Research to Enhance Rail Network Performance
A Workshop

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Breakout Discussion Reports

Capacity

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

Capacity

- National network capacity modeling.
- Health monitoring systems and methodologies: To research effective, reliable, and cost-efficient intelligent systems that can be used in real time for detecting/monitoring rolling stock and rail (infrastructure) health.
- Better understanding of the operations, service speed, line capacity, labor, and fuel consumption impacts of PTC.
- Projects of regional and national significance.
- Reduce reliance on fossil fuel.
- Network modeling, analysis, and optimization.
- Continuing to develop PTC to standardize platforms to the extent possible and to jump start the implementation. The business cases must be further promoted.
- Communication systems to support future RR operations.
- Complete research on electronically controlled braking (ECP) systems.
- Develop employee optimization model that minimizes employee fatigue and strives to improve employee's safety quality of life, while meeting the need for efficient operations.
- Improve MOW process to limit time required on track. Model development to select work locations and to schedule maintenance activities; need to assess impact of process charge or worker performance.
- How do we bridge the time gap between investment and return on investment?
- Study train dispatcher T/D workload and communication access.
- Determine parameters leading to optimal train length.
- System performance measurers.
- Development of models to measure the capacity of the system, either a single system of combinations of systems.
- Train control systems that incorporate safe operating practices as well as operational experience.
- Examine performance of single vs. multi-track corridors.
- Positive train control implementation.
- Service failure recovery plan.
- Electronic brakes to allow improved capacity.
- Public-private partnerships:
  - Allocation of benefits of added capacity, and
  - Demonstration of actual benefits
- Capacity assessment tool kit to understand the capacity of rail network and payback of investments.
- Develop best practices strategies for improving and expanding terminal capacity.
- Obtain a consensus understanding of what train delays cause mainline capacity limits.
- Develop a framework for an intelligent dispatching system that can act as a traffic management system.
- Balanced transportation policy.

- Maintenance best practices.
- Mainline velocity smoothing.
- Unmanned electronic track inspection which is predictive and can trend maintenance requirements.
- Opportunity for increased capacity of carload freight classification yards.
- Virtual signal system that is vital and increases capacity on dark railroad.
- Causes of capacity constraints, their respective contribution and associated cost.
- Identification and enhancement of existing capacity.
- Establish RR R&D (clearinghouse) function.
- Operations research, network planning.
- How to economically implement PTC.
- Development and implementation of fully automated train inspection systems to increase network reliability.
- Capacity improvements and asset utilization improvement.
- Identification of regulatory processes and impediments to the establishment of public–private partnerships (P3).
- Review opportunities to improve the movement of freight and people in major metropolitan areas.
- Currently, there is no commonly accepted method to allocate costs in relationship to benefits for rail network capacity improvements that use some level of public funding.
- Research the effect of replacing current FRA inspection regulations with a risk based performance system.
- Solutions to the root causes of the most disruptive track outages or in-service structural failures.
- More capacity (in the actual operations phase) by reducing unplanned variances to the operating plan.
- More capacity (in the planning phase) by building and utilizing a network flow Model that quantifies benefits of new technologies.
- Justification for public investment in rail capacity as part of public-private partnerships.
- Research and development of software and tools to support intelligent train dispatching minimizing the workload on the dispatcher and optimizing system performance.
- Quantify the impact of unplanned disruptions on capacity, and identify solutions to correct the causes.
- Examine the obstacles to attracting and retaining a qualified workforce. Find solutions to overcome those obstacles.
- Optimization of nationwide rail network through the development of a nationwide model.
- Develop a recommendation for a capacity model.
- Quality of life and human resources.
- Develop equipment to support higher tare weight.
- Evaluate economic and safety benefits of electronic brake technology implementation.
- PTC research gaps to explore.
- Parking lot: other issues to consider.

Group #1

National network capacity modeling.

DESCRIPTION

Develop means to understand rail network capacity for main lines and terminals, evaluate bottlenecks in terms of system impacts, and use as tool to prioritize potential public investment in rail infrastructure.

SUBTOPICS

- Line segment
- Terminal
- Strategic vs. tactical uses

TIME FRAME

☒ Gap in current research

☐ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

- We need a means to rationally examine network capacity across the entire system, not just individual lines and terminals.
- As demand for public investment grows, potential investments must be prioritized.
- Ties in with other efforts to examine impacts of rail investment that are ongoing.

Group #1

Health monitoring systems and methodologies: To research effective, reliable, and cost-efficient intelligent systems that can be used in real time for detecting/monitoring rolling stock and rail (infrastructure) health.

DESCRIPTION

Use the latest technologies in laser measurement systems, sonic evaluation methods, wireless radio communication, energy harvesting, signal processing, and high accuracy GPS gathering/analysis (GIS data) to provide a real-time assessment of the track and equipment health.

SUBTOPICS

- Wireless Communications
- Low-power (Class I) laser measurement systems (Laders and Loders)
- Sonic-based systems
- High accuracy (survey-grade) GPS methods and implementation
- Data and information harvesting
- NDGPS utility

TIME FRAME

☒ Gap in current research: 5 – 10 years

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

This research will greatly contribute to maximizing the usage of equipment and rail, without the current requirement for periodic inspection that reduces available track capacity. This research will introduce “intelligence” into our current railroad practices.

Group #1

Better understanding of the operations, service speed, line capacity, labor, and fuel consumption impacts of PTC.

DESCRIPTION

Comprehensive modeling and cost benefit assessment of PTC implementation in at least three distinct corridors or regions.

SUBTOPICS

- Leveraging enriched OPS data streams
- Physical infrastructure design implications
- Motive power strategies
- Labor impacts

TIME FRAME

☐ Gap in current research

☐ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Current focus of PTC is safety only or use in dark territory only.

Group #1

Projects of regional and national significance.

DESCRIPTION

Identify rail chokepoints (including coexistence with commuter and passenger) and root causes for major delay. Define macro multi-state private public benefits, including ability to divert major million ton per year. truck moves to rail mode. Involve all stakeholders into the solution.

SUBTOPICS

- Infrastructure fixes that benefits corridor performance
- Infrastructure fixes that benefits multiple states and regions
- Infrastructure fixes that permit major increase in trains/growth
- Infrastructure fixes that now preclude growth, forcing traffic to highway
- Safety, hazardous materials, and air quality benefits

TIME FRAME

☒ Gap in current research: DO IT NOW! It's a mess out there.

☐ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Rail is at capacity; some projects so big, only multiple beneficiaries can justify the investments. Without action, future rail growth will be forced to already congested highways.

Group #1

Reduce reliance on fossil fuel.

DESCRIPTION

Research Project: Identify the most effective/efficient alternative to diesel fuel. Develop concept to exploit selected alternative to include infrastructure required to support the selected alternative.

SUBTOPICS

- Nuclear energy
- Hydrogen
- Bio
- Electricity

TIME FRAME

☒ Gap in current research: Immediate

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

- Dependency on energy from foreign countries
- Rising cost of oil
- Diminishing resource – ultimate capacity reduction
- Price of fuel could potentially box out short lines from competing, reducing rail network capacity

Group #1

Network modeling, analysis, and optimization.

DESCRIPTION

Development of rail network modeling, analysis simulation and optimization tools to support improved decision-making from the micro to macro level. Decisions include designing optimal service plans to improve resource utilization, increasing capacity, reducing line and yard congestion. Optimal investment in infrastructure.

SUBTOPICS

- Infrastructure design (expanding line capacity-multiple tracks, sidings, signaling)
- Tools for yard modeling, tactical operations, & yard capacity expansion
- Decision support systems for designing blocking plans and train schedules.
- Dynamic trip modeling–assigning cars to blocks and blocks to train dynamically to improve resource utilization

TIME FRAME

☒ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Group #2

Continuing to develop PTC to standardize platforms to the extent possible and to jump start the implementation. The business cases must be further promoted.

DESCRIPTION

Various PTC or PTC like projects are under consideration or in the demonstration process. These include NAJPTC, ETMS, and CBTC. FRA research can sort out the pros and cons of each such that a common technology can be developed and deployed on an interchange basis.

SUBTOPICS

- Switch point position
- Broken rail detection
- GPOS mapping
- Communications platforms

TIME FRAME

☒ Gap in current research: What is the best technology for implementation? Need broken rail mapping strategies for signal and non-signal lines.

☒ 5-year research need: Continue development and implementation described above.

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

A fully implemented PTC technology will provide safety, capacity, and efficiency benefits.

Group #2

Communication systems to support future RR operations.

DESCRIPTION

Analysis of emerging communication systems, to support the expected growth of data flow/transmissions (From multiple, data-rich sensors) with the railroad network.

SUBTOPICS

- Support to PTC systems
- MOW digital data requests
- Onboard data transmission and train handlings
- Train health
- Train location
- Database integration efforts

TIME FRAME

☒ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Volume of data through the communications backbone will support goal of increasing railroad operations

Group #2

Complete research on electronically controlled braking (ECP) systems.

DESCRIPTION

Significant preliminary research has been conducted on ECP braking systems that permit train braking applications to take place more rapidly and consistently. Such technology will permit a closer interval between trains (thereby enhancing capacity and efficiency) as well as promote safety (shorter stopping distances). Further research and testing is necessary before this technology can be adopted into revenue service.

SUBTOPICS

TIME FRAME

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

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

A high perceived cost-benefit ratio and promising research to date.

Group #2

Develop employee optimization model.

DESCRIPTION

Develop employee optimization model that minimizes employee fatigue and strives to improve employee's safety quality of life, while meeting the need for efficient operations.

SUBTOPICS

- Fatigue
- Quality of life
- Rest days
- Holiday coverage

TIME FRAME

☐ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Employee turnover reduction is important in this day of worker shortages. Improving quality of life for employees will help address employee satisfaction and retention.

Group #2

Improve MOW process to limit time required on track. Model development to select work locations and to schedule maintenance activities; need to assess impact of process charge or worker performance.

DESCRIPTION

As increased track densities and levels of train operations compete for time slots with track maintenance activities, the need for more efficient maintenance procedures and practices and more effective materials and track components are required to minimize operational degradation and maximize worker safety.

SUBTOPICS

TIME FRAME

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

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Group #3

How do we bridge the time gap between investment and return on investment?

DESCRIPTION

Long-term national planning may require private railroads to make investments many years before the return is realized. Are there ways to provide incentives to (a) help realize benefits earlier and (b) see it in their self interest to commit despite the delays.

SUBTOPICS

- Environmental review process
- Availability of "gap" financing through public – private partnerships
- Note relationships to development of metric to measure capacity
- Role for STB, SEC, public funding? (tax credits, RIFF, etc.)

TIME FRAME

☐ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Cannot ask private actors to support what Wall Street cannot support.

Group #3

Study train dispatcher (T/D) workload and communication access.

DESCRIPTION

As network capacity diminishes, the demands for the attention and time of the T/D proliferate. At all times, there are multiple, simultaneous request from the field (and the office) for information and authority, as well as attempted transmittals of critical information for the T/D; including for example, “Emergency! Emergency! Emergency!” Increasing modes of communication and centralization of dispatching locations may or may not improve the safety and efficiency of the dispatching function. The current generational shift in control center staffing will have a negative effect on dispatching efficiency, and therefore capacity.

SUBTOPICS

- Communication Access
- Human- Machine Interface
- Centralization Dispatching Facilities
- Impact of T/D Retirements on available institutional knowledge
- 21st Century Technology applied to an aging plant

TIME FRAME

☒ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

The utilization of the institutional knowledge of current and former T/D’s should be a central component of long-term planning of operational needs and capacity.

Group #3

Determine parameters leading to optimal train length.

DESCRIPTION

It is necessary to determine optimal train length for specific yard, power and main line characteristics versus the cost of running more frequent shorter trains.

SUBTOPICS

- Capacity/ speed/ infrastructure maintenance conflict
- Effects of scheduling
- Human factors in negative behavior at grade crossings
- Track-train dynamics
- Calculating the full (social) cost of train failures

TIME FRAME

☐ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Concept that longer trains = more productivity is not proven.

Group #3

System performance measures.

DESCRIPTION

Although there is an emerging consensus that the U.S. Class I's are encountering "capacity" problems, there is no real agreement on capacity problems, how serious they are, how fast they are emerging, and what to do about them. There is a need for a uniform set of performance measures (by railroad, possibly regions by region, or line by line) to show where capacity problem exist or will exist given traffic trends.

SUBTOPICS

- On-time performance for freight trains
- Measures of yard congestion
- Average train speeds
- Trend in output per locomotive, car, and employee.

TIME FRAME

☒ Gap in current research: Initial measures

☒ 5-year research need: Develop better measures, establish time series

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

"Capacity" or "congestion" is not an adequate way to characterize the problem especially if scarce public investments (or tax credit resources) are to be targeted and prioritized. If capacity or congestion is to be alleviated, we need better measures to identify capacity or congestion problems, where they are emerging, and how to alleviate them.

Group #3

Development of models to measure the capacity of the system, either a single system of combinations of systems.

DESCRIPTION

What are the elements of the system or combination of systems that define capacity? How do we model the capacity and identify the bottlenecks to know the capability of the system to be improved or the additional business to be taken.

SUBTOPICS

- Track/line capacity
- Terminal capacity
- Network design – train speed, schedules
- Operating practices – schedule vs. tonnage, PTC vs. CTC or TWC
- Locomotive management
- Equipment management/capability
- Signaling system

TIME FRAME

☒ Gap in current research

☐ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

With additional demand for freight transport, primarily intermodal and coal, the rail system appears to be near capacity. It is important to know the best place to add capacity.

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/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)

To improve the safety of the systems by maximizing the intelligence of the train control systems to be implemented thereby minimizing the risk.

Group #4

Examine performance of single vs. multi-track corridors.

DESCRIPTION

Conduct a parametric analysis of the cost, service, safety, and capacity of single, double, triple-track corridors. Consider technologies potentially available for track, locomotives, equipment, maintenance, and train control. Consider multiple classes of service, both freight and passengers.

SUBTOPICS

- Life-cycle infrastructure cost
- Train speed, train delays
- Safety and recovery

TIME FRAME

☐ Gap in current research:

☒ 5-year research need: This information will support public/private partnerships.

☒ 20-year research need: Basic knowledge necessary to understand nature of Interstate Rail System

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Average train speed on single track is limited to 20-25 mph, which limits capacity and increases equipment requirements. With multiple tracks, a corridor can handle more trains, more efficiently and also handle different classes of trains more easily. The costs of the track structure need to be composed with the operating savings and safety benefits as well as opportunities for increasing labor productivity.

Group #4

Positive train control implementation.

DESCRIPTION

Explore strategies to enhance PTC implementation. Develop lessons learned for information sharing purposes.

SUBTOPICS

- Message latency between loco/dispatch/way side
- Moving block strategies in PTC to increase capacity
- Braking algorithm for PTC when train's mass is not known
- End of train position/exact train length for clearing sidings
- PTC operations when system components fail
- Mixing PTC equipped and non-equipped trains on a given track segment. Should it be allowed?
- Maintaining accuracy of track GIS files, and up-dated for slow orders, MOW, etc.
- Establish interoperable industry operating rules for running train under PTC, failing gently and recovering

TIME FRAME

☒ Gap in current research: Breaking algorithm, message latency, lessons learned

☒ 5-year research need: Operating rules, EOT position, regional implementation

☒ 20-year research need: Goal of national system implementation

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

- Save lives, add capacity
- "Better to avoid the collision rather than clean up the mess."

Group #4

Service failure recovery plan.

DESCRIPTION

Develop plan to minimize service interruption delay time.

SUBTOPICS

- Identify root causes
- Improve methods and planning for service recovery
- Target top 5 causes and recommend plan to address, e.g., unplanned track maintenance, human factor, derailments, grade crossing accidents
- Quantify capacity gains if the service interruption had not happened at all

TIME FRAME

☒ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

- Great potential for direct capacity gains
- Recent/forecasted capacity demands do not allow for down time.

Group #4

Electronic brakes to allow improved capacity.

DESCRIPTION

An ECP brakes implementation strategy is needed. ECP will allow shorter occupancy blocks and increase capacity. Other benefits will include train component health monitoring. This will reduce service failure occurrence (and increase effective capacity).

SUBTOPICS

- Selection from competing technologies
- Allows for shorter stopping distances
- Train component monitoring to improve reliability
- In conjunction with PTC, will allow dynamic block definition and allocation
- More even braking should reduce wheel and brake component failures

TIME FRAME

☒ Gap in current research: Implementation strategy

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Will also have significant benefits to safety. This technology will improve train performance which can be used for capacity and/or efficiency improvements.

Group #4

Public-private partnerships

- **Allocation of benefits of added capacity, and**
- **Demonstration of actual benefits.**

DESCRIPTION

Need for economic research to support allocation between public and private entities
Document successes and failures
Provide incentives for increase participation

SUBTOPICS

- Freight operations growth forecast
- Capacity to accommodate commuter/intercity passenger
- Capacity for diversion of truck traffic

TIME FRAME

☒ Gap in current research

☒ 5-year research need

☒ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

AASHTO/TRB have identified need to accommodate growth in freight that cannot be accommodated by highways. Increasing interest by states and Metro areas in new commuter services, state initiatives in intercity passenger services.

Group #5

Capacity assessment tool kit to understand the capacity of rail network and payback of investments.

DESCRIPTION

One must assess where to invest in the infrastructure to improve capacity. To do this one must understand capacity on both a local and network level. Thus need suite of standard network and subcomponent analysis tools.

SUBTOPICS

- Overall network model to assess impact of improving specific subcomponents
- General capacity assessment handbook / guidelines
- Terminal capacity tools
- Line capacity tools
- Impact of traffic mix on capacity

TIME FRAME

☒ Gap in current research

☐ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Capacity is a key issue.

Group #5

Develop best practices strategies for improving and expanding terminal capacity.

DESCRIPTION

Highlight those areas where tools or physical design offer potential for improving terminal performance to include human factors.

SUBTOPICS

- Scheduling of work
- Physical configuration
- Entry / exit / bypass
- Operating techniques
- Management and training

TIME FRAME

☒ Gap in current research: Little done on national basis.

☒ 5-year research need: $1 million

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Terminals are the “nodes” in the rail network and can potentially offer impedance to flow equal to or greater than the “links.” All train movements eventually require a terminal

Group #5

Obtain a consensus understanding of what train delays cause mainline capacity limits.

DESCRIPTION

Gather data from all Class 1 railroads on mainline train delays and draw PARETO.

SUBTOPICS

For each bar of the PARETO, define needed research to reduce impact of that cause

TIME FRAME

- ☒ Gap in current research: No industry consensus and focused effort
- ☒ 5-year research need: Complete initial study (PARETO) in two years
- ☒ 20-year research need: Complete sub-project in 5 years

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Create ownership of problem of both FRA and railroads to establish team approach to problem resolution

Group #5

Develop a framework for an intelligent dispatching system that can act as a traffic management system.

DESCRIPTION

A system that can locate and track all trains in real time. Also, can automatically adjust schedules, minute by minute, and can make decisions concerning schedule adjustments.

SUBTOPICS

- PTC – real time tracking of trains
- Car scheduling / management and
- Power scheduling
- Crew scheduling

TIME FRAME

☒ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Maximizes existing assets

Group #5

Balanced transportation policy.

DESCRIPTION

Define, determine and document the public benefits of allocating transportation dollars:

- Public / private partnerships }
- PTC investments } use of highway trust funds?

SUBTOPICS

TIME FRAME

☒ Gap in current research

☐ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Group #5

Maintenance best practices.

DESCRIPTION

Define best practices to expedite maintenance to reduce time track out of service:

- Design track and time components with longer life
- FHWA “accelerated construction” model

SUBTOPICS

TIME FRAME

☐ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Group #5

Mainline velocity smoothing.

DESCRIPTION

Research into mainline velocity smoothing to reduce unnecessary speed changes and train handling—increase overall over-the-road capacity of the line.

SUBTOPICS

TIME FRAME

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

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Group #6

Unmanned electronic track inspection which is predictive and can trend maintenance requirements.

DESCRIPTION

Railbond equipment that is unmanned and can evaluate truck conditions and trend condition degradation as well as target planned maintenance for optimum tack time.

SUBTOPICS

- Wireless technology
- Automated systems integrated w/other predictive equipment
- Locomotive Base vs. Rail car
- GPS

TIME FRAME

☒ Gap in current research: ?

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

- Provided opportunity to do maintenance when the track time is available and enable more effective repairs at the right time.
- Does not take capacity from constrained confiders unnecessarily
- Prevents unnecessary slow orders which tend to be reactionary vs. planned.

Group #6

Opportunity for increased capacity of carload freight classification yards.

DESCRIPTION

Examine opportunity to increase capacity and performance of carload switching facilities through changes in management, inspection/safety regime, FRA regulations and technology.

SUBTOPICS

- FRA regulations pertaining to yard operations, particularly brake test/mechanical inspection
- Technological solutions to establish equivalent levels of safety w/increase production and productivity
  - employee safety
  - train accidents
- Alternate safety management systems to accomplish same goal
- Potential new design for classification facilities incorporating potential safety changes.

TIME FRAME

☒ Gap in current research: Very little yard design/operation research post-1990

☐ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

- Production has decreased at many carload freight yards over past two decades
- Merchandise carload freight has a particular public benefit as a result of direct rail delivery (generally no associated truck drayage in urban areas)
- Merchandise carload network is constrained by switching capacity at major network yards
- Adding yard capacity through infrastructure investment is extremely expensive.

Group #6

Virtual signal system that is vital and increases capacity on dark railroad.

DESCRIPTION

Issuing train movement authority to locomotive without wayside signals, and insulated joints. Would provide broken rail detection and switch position to locomotive.

SUBTOPICS

- PTC
- Wireless communication
- Broken rail protection
- Collision avoidance
- Subgrade condition monitoring

TIME FRAME

☒ Gap in current research

☒ 5-year research need: 5

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

If we don’t do something now-capacity on much of dark territory won’t be increased since economics will not be there.

Group #6

Causes of capacity constraints, their respective contribution and associated cost.

DESCRIPTION

Identify constraints and then link the constraint to impact on revenue, customer-satisfaction and profitability—prioritize and address root cause.

SUBTOPICS

- Derailment
- Crew availability
- Infrastructure configuration
- Network operations
- Non-signal vs. signal system use
- Environment (e.g., mudslides)

TIME FRAME

☒ Gap in current research

☐ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Group #6

Identification and enhancement of existing capacity.

DESCRIPTION

Identify low-cost "out –of box" uses of existing infrastructure and /or rolling stock to generate new business opportunities.

SUBTOPICS

- Short-haul intermodal opportunities
- Shorter trains/more frequency of services
- Creative uses of rolling stock

TIME FRAME

☒ Gap in current research

☐ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Eliminate waste of existing infrastructure and rolling stock assets, and use new "found" capacity to produce new business revenues with minimal capital investment.

Group #6

Establish RR R&D (clearinghouse) function.

DESCRIPTION

Catalog, rank and rate for practicality and applicability all known R & D efforts re: RR industry

SUBTOPICS

- Identify redundant efforts
- decide which efforts are most relevant.
- AAR, FRA, TRB, universities, ASME, IEEE

TIME FRAME

☒ Gap in current research

☐ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Group #7

Operations research, network planning.

DESCRIPTION

Predictive tools to manage asset utilization based on performance indicators

SUBTOPICS

- Market forecasting
- Mixed traffic freight / commuter

TIME FRAME

☒ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Group #7

How to economically implement PTC.

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 & braking prediction algorithm

TIME FRAME

☐ Gap in current research

☒ 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

Development and implementation of fully automated train inspection systems to increase network reliability.

DESCRIPTION

Develop, test, evaluate wayside car, train systems using machine vision & other technology driven systems, including safety appliances, truck components and car undercarriage etc.

SUBTOPICS

- Detection, inspection systems (machine vision) for car appliances and other car components
- Car features identification expert systems
- Integration of performance based inspection systems with regulatory relief
- Proactive health monitoring

TIME FRAME

☒ Gap in current research: Safety appliances undercarriage, coupler, develop gear system car features detection algorithms

☒ 5-year research need: Safety appliances and care features detection algorithms

☒ 20-year research need: Total integration

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

To reduce line of haul failures using advanced technology to improve capacity

Group #7

Capacity improvements and asset utilization improvement.

DESCRIPTION

Advanced designs in advanced materials, components and systems to improve reliability, maintainability and performance

SUBTOPICS

- Economical electronic braking systems
- Advanced components and materials to increase maintenance cycle
- Advanced designs to improve load density per track
- Freight car truck that reduces stress on track and railcar

TIME FRAME

☐ Gap in current research

☒ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Increased train traffic requires maintenance cycles to be lengthened as windows for maintenance takes away too much capacity. Utilization of assets needs to be improved, so the railroads can earn their cost of capital.

Group #7

Identification of regulatory processes and impediments to the establishment of public–private partnerships (P3).

DESCRIPTION

Development of techniques and recommended practices for identifying and communicating regulatory processes in P3 project development. Areas covered to include financial, environmental, public involvement and methods and means. Emphasis to be toward streamlining P3 projects.

SUBTOPICS

- Impediments to P3 projects
- Public funding sources
- Institutional barriers to implementation, public concerns, etc.

TIME FRAME

☒ Gap in current research: Not much, a lot of work has been done in other areas like roadway financing and project delivery.

☒ 5-year research need: Need to get all stakeholder assumptions on the same page

☒ 20-year research need: Should be a component of our national transportation policy and legislation

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

- Addresses common stakeholders interests in joint development
- Educates all stakeholders and creates common assumptions and perceptions.
- May identify numerous “grass roots” industry needs currently not part of transportation planning yielding a greater return on transportation investment.

Group #7

Review opportunities to improve the movement of freight and people in major metropolitan areas.

DESCRIPTION

Joint projects to solve public and private transport bottlenecks. For example: Expanded rail infrastructures would create the opportunity to increase freight movement, passenger and commuter rail, and the intermodal shippers.

SUBTOPICS

- Expansion of intermodal facilities
- Increase opportunities for commuter rail
- Identify bottlenecks that exist in current network
- Remove truck and passenger traffic from highway
- Reroute locomotive operations
- Reduce slow speed operation and idling

TIME FRAME

☒ Gap in current research

☐ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

- Reduce overall truck traffic.
- Improve overall rail capacity.
- Better utilization of rail, truck, and commuter rail equipment.
- Improved air quality.
- Greater efficiency and reduced cost.

Group #8

Currently, there is no commonly accepted method to allocate costs in relationship to benefits for rail network capacity improvements that use some level of public funding.

DESCRIPTION

To develop a uniform methodology and tools to quantify the benefits of public investment in rail network capacity improvements.

1. Research existing methodology and models
2. Develop tools/processes that are mutually acceptable which will allocate public and private benefits and costs.

SUBTOPICS

- Prioritizing projects for public funding
- Decision making regarding right-of-way preservation

TIME FRAME

☒ Gap in current research

☐ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Public and private sector entities have differences of opinion regarding the relative percentage of project costs each party should be expected to contribute in a public private partnership. Both sectors need realistic tools based on commonly accepted principles to access benefits and allocate benefits and costs to each party.

Group #8

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

DESCRIPTION

FRA regulations are designed to improve rail safety. Many of the regulations are very specific, are time based and based on old experience. If new technology and better methods can be employed to get the same results, the industry should be allowed to use these methods.

SUBTOPICS

- Reduce the variability of interpretation in enforcement of regulations.
- Look at use of wayside defect detectors in eliminating inspections.
- Look at on-board diagnostics on locomotives to eliminate inspections.
- Look at use of new rail detection technology to eliminate 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 or reduce the frequency of certain required inspections and improve safety at the same time. Reduction and/or elimination of the inspections will improve productivity and reduce down time on equipment.

Group #8

Solutions to the root causes of the most disruptive track outages or in-service structural failures.

DESCRIPTION

Detailed analysis of the track and structural failures having the greatest negative impact on over-the-road train velocity, identifying mitigation strategies.

SUBTOPICS

- Root causes of rail breaks (e.g., Six Sigma analysis)
- Weather-related outages
- More robust track structure
- Higher reliability materials, installation and maintenance techniques
- Failure predictability

TIME FRAME

☒ Gap in current research

☐ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Unplanned outages and service disruptions are a prime factor affecting line capacity and variance in train service performance. Reduced occurrences of unplanned track outages will significantly affect train velocity, increasing capacity at far lower cost than capital investments in capacity expansion.

Group #8

More capacity (in the actual operations phase) by reducing unplanned variances to the operating plan.

DESCRIPTION

1. Identify major causes of line of road failure
2. Develop methods to predict and mitigate major causes

SUBTOPICS

1. Locomotive and car diagnostics that keep a “failure prone” unit from leaving outbound terminal (wheel/axle/motor/other)
2. Train performance tracking that helps roads hold dispatchers and train crews for train movement quality.

TIME FRAME

☒ Gap in current research: Many, many line of road failures to run at plan level today without clean data to attach root causes.

☒ 5-year research need: Diagnostics are becoming feasible and an operating case that drives the business case is needed.

☐ 20-year research need: Should be a component of our national transportation policy and legislation

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Most roads have a feasible operating plan, but are unable to execute it due to a combination of equipment failure and lack of accountability.

Group #8

More capacity (in the planning phase) by building and utilizing a network flow model that quantifies benefits of new technologies.

DESCRIPTION

Model to include:

1. Safe "Moving" Blocks (PTS/PTC enabled)
2. Uniform Train Speeds (or quantify variance impact)
3. Shorter stopping distance (less train mass or better brakes?)

SUBTOPICS

TIME FRAME

☒ Gap in current research: Current planning models are usually fixed block "stringline" type tools and do not reflect emerging technology.

☒ 5-year research need: Be ready for PTC and new braking systems

☒ 20-year research need: Model impact of future economic growth and population shifts

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

We are going to bring these new technologies online and need tools to predict the results.

Group #9

Justification for public investment in rail capacity as part of public-private partnerships.

DESCRIPTION

Quantification of public benefits and costs of public-private funded projects to add or enhance rail capacity.

SUBTOPICS

- Air quality and locomotive idle times
- Environmental impacts/mitigation

TIME FRAME

☐ Gap in current research

☐ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

With new methods for funding railroad improvements (i.e. public-private funding partnerships) there is now a need to establish the costs and benefits associated with selecting good projects: ones that benefit the private rail companies and the system users and customers (i.e. the public)

Group #9

Research and development of software and tools to support intelligent train dispatching minimizing the workload on the dispatcher and optimizing system performance.

DESCRIPTION

Current dispatching has little automation of decision making to optimize the flow of trains across the network. There is not a systematic review of train crews, locomotive availability and selection of track maintenance windows except in the mind of the dispatcher.

SUBTOPICS

- Management of yard activity
- Management of train flow, speeds, meets and passes, optimum recovery for outages, delays, disruptions
- Track maintenance windows
- Rule based decision making
- Metrics to describe optimum system operation
- Displays of corridor congestion to describe or characterize system state

TIME FRAME

☐ Gap in current research

☐ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Optimization of the management and control of trains is needed to increase system capacity. This is beyond the scope of human decision-making. If we don't do this, we will need to spend large amounts of capital to increase system capacity by more locomotives, more crews, and greater infrastructure.

Group #9

Quantify the impact of unplanned disruptions on capacity, and identify solutions to correct the causes.

DESCRIPTION

Identify major causes of unplanned disruption and quantify these in terms of lost capacity. Rank these from highest to lowest impact. Focus corrective actions on top problems.

SUBTOPICS

- Categorize causes (groups)
- Calculate scale of disruption by group
- Identify solutions focused on top causes
- Cost/benefit analysis of solutions
- List best opportunities

TIME FRAME

☐ Gap in current research

☒ 5-year research need: Measure, rank problems, identify solutions

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

It will identify the most cost-effective methods for increasing capacity by reducing unplanned disruptions.

Group #9

Examine the obstacles to attracting and retaining a qualified workforce. Find solutions to overcome those obstacles.

DESCRIPTION

The availability of a qualified workforce, whether it be train crews, maintenance of way personnel, or mechanical forces has a direct impact on the capacity of a railway network. The purpose of this research would be to examine the obstacles to attracting and retaining a qualified workforce and to find solutions to overcome those obstacles.

SUBTOPICS

- Railroad quality of life
- Compensation and benefits in comparison to other industries
- Cost and time to qualify employees
- Public perception of railroad careers

TIME FRAME

☒ Gap in current research

☐ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Group #9

Optimization of nationwide rail network through the development of a nationwide model.

DESCRIPTION

Research is required in software to optimize the nation's rail network. Efforts are presently underway to do this by railroads individually, but with non-optimal results. This effort would produce an optimal model for the country, without impacting one particular railroad.

SUBTOPICS

- Improved train schedules
- Optimized crew schedules
- Optimized locomotive usage
- Optimized MOW work windows

TIME FRAME

☒ Gap in current research

☐ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Group #10

Develop a recommendation for a capacity model.

DESCRIPTION

Commonly agreed approach to capacity models.

SUBTOPICS

- Evaluate all models.
- Determine judgment standards
- Identify needed improvements

TIME FRAME

☒ Gap in current research

☒ 5-year research need: Less than

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Group #10

Quality of life and human resources.

DESCRIPTION

What will it take to attract and retain employees.

SUBTOPICS

- Understand quality of life issues for potential employees
- Quality of life is lower for railroad employees
- Demographics
- Populations aging
- Close the gaps, economics of effect on bottom line to attract personnel

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)

Group #10

Develop equipment to support higher tare weight.

DESCRIPTION

Information on the economic and safety implications of heavier freight cars (e.g., 315k lbs. GRL)

SUBTOPICS

- Effects on system capacity.
- Mechanical, engineering and operational effect, and requirements.
- Opportunities where economics are most likely to work out positively.
- Safety opportunities in hazmat transportation.
- Optimal weights in benefit-cost terms.

TIME FRAME

☐ Gap in current research

☐ 5-year research need

☒ 10-year research need:

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

If capacity will continue to be at a premium, inevitably car capacity must be explored again as technology and design advance. Newer opportunities such as unit trains may change the economics vs. how they appeared in previous studies. Continuous improvement of hazmat safety may require additional car features, i.e., weight.

Group #10

Evaluate economic and safety benefits of electronic brake technology implementation.

DESCRIPTION

Current cost/benefit methodologies may not fully capture real total benefits of ECP implementation, including capacity benefits.

SUBTOPICS

- Identify various optimal implementation scenarios.
- Single train operations.
- Unit train operations.
- Implementation bar.

TIME FRAME

☒ Gap in current research

☐ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

ECP has significant potential to enhance both safety capacity with improved train handling. Technology is almost fully proved, but cost barriers exist to full or even moderate implementation. A complete understanding/study of the benefits may overcome that inertia.

Group #10

PTC research gaps to explore.

DESCRIPTION

Conduct additional research to resolve interoperability issues, configuration requirements and full implementation of PTC core features to improve capacity, productivity and utilization.

SUBTOPICS

- Deal with human factors–related issues to PTC System
- Safety impact of override without unique authorization

TIME FRAME

☒ Gap in current research

☐ 5-year research need

☐ 20-year research need

WHY THIS RESEARCH IS IMPORTANT (TIME PERMITTING)

Group #10

Parking lot: other issues to consider.

HUMAN RESOURCES

- Training
- Recruitment/retention

ASSETS

Intermodal terminals

- Facility capacity
- Equipment standardization

NETWORKS

- Scheduling – handling for service interruptions (power failures, break in two).
- Methods to determine integrity of shipments throughout the trip. (example on double stacks)
- Security/capacity integration for railroads—railroad specific (standards being developed for ports/borders may not overlay if imposed on the rail industry)

PTC

Electronic Proximity Warning

- Economic analysis
- Maintenance
- Safety
- Reliance

CONSTRUCTIVE CHALLENGE TO STANDARDS

- How safe is safe enough?
- Establish a structured process for evaluating effectiveness.

TRB
TRANSPORTATION RESEARCH BOARD
500 Fifth Street, NW
Washington, DC 20001