employee fatigue: how does fatigue affect employee reactions and railroad operations
- Communication between generations: how do the generations react to and interact with one another, when part of the workforce is at the end of a career and the other is just starting
- Risk-taking, especially slipping/falling
- Effectiveness of training

TIME FRAME

- Gap in current research
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Fatigue is a general problem for all transport modes. Arbitrary rules, such as hours of service, may not address the issues of fatigue on a practical and constructive basis.

Group #9

Enhance community involvement on grade crossing safety and trespasser issues.

DESCRIPTION

Research is required to gain community involvement on grade crossing elimination and safety improvements to crossings. This research should also encompass trespasser fatalities. Focus should be on grade crossing and trespasser accident elimination.

SUBTOPICS

- Grade crossing closures
- Grade separations
- Crossing safety enhancement
- ROW management (e.g. environmental issues, such as spraying)
- Trespasser issues

TIME FRAME

- Gap in current research
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Grade crossing and trespasser accidents have the potential to cause derailments from emergency braking procedures. Elimination of these hazards would significantly decrease the derailment potential.

Group #10

Human factor research description.

DESCRIPTION

Develop and validate human factor guidelines for the design and evaluation of the rail system including:

- Improve cause code taxonomy and classification system and process to ensure they are collected consistently and provide deeper understanding of root cause.
- Tie all data together for producing leading indicators data for system safety.
- Develop stakeholder R&D program development to review data for making proactive R&D investments and other actions.
- Develop a risk model of causes and consequences to include human factors and other aspects of system behavior.
- Training and simulation guidelines for emergency situations, i.e., derailments, attacks, system failures etc.
- Ergonomics design guidelines for equipment and displays.

TIME FRAME

- Gap in current research
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Group #10

Visual track inspection.

DESCRIPTION

Conduct research to develop criteria for determining geographic size of assigned inspection territory base upon factors such as traffic density, traffic operating characteristics, environmental characteristics, structural characteristics , inspector duties (i.e., inspect only vs. inspect and repair) and training.

SUBTOPICS

- Number of inspector riding in hi-rail inspection vehicle
- Frequency of recurrent training
- Opportunities to automate process through locomotive-borne sensors or other technologies

TIME FRAME

- Gap in current research
- 5-year research need: As soon as possible.
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Time available to conduct comprehensive track inspection is contingent upon factors identified in description above. Research will provide guidance for determining territory size and optimum inspection speeds to improve inspection quality.

Group #10

Track structure, ties.

DESCRIPTION

Research concrete tie degradation with considerations to training, inspection, maintenance and failure rates.

SUBTOPICS

- How does it occur and track train forces that contribute
- How to detect failure before it occurs
- What type of program on maintenance and inspection would improve tie life
- Training needs for inspectors
- Develop criteria/standards for assessing concrete ties that can easily be performed by an inspector

TIME FRAME

- Gap in current research
- 5-year research need: As soon as possible.
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

FRA standards and the experience of most industry track inspectors are based on wood tie performance and degradation. Recent derailments caused by concrete tie rail seat abrasion, demonstrate the limitations of using current wood tie based inspection strategies to inspect concrete ties.

Group #10

Reduction of grade crossing accidents.

DESCRIPTION

Grade crossing safety—analyze all available data to determine adequacy to support and conduct root cause analysis. Conduct root cause analysis of grade crossing accidents.

SUBTOPICS

- Weather conditions
- Angle of intersection
- Sight distance and humped crossing detection and signage
- Effectiveness of enforcement strategies

TIME FRAME

- Gap in current research: Root cause analysis of grade crossing accidents.
- 5-year research need: Cost-effectiveness of preventive and corrective actions to enhance crossing safety.
- 20-year research need: Low-cost eliminators of grade crossings, low-cost train-car communication and warning devices.

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Grade crossing accidents account for more than 90% of railroad-related deaths. As railroad traffic and train speeds increase, risks will increase. Action is required now to prevent increased deaths. If the FRA and the industry don't take more aggressive action and produce results in grade crossing safety, Congress will probably get involved.

Group #10

Risk-based pricing, operational strategy.

DESCRIPTION

Determine optimum strategy for handling hazmat considering operating cost, risk factors, and packaging performance.

SUBTOPICS

- Risk proposed by high prices driving hazmat to highways.
- Packaging
- Changes in rail service and pricing could have unintended consequences (i.e., traffic onto highway)
 - Critical need for “honest broker” armed with sound data.
 - Issue has huge political, economic, and regulatory consequences.
 - Study risk effect of moving traffic patterns from one are of high density to other or diversion of hazmat traffic to highways (example: DC to Pittsburgh)
 - Use of CEM technology in equipment design (consider airline, highway passenger standards)

TIME FRAME

- Gap in current research: As soon as possible.
- 5-year research need
- 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Hazmat is increasingly a high profile issues because of Graniteville and terrorist threats. The mitigating strategies (re-routing) special trains, more robust cars, all have cost and operating consequences. Project has broad use that transcend across local and State boundaries.

Group #10

Parking lot: other issues to consider.

CROSSING ACCIDENTS

Communication with autos engine approach or when approaching a crossing signal/warning goes to the driver of auto through radio, on-star type frequencies etc., install on emergency vehicles and all trucks and autos. Obstruction detectors on crossing red light cameras at crossings. How to improve enforcement (use signage/laws/zones). Public education programs (effectiveness/implemented new) work closer with court systems for enforcement of penalty.

EQUIPMENT

Locomotive sensors that can detect (structural awareness) track conditions, trespassers, weather, use to inspect tracks via video/tapes.



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