Research to Enhance Rail Network Performance
A Workshop

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Breakout Discussion Reports

Efficiency

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

Efficiency

- Eliminate potential for human error in safety and operations critical situations through application of new technologies to reduce mishaps and injuries that impact OP efficiency.
- Simplify and improve data collection with less human intervention.
- Develop performance-based standards.
- Determine the viability of performing in-consist repair to rolling stock.
- Single carload traffic assessment.
- Examine socio-technical systems to achieve velocity improvements.
- Developing tactical scheduling systems for locomotive, crew, and car assignment.
- Developing terminal decision support systems for optimizing yard operations and reducing congestion.
- Study of regulatory revisions that would encourage adoption of safer, more efficient technologies.
- Research on ways to improve mechanical, infrastructure, and operations reliability.
- Seek to increase weather preparedness and mitigate weather-related inefficiencies.
- Railway MOW efficiency: improved hardware and management systems.
- Effective minimization of grade crossings.
- To gain efficiencies by applying enhanced wayside and on-board detection systems.
- Identify technologies that can minimize or eliminate descriptive regulations.
- Extend ECP brake implementation research to describe path to application to intermodal fleet and balance of rail rolling stock.
- Complete NDGPS and research on methods for intensive use.
- Yard management system.
- Physical infrastructure reliability.
- Energy efficiency.
- Complete integration of information systems.
- Optimizing crew utilization and management.
- Increase and enhance efficiency of crew utilization.
- There are inefficiencies in railroad operation due to errors in routing.
- Improve asset utilization.
- Strategies to increase throughput and reduce dwell time of terminals.
- Research is needed to determine whether railroad efficiency can be improved through changes in the corporate organization.
- Research strategies to improve railroad energy efficiency.
- Improvements to merchandise carload network.
- Single-person crew.
- Develop computer-based train control logic to maximize efficiency of train operation, track maintenance time, locomotive utilization, and one-person crew through review of customer data.
- Objective reevaluation of safety regulations.

- Develop equipment and infrastructure monitoring systems for bad acting equipment and components removal to improve efficiency.
- Examine and analyze variations in train makeup, handling to optimize operating efficiency (e.g., train length and layout).
- Parking lot: other issues to consider.
- Heavy axle load research.
- Network efficiency.
- Research on technologies to improve rail efficiencies.
- Risk-based safety performance standards for locomotives.
- Automated track inspection. (see Safety Breakout Discussion Reports, p. 37).
- Development and implementation of fully automated train inspection systems to increase network reliability (see Capacity Breakout Discussion Reports, p. 38).
- Research the effect of replacing current FRA regulations with a risk based performance system.
- Develop computer-assisted train driving system.
- Rail employee effectiveness.
- The efficiency of terminal operations is increasingly important given the drastic growth of intermodal traffic and railroad/trucking partnerships.
- Find ways to reduce fuel costs through efficient alternate power sources, improved car design, and reduction of locomotive idling.
- Identify regulations that impede efficiency and have little remaining value for safety or other purposes.
- Social efficiencies.
- Implementation of one-person train crews.
- Fuel efficiency.
- Methods to improve the utilization of “loose cars.”
- Efficient utilization of human resources.
- System velocity.
- A review of national transportation policy.
- Fuel efficiency.
- Improve Class-I-to-Class I and Class-I-to-regional interface.
- Parking lot: other issues to consider.

Group #1

Eliminate potential for human error in safety and operations critical situations through application of new technologies to reduce mishaps and injuries that impact OP efficiency.

DESCRIPTION

Identify key error frequencies for process disruptions and target new technologies to override or provide a check on employee decisions.

SUBTOPICS

- M of W work limit protection
- Dispatch error protection
- Authorities to isolate “at risk” situations.

TIME FRAME

☐ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Near full capacity state of rail systems contribute to major systems impacts when employee errors disrupt planned workflow.

Group #1

Simplify and improve data collection with less human intervention.

DESCRIPTION

Integrate data collection as part of doing work vs. a separate task.

SUBTOPICS

- Bar coding
- RFID
- Wireless downloading

TIME FRAME

☒ Gap in current research

☐ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Collection of real time data in conjunction with troubleshooting, trending and routine maintenance analysis will free up maintenance time to perform more wrench turning vs. non valued added activities.

Group #1

Develop performance-based standards.

DESCRIPTION

Collect, analyze demo data that demonstrates improved efficiency without sacrificing safety by moving to performance based inspections.

SUBTOPICS

- Potential elimination of intermediate inspections
- Train movement origination to destination

TIME FRAME

☒ Gap in current research

☐ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Eliminate the need to stop trains to perform required inspections. Train stops would be on an exception basis.

Group #1

Determine the viability of performing in-consist repair to rolling stock.

DESCRIPTION

Repairing certain car defects without resorting to cutting the offending car from the consist.

SUBTOPICS

- Car design-for-maintenance (DFM)
- Mobile structures to facilitate repairs
- Training to identify candidate cars

TIME FRAME

☒ Gap in current research

☐ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

This technique would avoid wasted time and effort in cutting, handling, and reassembling the consist.

Group #1

Single carload traffic assessment.

DESCRIPTION

Re-examine the impacts, benefits, and costs of single carload traffic on the carriers, shippers, and the broader economy. What is its future, and how might it be improved?

SUBTOPICS

- Economic and collateral impacts (community, industry, environmental, etc.)
- Operational and system improvements to lower costs
- New technology—classification facilities, local switching, etc.
- Shortlines
- Cross-modal

TIME FRAME

☐ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Carload system is rapidly changing as railroads devote resources to unit trains and TTX traffic that is growing rapidly. At the same time, the shipping community is evolving rapidly as well, which affects the future value of carload service.

Group #1

Examine sociotechnical systems to achieve velocity improvements.

DESCRIPTION

Research would identify key aspects of worker morale and engagement, and identify social issues that could impede efficiency improvements identified as achievable with technology improvements.

SUBTOPICS

- Improve sociotechnical systems to increase efficiency and buy-in
- Examine demographic differences in the workforce
- Use scanning technologies where feasible
- Improve methods to keep workers involved in system performance and success
- Involve workforce from inception to make training effective

TIME FRAME

☒ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Understanding and responding to workforce motivations and capabilities will play a central role in increasing velocity in areas (e.g. yards) where significant improvements in efficiency could be achieved.

Group #2

Developing tactical scheduling systems for locomotive, crew, and car assignment.

DESCRIPTION

A railroad uses three important resources: car, crew and locomotives. Most of the resource assignment is done manually. There is a significant need to develop algorithms and software solutions that would assign cars, locomotives and crew to trains to optimize system-wide efficiency. This project consists of developing optimization-based approaches that would assign cars to trains considering train capacities, assign locomotives to trains depending upon the pulling power required and assign crew to trains considering crew rules. Dynamic resource assignment will increase network capacity significantly and increase velocity; the two most important challenges faced by the major railroads.

SUBTOPICS

- Developing tactical locomotive assignment systems for trains to reduce delays due to locomotive power
- Developing tactical crew assignment to minimize crew costs
- Dynamic car to block assignment to improve car velocity
- Dynamic block to train assignment to reduce yard congestion

TIME FRAME

☒ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Group #2

Developing terminal decision support systems for optimizing yard operations and reducing congestion.

DESCRIPTION

As traffic is increasing on U.S. railroads, yards are getting congested and increasingly becoming bottlenecks in network capacity. This project concerns developing software solutions for yard design, operation and expansion. There are three types of yards: hump, flat and intermodal with their own unique characteristics. This project will develop algorithms for tactical assignment of yard resources (crew, locomotive, and track) to improve utilization; and embed these algorithms within a simulation framework to understand system performance and to perform a variety of what-if analyses.

SUBTOPICS

- Developing algorithms for block-to-train assignment (flat and hump)
- Developing box to car loading at intermodal terminals
- Developing methods for determining yard capacities
- Developing simulation framework for analyzing yard operations
- Optimal new yard design and expansion and redesign of existing yards

TIME FRAME

☒ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Group #2

Study of regulatory revisions that would encourage adoption of safer, more efficient technologies.

DESCRIPTION

Certain FRA regulations are stifling efficiency and are even a deterrent to improving safety. For example, railroads must seek waivers with regard to rail defect detection. FRA also imposes burdensome requirements with regard to implementation of flange bearing crossing diamonds even when research indicates they would be safer than conventional diamonds. Certain locomotive, car and train inspection requirements are also unnecessary and inhibit efficiency improvement.

SUBTOPICS

- Flange bearing crossing diamond research (already completed)
- Development of internal rail defect growth prediction models to support regulation relief
- Locomotive defect data/review with goal of reducing inspection requirements
- Research to determine if safety appliances can be reduced on equipment

TIME FRAME

☒ Gap in current research: Need for reviewing regulations and determining whether new technologies or research makes some regulations impractical.

☒ 5-year research need: Continue regulatory review, migrate to performance-based regulations.

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

This research is important for efficiency/capacity increases. In some cases, regulation revisions can improve safety by allowing unimpeded introduction of new technologies that supplant the need for certain regulations.

Group #2

Research on ways to improve mechanical, infrastructure, and operations reliability.

DESCRIPTION

Quantitative analysis of principal factors affecting train delay and the most effective preventive measures.

SUBTOPICS

- Track system and bridges
- Rolling stock
- Locomotives
- Traffic control system
- Operations and dispatching

TIME FRAME

☒ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Group #2

Seek to increase weather preparedness and mitigate weather-related inefficiencies.

DESCRIPTION

Institute research and related programs to overcome network inefficiencies and related problems brought on by extremes of weather.

SUBTOPICS

- Improved lighting-protection for wayside electronics
- Greater regional RR cooperation
- Ensure communications redundancies
- Improved technologies to overcome weather-related problems
- Improved cold weather braking systems

TIME FRAME

☒ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Group #2

Railway MOW efficiency: improved hardware and management systems.

DESCRIPTION

R&D on MOW equipment to improve the effectiveness and efficiency of maintenance crews and minimize track time requirement. Development of data systems and software to better manage and schedule maintenance activities and MOW gang assignment.

TIME FRAME

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

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Group #3

Effective minimization of grade crossings.

DESCRIPTION

Researching and determination of an incentive program that is effective at eliminating unnecessary grade crossings ($15K U.S./$20K Canada does not seem to be sufficient).

SUBTOPICS

Research into

- Community impact vs. cost-benefit
- Establishing a “productivity cost” of a crossing
- Establishing restricted use grade crossings at specific times (restricted use = denied use)

TIME FRAME

☐ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

- Reduced grade crossing collisions and fatalities.
- A grade crossing is a productivity cost to the railroad.

Group #3

Develop to gain efficiencies by applying enhanced wayside and on-board detection systems.

DESCRIPTION

Develop and improve upon wayside and on-board detection systems to predict component failure and detect excessive wear.

SUBTOPICS

- Economic on-board track inspection equipment providing daily inspection
- Communication from wayside and on-board systems to train control systems
- Automate inspections to eliminate scheduled stops due to FRA regulations

TIME FRAME

☒ Gap in current research

☐ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Predicting pre-fail conditions that will cause rail carriers to react to conditions and schedule repair activity and eliminate catastrophic failure.

Group #3

Identify technologies that can minimize or eliminate descriptive regulations.

DESCRIPTION

New technologies have been developed that can allow activities that were heretofore performed annually on a prescriptive basis to be clear as needed in an automated manner. These technologies can potentially continuously improve upon the accuracy of these activities.

SUBTOPICS

- Maintenance process
- Automated inspection techniques
- Operating requirements

TIME FRAME

☐ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

This research can improve the operating efficiency of the maintenance and operating departments.

Group #3

Extend ECP brake implementation research to describe path to application to intermodal fleet and balance of rail rolling stock.

DESCRIPTION

Describe costs, benefits and ways and means to transition to electronically-controlled pneumatic brakes.

SUBTOPICS

- Locomotives
- Intermodal fleet
- Other unit trains (e.g., grain fleet, chemicals)
- General merchandise
- Costs, benefits, assignment of responsibility

TIME FRAME

☒ Gap in current research

☐ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

On going FRA research suggests initial application to Powder River Basin coal fleets (locomotives and cars). Need to determine migration for balance of the rolling stock.

Benefits

1. Reduced fuel consumption
2. Higher speeds with existing blocks (shorter stopping distances)
3. Higher reliability (e.g., fewer UDEs)
4. Reduced loss and damage
5. Reduced component wear

Group #3

Complete NDGPS and research on methods for intensive use.

DESCRIPTION

NDGPS will, when completed, have manifest value in some areas (PTC, for example); but, there are likely to be many additional ways to use the improved position determination and communications capability. Research should pinpoint these added uses.

SUBTOPICS

New Uses of NDGPS

- Location of track faults
- Accident location
- Tracking of hazardous shipments
- Management of high-priority trains including passenger trains

TIME FRAME

☒ Gap in current research: Complete ND GPS System.

☒ 5-year research need: Evaluation of added uses.

☒ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

NDGPS should be completed in the next few years. The value of good position determination in real time is vital for PTC applications, but can also be high for other uses described above. Since added use of the basic signals is effectively at zero marginal cost then added uses can add a lot of value and should be identified and promoted.

Group #4

Yard management system.

DESCRIPTION

Develop an electronic information management system to increase efficiency and safety of yard operations.

SUBTOPICS

- Integrated with other management systems
- Will assist in helping decide when and where to land trains and the most efficient methods of switching. This system, similar to positive train control, should look for broken rail, and open or closed switches.

TIME FRAME

☒ Gap in current research

☐ 5-year research need

☒ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

If we electronically devise the most efficient way to switch, we can minimize time needed and exposure to risk by minimizing moves.

Group #4

Physical infrastructure reliability.

DESCRIPTION

Focus research on eliminating service interruptions caused by track issues, human factors and car health issues.

SUBTOPICS

- Track health monitoring—on-board locomotive
- Car health monitoring system
- Management system to direct decisions based on analysis of data

TIME FRAME

☒ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Matt Rose and Will Moorman both emphasized this as the top critical issue having the greatest potential for increasing network capacity.

Group #4

Energy efficiency.

DESCRIPTION

New research is needed to understand the implications of more expensive energy, the environmental impacts of today's mix of energy sources, alternative strategies to increase efficiency through sustainable energy strategies, and increased use of railroads for freight and passenger movements.

SUBTOPICS

- Lessons learned from fuel management strategies.
- Research and development of fuel-cell locomotives as a prototype for other hydrogen-based transportation.
- Research revisiting the idea of main-line electrification as a contribution to lowering emissions of greenhouse gases.
- Investigate practicality of nano-technology applications to reduce train rolling resistance.
- Understand fuel saving benefits of electronically controlled brakes and PTC-based train pacing.
- Development of improved locomotive crew assists for better fuel use.

TIME FRAME

☒ Gap in current research: Lessons learned research.

☒ 5-year research need: PTC and improved locomotive designs, such as Green Goat and truck engine switches.

☒ 20-year research need: Alternative fuel locomotives and electrification.

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

- Higher fuel costs may persist.
- Railroad inherent fuel efficiency may help RRS attract freight back from highways.
- Global climate change impact is becoming increasingly well understood, and solutions will be sought more aggressively in the near future.

Group #4

Complete integration of information systems.

DESCRIPTION

Need to bring together information from multiple, independent systems, to eliminate duplication and to provide comprehensive data to all who need it, and only those who need it.

SUBTOPICS

- Identify existing systems.
- Identify gaps and overlaps.
- Develop design for integration.
- Identify stakeholders.
- Design new system to be compatible with existing systems.

TIME FRAME

☒ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Individual systems provide limited data for planning operations and maintenance. Need to disseminate more broadly to operations managers. Needed to understand interrelationship of independent systems.

Group #4

Optimizing crew utilization and management.

DESCRIPTION

Study current problems resulting from non-productive time by train crews and efficiency impact of mass hiring in recent years.

SUBTOPICS

- Length of runs as factor in crews outlawing.
- Excessive duty tours/limbo time/relieving crews on line of road (deadhead issues).
- Better tools for crew management and utilization (e.g., tracking qualifications).
- Effects of operating "Too close to the edge."
- Training next generation of operating employees.

TIME FRAME

☒ Gap in current research

☐ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Millions of dollars and thousands of hours are spent by "outlawed" crews annually, adversely affecting efficiency. Most of this waste should be susceptible to remediation. Also, significant hiring of operating employees is ongoing to address systemic shortages. How can current training be improved to integrate these new hires into the workforce as seamlessly as possible?

Group #5

Increase and enhance efficiency of crew utilization.

DESCRIPTION

Provide predictable work plans for train crews

SUBTOPICS

- Improve retention of qualified employees
- Provide work windows that produce regularly scheduled days of rest
- Time of work schedule provided to employee X hours / days in advance

TIME FRAME

☒ Gap in current research: Some experiments underway—to permanent system.

☒ 5-year research need: $2.0 million

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

- Turnover of new employees
- Fatigue
- Family stress
- Divorce
- Other

Group #5

There are inefficiencies in railroad operation due to errors in routing.

DESCRIPTION

Develop strategies to improve execution quality, e.g. eliminate excess handling due to incorrect routing e.g. improve switching accuracy and consist accuracy

SUBTOPICS

- Incorrect identification of cars and lading
- Incorrect routing of cars in hump yards
- Inaccurate (out of service?) AEI operation / readers

TIME FRAME

☒ Gap in current research: Car and lading logistic error identification and rectification.

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Group #5

Improve asset utilization.

DESCRIPTION

Research methods, processes, approaches, etc., to improve railroad key assets utilization

SUBTOPICS

- Improve locomotive velocity/utilization
- Improve car velocity/utilization, particularly carload traffic (cycles/yr , loaded car miles /yr)

TIME FRAME

☒ Gap in current research: Document current state-of-the-art in optimizing car and locomotive utilization.

☒ 5-year research need: To conduct studies.

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Although train velocity is sometimes used as a key efficiency measure, improvements in utilization of locomotives and cars (as separate independent elements) are more precise measures of improving overall system efficiency

Group #5

Strategies to increase throughput and reduce dwell time of terminals.

DESCRIPTION

Terminals have significant impact on the efficiency of the network due to locomotive and car dwell and throughput performance. This includes all terminal activities including classification yards, intermodal terminal performance and other terminal types.

SUBTOPICS

- Hump yard and flat yard performance
- How to increase throughput of classification activities
- Improved network coordination for locomotive, crew and train operations
- Intermodal terminal management
- Car and locomotive servicing management
- Impact of remote control of locomotives on efficiency

TIME FRAME

☒ Gap in current research

☐ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Asset velocity is highly dependent on time spent in terminals and back-ups in terminals adversely impact line of road performance. Effective capacity of classification yards appears to be dropping, which further increases the importance of this issue.

Group #5

Research is needed to determine whether railroad efficiency can be improved through changes in the corporate organization.

DESCRIPTION

The major railroads are organized internally along functional lines developed over 100 years ago. The question arises as to whether these structures create internal and external divisions that effect performance and efficiency. The issue of centralization of functions further complicates this issue. The research would examine the potential effects of alternative structures on efficiency.

SUBTOPICS

- Centralization of functions
- Barriers to performance
- Information flow
- Coordination of activities
- Strategic planning

TIME FRAME

☒ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Institutional changes may be more easily converted to increased efficiency than hard side (physical structures, etc.) changes that require R&D and intensive capital investment.

Group #5

Research strategies to improve railroad energy efficiency.

DESCRIPTION

Railroads are energy efficient but a major operating cost component remains, that of fuel. Small savings in fuel relate to larger energy cost savings.

SUBTOPICS

- Reduce energy costs by improving locomotive energy utilization using information technology
- Research the use of alternative fuels
- PARETO and research sources of energy wastage in hauling trains

TIME FRAME

☒ Gap in current research: Opportunities to further reduce energy costs and oil dependence.

☒ 5-year research need: All subtopics.

☒ 20-year research need: Alternative fuels.

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Reduce energy cost to railroads and U.S. strategic dependence on oil.

Group #6

Improvements to merchandise carload network.

DESCRIPTION

Research opportunities to improve performance of the merchandise carload network to enhance:

- Shipment/car velocity
- Shipment reliability
- Investability

SUBTOPICS

- Leveraging 21st century IT/communications technology.
- Updating FRA/AAR research from 1980's/1990's (MIT)
- Customer perspective on cost/service tradeoffs.

TIME FRAME

☒ Gap in current research

☐ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Merchandise carload freight comprises approximately 1/3 of national rail loadings but has proven the segment most resistant to improvements in service and asset utilization. Customer satisfaction remains low although much latent demand remains for the service, if improved. Merchandise carload service has a high public benefit due to avoidance of most urban congestion associated with truck or intermodal. New technology may offer opportunity for step-change input.

Group #6

Single-person crew.

DESCRIPTION

Research impact of single-person operations on safety and efficiency of over-the-road operations and impact on line capacity.

SUBTOPICS

- Supplemental safety measures required/changes in existing regulations.
- Varying requirements for speed/territory/train type size.
- Work/rest issues unique to SPC.
- North American operating environment vs. other continents where SPC in effect now.
- Train/employee assistance issues – how to best handle.

TIME FRAME

☒ Gap in current research: Depends on outcome of current railroad contract negotiations.

☐ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Single person crew is the next major productivity enhancement for NA Class I railroads. The current subject of collective bargaining, a move to SPC could come quickly. SPC is widely utilized in Europe, Asia, and Australia, but NA operating conditions may require different approaches to the safety and operating environment.

Group #6

Develop computer-based train control logic to maximize efficiency of train operation, track maintenance time, locomotive utilization, and one-person crew through review of customer data.

DESCRIPTION

This is all about using the computer to make decisions that people must make using their logic patterns that will effectively utilize the railroad network and all its assets. This will also enable one-person crews to safely and effectively operate trains over great distances.

SUBTOPICS

- Review of current regulations.
- Review of computer algorithms.
- Understand major customer requirements for flow.

TIME FRAME

☒ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

- Will enable safe one-person crews.
- Will enable more trains to operate in same corridor.
- Will improve utilization of assets.

Group #6

Objective reevaluation of safety regulations.

DESCRIPTION

Reevaluate existing safety regulations that may not add net value to current environment. Safety that could result in improved efficiency +/- velocity if restructured.

SUBTOPICS

- Immediately taking track out of service when rail defect is located.
- Equipment/train inspection requirements that are time- or departure-based rather than performance-based.

TIME FRAME

☒ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

There is a (possibly under-evaluated) cost/efficiency loss resulting from dated safety regulations that may not fully recognize new SOA monitoring and defect detection technologies.

Group #6

Develop equipment and infrastructure monitoring systems for bad acting equipment and components removal to improve efficiency.

DESCRIPTION

Would include wayside and on-board technologies including telematics to relay information to local crews and to control office for remediation planning and execution.

SUBTOPICS

- Sensors
- Computer-based models
- Artificial vision and intelligence systems
- Novel maintenance/replacement techniques (for components)

TIME FRAME

☒ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Minimize delays, reduce safety threats, reduce operating costs.

Group #6

Examine and analyze variations in train makeup, handling to optimize operating efficiency (e.g., train length and layout).

DESCRIPTION

Integration of all pertinent operational environmental customer data at the atomic level, which is then filtered by applicable business rules to produce a "Day of Operation" recommendation and "cost" of variation from the recommendations. Presupposes data availability.

SUBTOPICS

- Objective is to express optimal train length.
- Train handling and train makeup conditions based on each day's operation.

TIME FRAME

☒ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Group #6

Parking lot: other issues to consider.

SAFETY

- Develop a database that identifies equipment, signal, and infrastructure reliability.
- Develop a model to measure comparative safety data across modes. Have it be:
  - Risk-based analysis.
  - Look at effects on and from other modes (e.g., service patterns and technology).

EFFICIENCY

- Vision and Research need: Develop and apply business case and social case model to research items to help maximize benefits.

Group #7

Heavy axle load research.

DESCRIPTION

Advanced materials and designs, testing and evaluation. Mitigate impact on travel and equipment through testing at FAST and in revenue service.

SUBTOPICS

- Improved special tradework designs and materials
- Flange bearing frogs
- Bridge designs, materials, and upgrades
- Core fatigue Load environment
- Improved trade transition designs
- Testing of cars, wheels, axles and suspension systems

TIME FRAME

☒ Gap in current research: Confined research to mitigate effects.

☒ 5-year research need

☒ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Fewer locos, cars will lead to improved safety and efficiency while improving available capacity.

Group #7

Network efficiency.

DESCRIPTION

Increase throughput and velocity on entire North American network of main lines and terminals.

SUBTOPICS

- Improved, modern hump yard systems
- Models to optimize train lengths
- Dispatch techniques to smooth speeds, avoid hurry and wait
- Coordination between nearby carriers
- Quantify benefits of CREATE project

TIME FRAME

☒ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Allow RRs to absorb growth in traffic as congestion relief, especially on highways.

Group #7

Research on technologies to improve rail efficiencies.

DESCRIPTION

Improve rail efficiency utilizing alternate power sources, more efficient locomotives, reduced idling technologies, improved wheel–rail interface, steerable trucks, and improved aerodynamics.

SUBTOPICS

- Idling reduction
- Fuel efficient locomotives
- Wheel–rail interface lubricants
- Reduced drag
- Efficient car design

TIME FRAME

☒ Gap in current research

☐ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Great opportunity to reduce fuel consumption, reduce pollutant emission and decrease costs to rail.

Group #7

Risk-based safety performance standards for locomotives.

DESCRIPTION

Develop/modify proposals to implement risk-based safety performance standards for locomotives that would enable suspension of detailed regulatory requirements for daily and periodic locomotive inspections.

SUBTOPICS

- Review/refine existing proposals
- Identify/collect data to demonstrate feasibility
- Apply data run in accident, injury, inspection and/or precursor in parallel with current regulations
- Implement standards, suspend inspection requirements

TIME FRAME

☐ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Permits major increase in the efficiency and flexibility of locomotive maintenance and management.

Group #8

Research the effect of replacing current FRA regulations with a risk based performance system.

DESCRIPTION

Identify suitable areas to pursue, develop performance metric, estimate cost benefits, then implement a pilot project to measure/test the process.

SUBTOPICS

- Use of wayside defect detectors to eliminate visual inspections
- Use of on-board diagnostics to eliminate locomotive inspections
- Use of track/rail inspection technology to eliminate track inspections

TIME FRAME

☒ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

This has the potential to eliminate the need for certain inspections while improving safety. Reduced inspections will improve efficiency and reduce down time on equipment.

Group #8

Develop computer-assisted train driving system.

DESCRIPTION

Computer-aided operations to optimize fuel economy, scheduling, advance look-ahead distance. Research should be focused to result in reduced crew size.

SUBTOPICS

- Efficient use of fuel (controlled accelerations and breaking)
- Man-machine interface
- Pass on wayside and on-board monitoring system to communicate with central dispatch

TIME FRAME

☒ Gap in current research: Human factors to incorporate more routing and network information into cab.

☒ 5-year research need: Simple man-machine interface

☒ 20-year research need: A highly reliable system to replace train crews.

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

To eliminate potential for human error while reducing long, boring hours of labor that can be automate.

Group #8

Rail employee effectiveness.

DESCRIPTION

With regard to the effectiveness of the rail industry workforce, develop an operating and business model that delivers on efficient return on the business assets.

SUBTOPICS

- Clarity on definitions of success
- Equitable transition plan
- Management and contract goal alignment
- Rational work rules
- Goal-driver training for both task execution and on improved management approach

TIME FRAME

☒ Gap in current research: Unknown.

☒ 5-year research need: Roads will lose 50% of all employees in next 5 years which creates a change-receptive environment.

☒ 20-year research need: Equip roads to better use newer technologies and respond to market changes.

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Today’s management and labor interaction is driven by 100 year old rules based on ancient technology and decades of thinking about shrinking, not about growing.

Group #8

The efficiency of terminal operations is increasingly important given the drastic growth of intermodal traffic and railroad/trucking partnerships.

DESCRIPTION

Operations research into the transfer of containers within an intermodal yard could yield process improvement which improve the speed of throughput and reduce the cost of handling. Similarily, O.R. for terminal operations may have promise.

SUBTOPICS

- Implications on demand for intermodal service of recent surge in rail/track partnerships
- Cost effective means of local distribution
- Implications on economical rail trip length of more efficient terminal ops and local distribution
- External benefits (air quality, highway congestions, energy consumption way maintenance of increased use of rail for carload and intermodal

TIME FRAME

☐ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Improved terminal operations could play a significantly positive role in reducing trip times (increasing velocity) and shifting freight movement from highways to rail with the attendant public benefits to congestion, air quality, highway maintenance, safety and energy efficiency.

Group #8

Find ways to reduce fuel costs through efficient alternate power sources, improved car design, and reduction of locomotive idling.

DESCRIPTION

Research to identify methods and technologies that can reduce fuel usage.

SUBTOPICS

- Alternate fuels: bio diesel, natural gas, electricity
- Improved train aerodynamics
- Alternate generating sources (gas turbines)
- Stand-by power for shut-down locomotives
- Waste energy recovery from dynamic brakes, etc.

TIME FRAME

☒ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

With fuel costs remaining high, the need to reduce fuel usage has become paramount.

Group #9

Identify regulations that impede efficiency and have little remaining value for safety or other purposes.

DESCRIPTION

Assess costs/benefits of existing regulations. High cost/low value regulations would be identified, along with alternative responses including: revocation, sunsetting, replacement with performance-based regulations, replacement with new/revised regulations.

SUBTOPICS

- Consider use of value-analysis techniques.
- Important for government and industry to work together throughout the process.

TIME FRAME

☐ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Old, obsolete, ineffective regulations create inefficiency and add costs with little benefit.

Group #9

Social efficiencies.

DESCRIPTION

Assess ways to improve and/or develop trust, awareness, and knowledge within communities.

SUBTOPICS

- Protocols between railway and emergency services
- Mechanisms to address issues when they arise
- What makes communities/groups distrust the rail industry
- How to enhance rail culture's attention to its responsibility to communities that railroads run through

TIME FRAME

☐ Gap in current research

☐ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Group #9

Implementation of one-person train crews.

DESCRIPTION

Research is required on the efficient implementation of one-person train crews. Solutions will be required for line of road failures and fatigue issues for one person crews will be different than with present crew sizes. Locomotive cab issues will also need to be addressed.

SUBTOPICS

- How to handle line of road failures
- Fatigue issues
- Locomotive cab issues
- Operating practices changes

TIME FRAME

☐ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

For the improved efficiency of railroad operations.

Group #9

Fuel efficiency.

DESCRIPTION

Research on the causes of fuel efficiency and changes in practices are needed to improve our fuel efficiency. Alternative fuels may offer savings in fuel costs.

SUBTOPICS

- Locomotive efficiency
- Train resistance: bearings, wheel/rail friction, aerodynamic drag
- Train handling practices
- Locomotive consist management
- Alternative fuels
- Regenerative braking and energy storage

TIME FRAME

☐ Gap in current research

☐ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Fuel consumption is a large cost to railroads, amounting to 15% of total operating costs.

Group #9

Methods to improve the utilization of “loose cars.”

DESCRIPTION

Conduct a review of effective practices (past and present) that improve the utilization of “loose” cars, so that the entire rail system (and customers and labor) will benefit and a balkanized approach is avoided.

SUBTOPICS

- How take a network-level perspective?
- Balkanization of approaches

TIME FRAME

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

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Car utilization for “loose car” business is very poor.

Group #10

Efficient utilization of human resources.

DESCRIPTION

Define future railroad skill set requirements in order to develop proper training, job aids, and levels of automation, to perform work more efficiently.

SUBTOPICS

- Job aids to provide engineer with the means to deliver better fuel efficiency, without the need to memorize local geography and track geometry.

TIME FRAME

☐ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Given major workforce turnover, increased introduction of technology, and the need to attract and retain new workforce, this research is needed in order to maintain the proper number of skilled staff.

Group #10

System velocity.

DESCRIPTION

Research on new management techniques to improve speed and volume of shipments through better control of dwell time system outages.

SUBTOPICS

- Dynamic classification yard management.
- Traffic forecasting.
- System disruption recovery planning.

TIME FRAME

☐ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Idle and dwell times remain the dominant consumers of railcar utilization.

Group #10

A review of national transportation policy.

DESCRIPTION

Review current trends that will impact the efficient movement of freight and passenger traffic.

SUBTOPICS

- Future energy costs.
- Future traffic volumes.
- Environmental issues.
- Projected standard of living.

TIME FRAME

☐ Gap in current research

☐ 5-year research need

☒ 20-year research need: 10–20 years.

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Environment, congestion, energy costs trends in public health would indicate a fundamental change is coming. A systematic study of trends and perspective outcome could help guide public policy.

Group #10

Fuel efficiency.

DESCRIPTION

Fuel costs are rising for railroads, and fuel efficiency continues to be a critical goal of research efforts and technical development. USDOE research funding for railroad fuel efficiency is very small in comparison to funding for highway/automobile fuel efficiency.

SUBTOPICS

- Locomotive engine efficiency
- Alternative fuels
- Friction minimization/air/top of rail
- "Autopilot" systems for locomotive operation (similar to airplane autopilot)

TIME FRAME

☐ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

- Environment sustainability
- Dependence on foreign oil
- Cost efficiency of transportation

Group #10

Improve Class I-to-Class I and Class I-to-regional interface.

DESCRIPTION

There appears to be "dead time" in interchange points. This reality has been a driving factor in rail mergers.

SUBTOPICS

- Different priorities in investments
- Are there public policy investments in systems, infrastructure etc. that will encourage parties to cooperate.

TIME FRAME

☒ Gap in current research: One year gap.

☐ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Government needs to invest in improving interchanges (like Chicago project). Different companies have (and properly so) differing business models – different priorities for service, investments, etc. Service to the customer is often the victim of such disconnects.

Group #10

Parking lot: other issues to consider.

CONSIST DATA INTEGRITY

- Inventory entering/leaving terminals

IMPROVE INTERMODAL YARDS EFFICIENCY

- Load/Unload in public facilities
- Highway capacity
- Environmental
- Wayside-noise
- Use of land

TRACK REPAIR

- When/How to do track work to optimize use of track, time, schedule, trains, manpower, etc.
- Scheduling versus ad hoc.
- Track equipment with increased speed mobility.
- Train vs. crew wait time.
- Are blitzes more efficient?

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