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PATHWAYS AND POLICY FOR 21ST CENTURY FREIGHT RAIL

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PART 1

INTRODUCTION

In recent years, transportation automation technologies and their associated impacts have been widely discussed in academic, public policy, and news media environments. Most of this discussion has focused on self-driving cars, which are currently being tested by dozens of developers. Automated trucking has also seen sizable interest. But rail automation and especially automation in freight rail has garnered little attention, despite the large potential for automation-spurred safety and efficiency improvements.

The U.S. enjoys the largest and most productive freight rail network in the world. This network is privately owned, operated, and maintained, with freight rail being the least subsidized mode of transportation in the U.S. However, recent changes in rail traffic, as well as research and development activities in competing modes, underscore the need for freight rail carriers to innovate in order to remain an important segment of the transportation sector in the 21st century and beyond. The successful development and deployment of automation technologies in the future is key to ensuring freight rail's ongoing success.

This brief examines the current freight rail automation landscape. It begins by summarizing the current state of the U.S. freight rail industry, surveys recent freight rail automation development activities as well as those in competing transportation modes, continues with a discussion of current policy barriers to increasing automation in the freight rail industry, and concludes with recommendations for policymakers.

PART 2

TODAY'S FREIGHT RAIL INDUSTRY AND TOMORROW'S COMPETITION

Freight rail is well-positioned to remain viable and competitive in the U.S. during the 21st century. However, the industry must innovate to ensure this occurs. This part surveys the current state of U.S. freight rail, automation technology development activities in competing modes, and automation technology development in the freight rail industry.

2.1 STATUS OF THE U.S. FREIGHT RAIL SYSTEM

The U.S. contains the world's most extensive and productive freight rail network.[1] Carriers are privately owned and play a significant role in the broader transportation sector. But in

1 Arne Beck, et al., "Railway Efficiency: An Overview and a Look at Opportunities for Improvement," International Transport Forum, Discussion Paper No. 2013-12 (May 2013). https://www.itf-oecd.org/sites/default/files/docs/dp201312.pdf (accessed 23 June 2021).

the relatively recent past, the U.S. railroad industry was in decline and facing collapse as generations of counterproductive economic regulation took their toll.[2] Fortunately, a bipartisan consensus recognizing the harm of over-regulation formed in the 1970s. Shortly thereafter, the federal government began deregulating the industry, which culminated in the Staggers Rail Act of 1980.[3]

Partial economic deregulation under the Staggers Act led to falling freight rates and better service for customers, revitalization of national rail network infrastructure, improved safety, and more rapid uptake of new technologies and practices.

Partial economic deregulation under the Staggers Act led to falling freight rates and better service for customers, revitalization of national rail network infrastructure, improved safety, and more rapid uptake of new technologies and practices. Since 1980, average inflation-adjusted freight rates have fallen by 44%,[4] train accident rates are down 75%,[5] employee injuries and occupational illnesses have fallen by 83%,[6] all while freight railroads have invested more than $740 billion of their own funds to revitalize their networks to support a 75% increase in freight volume.[7]

In contrast to its dismal outlook in the pre-Staggers 1970s, freight rail has reemerged as a vital freight mode in the U.S. Today, freight rail effectively competes with road, water, and

2 Clifford Winston, *The Success of the Staggers Rail Act of 1980*, (Washington: AEI-Brookings Joint Center for Regulatory Studies, Oct. 2005). https://www.brookings.edu/wp-content/uploads/2016/06/10_railact_winston.pdf.

3 Staggers Rail Act of 1980, 94 Stat. 1895, Pub. L. 96–448 (14 Oct. 1980).

4 Association of American Railroads, “Freight Railroads Under Balanced Economic Regulation,” (Washington: Association of American Railroads: April 2021). https://www.aar.org/wp-content/uploads/2020/08/AAR-Railroads-Under-Balanced-Economic-Regulation-Fact-Sheet.pdf (accessed 23 June 2021).

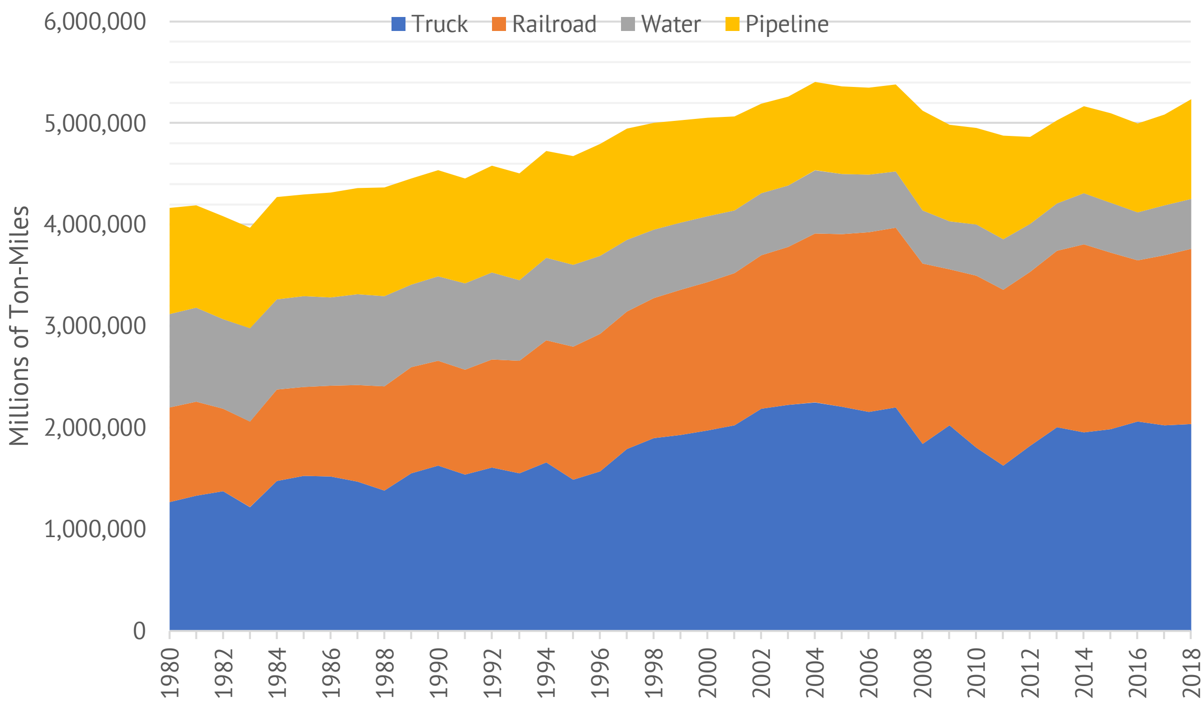
5 Association of American Railroads, *Railroad Facts 2020 Edition*, (Washington: Association of American Railroads, 2020). 62.

6 Ibid. 63.

7 Association of American Railroads, “Freight Railroads Under Balanced Economic Regulation”; Association of American Railroads, *Railroad Facts 2020 Edition*. 30.

pipeline transportation. Figure 1 displays the changing modal mix of freight transportation volume over the last four decades in U.S., where total annual freight volume moved by all modes now tops 5.2 trillion ton-miles.

FIGURE 1: U.S. FREIGHT TRANSPORTATION VOLUME BY MODE, 1980-2018



Source: Bureau of Transportation Statistics, National Transportation Statistics, Table 1-50.

Shippers may use a variety of modes depending on the circumstances. Pipeline, waterway, and rail freight transportation tend to offer significantly lower rates, greater capacity, and less environmental impact when compared to trucking, but trucking generally remains the faster and more flexible option. As such, mode choice is determined by factors such as network access, physical characteristics of the commodity being shipped, commodity value, and the value of time-in-transit.

Class I railroads are the largest railroads and own nearly 160,000 miles of track on nearly 93,000 miles of road, which forms the core National Rail Network.[8] Class I railroads are

8 Association of American Railroads, *Railroad Facts 2020 Edition*. 47. Some roads have multiple track segments, accounting for the difference between miles of road and miles of track.

defined by the Surface Transportation Board on a revenue basis, for which a $250 million annual revenue threshold was established in 1992 and is annually adjusted for inflation. For 2019, the Class I revenue threshold was just under $505 million.[9] Although there are several hundred freight railroads operating today in the U.S., the seven Class I railroads account for approximately 68% of freight rail mileage, 88% of employees, and 94% of revenue.[10] Table 1 ranks Class I railroads by revenue and includes statistics on carrier operations.

TABLE 1: CLASS I RAILROAD OPERATING STATISTICS, 2019

Railroad	Operating Revenue ($ millions)	Share	Miles of Road Operated	Share	Revenue Ton-Miles (millions)	Share
BNSF	$23,133	31.13%	32,619	27.51%	665,033	41.19%
Union Pacific	$21,708	29.22%	32,340	27.28%	423,433	26.23%
CSX	$11,612	15.63%	20,107	16.96%	199,211	12.34%
Norfolk Southern	$11,296	15.20%	19,451	16.41%	194,045	12.02%
Canadian National	$3,484	4.69%	5,854	4.94%	62,607	3.88%
Canadian Pacific	$1,582	2.13%	4,798	4.05%	37,544	2.33%
Kansas City Southern	$1,485	2.00%	3,397	2.87%	32,625	2.02%
Total	**$74,300**	**100%**	**118,566**	**100%**	**1,614,498**	**100%**

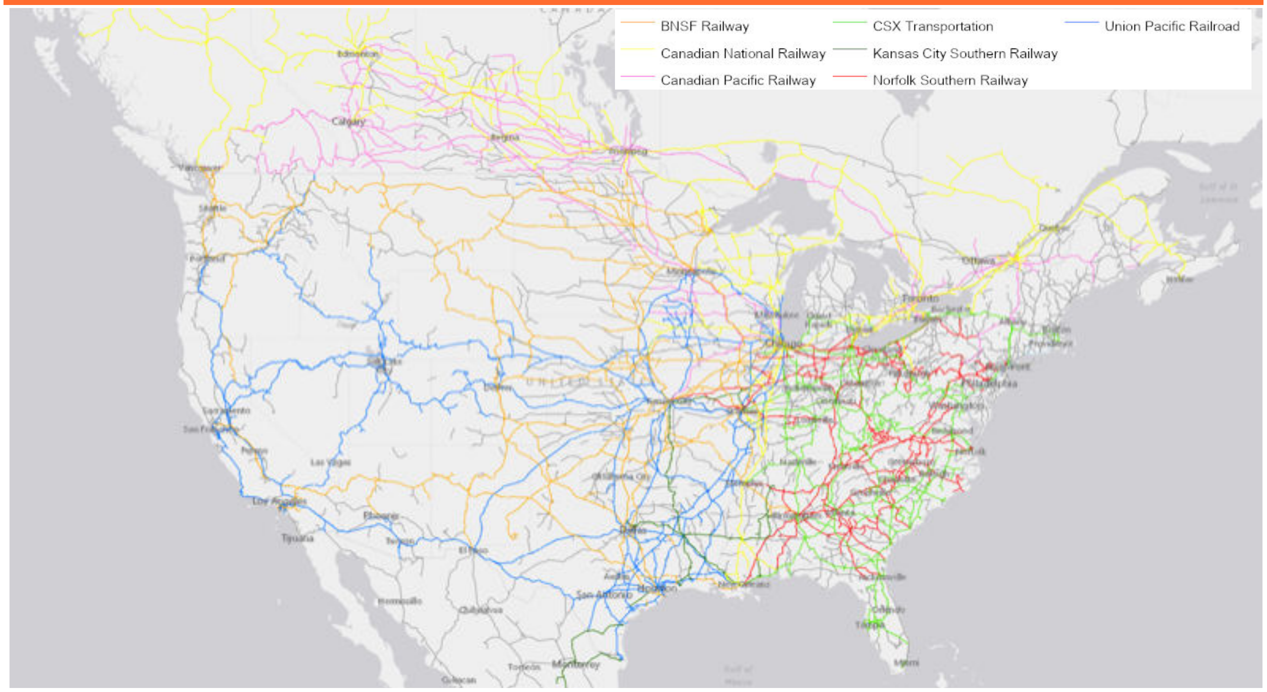
Source: Association of American Railroads, *Railroad Facts 2020 Edition*.

As Table 1 indicates, the four largest Class I railroads account for 91.18% of operating revenue, 88.16% of miles of road operated, and 91.78% of ton-miles among the seven Class I carriers. The two largest (BNSF and Union Pacific) compete most directly in the western and midwestern U.S. The third and fourth largest (CSX and Norfolk Southern) compete most directly in the northeastern and southeastern U.S. Fifth-largest Canadian National competes most directly with sixth-largest Canadian Pacific in the north, while also competing with the smallest Class I carrier Kansas City Southern on north-south traffic in the center of the continental U.S. Figure 2 shows the extent of service provided by these carriers on a North American rail network map.

9 "Railroad Revenue Deflator Factors," *STB.gov*, Surface Transportation Board, https://prod.stb.gov/ reports-data/economic-data/railroad-revenue-deflator-factors/ (accessed 13 May 2021).

10 Association of American Railroads, "Railroad 101" (Washington: Association of American Railroads, April 2021). https://www.aar.org/wp-content/uploads/2020/08/AAR-Railroad-101-Freight-Railroads-Fact-Sheet.pdf.

FIGURE 2: CLASS I RAILROAD NORTH AMERICAN NETWORK MAP



Source: Surface Transportation Board, *National Rail Network Map (ArcGIS)*.

Railroads have long served as the backbone of bulk commodity movements, especially in areas where inland waterway barge transportation is not feasible. Historically, coal was the largest single commodity group moved by rail, accounting for 30.12% of tons originated and 12.73% of gross revenue in 2019.[11] However, the sharp decline of coal-fired electricity generation has led coal-by-rail tonnage to decline by nearly half since 2008.[12]

Since partial deregulation of the railroad industry under the Staggers Act, the fastest growing traffic segment has been intermodal—the shipping containers and trailers that can be moved between rail, truck, and waterborne carriers—where intermodal rail traffic increased by nearly 350% between 1980 and 2019.[13] Intermodal rail traffic in 2019 accounted for more than 8.46% of total tons originated and more than 15.81% of gross revenue, which would constitute the largest revenue share of any commodity group if intermodal traffic was grouped together. Much of the future growth of intermodal traffic on rail is likely to depend on how adequately rail can compete with and complement over-the-road trucking.

11 Association of American Railroads, *Railroad Facts 2020 Edition*. 32.

12 Ibid. 34.

13 Ibid. 29.

Table 2 ranks Class I railroad commodity groups by tons originated and includes information on revenue by commodity group.

TABLE 2: CLASS I RAILROAD TRAFFIC BY COMMODITY GROUP, 2019

Commodity Group	Tons Originated (thousands)	Share	Gross Revenue ($ millions)	Share
Coal	471,387	30.12%	$9,339	12.73%
Chemicals & allied products	182,540	11.66%	$11,264	15.36%
Non-metallic minerals	167,692	10.71%	$3,336	4.55%
Farm products	145,382	9.29%	$6,113	8.33%
Miscellaneous mixed shipments*	121,661	7.77%	$10,178	13.88%
Food & kindred products	95,782	6.12%	$6,280	8.56%
Metallic ores	66,010	4.22%	$557	0.76%
Refined petroleum & coke	58,825	3.76%	$3,488	4.76%
Metals & products	44,746	2.86%	$2,713	3.70%
Stone, clay & glass products	43,414	2.77%	$1,910	2.60%
Waste & scrap materials	38,559	2.46%	$1,306	1.78%
Pulp, paper & allied products	30,534	1.95%	$2,404	3.28%
Lumber & wood products	23,587	1.51%	$2,096	2.86%
Motor vehicles & equipment	20,074	1.28%	$5,810	7.92%
Crude petroleum	19,847	1.27%	$1,564	2.13%
Apparel & finished textiles*	5,414	0.35%	$541	0.74%
Semi-trailers, empty*	5,260	0.34%	$871	1.19%
All other commodities	24,326	1.55%	$3,582	4.88%
Total	**1,565,040**	**100%**	**$73,353**	**100%**

Source: Association of American Railroads, *Railroad Facts 2020 Edition*.
*** Over 99% of this commodity's tonnage moves as intermodal. Some intermodal traffic is also included in other categories, especially "All other commodities."**

The 21st century competitive landscape of freight transportation is likely to be largely determined by future advances in transportation technology, especially automation. Section 2.2 discusses ongoing freight rail automation efforts. Section 2.3 discusses ongoing automation efforts in truck and waterborne transportation.

2.2

CURRENT EFFORTS ON FREIGHT RAIL AUTOMATION

Railroads are interested in a variety of automation technologies to improve safety, productivity, and their competitive standing with other modes that are anticipated to become increasingly automated. This section examines two examples of automated rail technologies: infrastructure inspection and train operations.

2.2.1 INFRASTRUCTURE INSPECTION AUTOMATION

In November 2018, the Federal Railroad Administration (FRA) approved BNSF's proposed test program to evaluate manned and unmanned track geometry cars that could replace visual track inspections as well as augment those visual inspections through data-driven selections of track segment in need of closer monitoring.[14] BNSF's pilot program would last one year, allowing the railroad to collect, analyze, and share data on the usefulness of these technologies.

Manned track geometry cars have been in service for nearly a century after rail networks grew too large and dense for manual visual track inspections alone. While the parameters measured may vary, the general purpose for geometry cars is to examine track for defects to ensure compliance with industry and government standards, as well as inform and prioritize future maintenance actions. Today, automated track inspection vehicles may be hy-rail trucks (modified highway trucks with rail wheels that can be lowered to operate on tracks) or modified boxcars with inspection equipment that can accompany trains in revenue service.

BNSF found during its automated track inspection pilot program that its automated geometry cars not only identified many defects that went undetected by visual inspections, but also allowed for the redeployment of manual track inspectors to segments with greater known needs. As a result, its track inspectors on the pilot territory were "recording nearly three times the number of geometry defects per 100 miles than were identified by track inspectors systemwide."[15]

14 Approval of BNSF Railway Company Test Program To Evaluate Automated Track Inspection Technologies, *Notice of Approval*, Federal Railroad Administration, Docket No. FRA-2018-0091, 83 Fed. Reg. 55,449 (11 Nov. 2018).

15 *BNSF Railway Company Petition for Waiver of 49 C.F.R. 213.233 to Allow for the Implementation of Automated Track Inspection Technologies to Supplement Visual Track Inspections*, Federal Railroad Administration, Docket No. FRA-2020-0064 (28 July 2020). 8.

BNSF also found safety benefits arising from reduced track occupancy—the number of inspectors and the amount of inspection time required to perform their duties—which reduces track inspectors' exposure to hazards in the field. Its pilot program saw 20% reductions in both the number of requests to occupy track and number of hours the track was occupied for inspections.[16] BNSF also believes increasing automation will lead to reductions in rail equipment accidents that may arise from track defects and human factors.[17]

"BNSF found during its automated track inspection pilot program that its automated geometry cars not only identified many defects that went undetected by visual inspections, but also allowed for the redeployment of manual track inspectors to segments with greater known needs."

At this early stage of deployment, BNSF concedes it is difficult to quantify cost savings derived from its automated track geometry cars, which require substantial upfront investment. However, the railroad told regulators that it anticipates immediate taxpayer savings due to reduced FRA enforcement activities and "substantial savings to both BNSF and the public" from improvements in rail safety.[18]

Despite the promise of automated track inspection, railroads are likely to face policy barriers to realizing the full potential of these technologies, which will be discussed in Section 3.1.

2.2.2 TRAIN AUTOMATION

In September 2008, a Metrolink commuter train crashed head-on into a Union Pacific freight train in the Chatsworth neighborhood of Los Angeles, killing 25. The National

16 Ibid. 9–10.

17 Ibid. 10–11.

18 Ibid. 11.

Transportation Safety Board determined the Metrolink engineer was distracted on his phone and had failed to notice a stop signal before overrunning it onto a stretch of single track authorized for the oncoming freight train.[19] A month later, Congress passed the Rail Safety Improvement Act of 2008.[20]

One major provision of the law mandated the installation of positive train control (PTC) systems. PTC refers to a range of communication and automation technologies designed to prevent train-to-train collisions (like the 2008 Metrolink accident), over-speed derailments, incursions into work zones, and improper switching.

One major provision of the law mandated the installation of positive train control (PTC) systems. PTC refers to a range of communication and automation technologies designed to prevent train-to-train collisions (like the 2008 Metrolink accident), over-speed derailments, incursions into work zones, and improper switching.[21] The PTC mandate was unfunded and forced railroads to spend billions of dollars to comply in the decade that followed enactment. One effect was growing interest in and development of freight train automation technologies.

A 2017 article published in *Transportation Research Record* reported the results of a survey of railroad managers and General Electric transportation engineers on their attitudes toward rail automation.[22] Survey responses indicate there is broad support for increased automation to mitigate safety risks, but also broad concern about technology development without train crew input, crew skill atrophy, and personnel training.

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[19] National Transportation Safety Board, *Collision of Metrolink Train 111 With Union Pacific Train LOF65–12, Chatsworth, California, September 12, 2008*, Railroad Accident Report NTSB/RAR-10/01 (21 Jan. 2010).

[20] Rail Safety Improvement Act of 2008, 122 Stat. 4848, Pub. L. 110–432 (16 Oct. 2008).

[21] 49 C.F.R. § 236.1005(a).

[22] James D. Brooks, et al., "Survey of Future Railroad Operations and the Role of Automation," *Transportation Research Record: Journal of the Transportation Research Board* 2608 (2017). 10–18.

Train automation is likely to be incremental as functions are gradually automated and personnel are relieved from certain tasks as safety is assured. For instance, an incremental automation phase-in could allow for reducing train crew sizes from two to one, which consultancy Oliver Wyman in 2015 estimated could save U.S. railroads up to $2.5 billion per year by 2030.[23] Certain lower-risk operations, such as those in railyards or those involving shorter trains, are likely to see automation technology deployed sooner. But international experience suggests that fully automating at least some long-distance freight trains in the U.S. may be on the horizon.

AutoHaul involves simultaneous operation of up to 50 unmanned trains, each 1.5 miles long and carrying 240 cars of iron ore from mines to ports on an average 500-mile, 40-hour journey. Loading and unloading is completely automated, although crews still get on board and manually operate the trains as they approach ports.

In 2019, mining giant Rio Tinto Group successfully launched its AutoHaul fully automated train operations in Western Australia.[24] AutoHaul involves simultaneous operation of up to 50 unmanned trains, each 1.5 miles long and carrying 240 cars of iron ore from mines to ports on an average 500-mile, 40-hour journey. Loading and unloading is completely automated, although crews still get on board and manually operate the trains as they approach ports. Rio Tinto's nearly $1 billion effort took over a decade of planning, development, and testing, but reductions in travel time, fuel consumption, and track and locomotive wear-and-tear have already been realized.[25]

23 "Analysis of North American Freight Rail Single-Person Crews: Safety and Economics," Oliver Wyman (3 Feb. 2015). https://www.reginfo.gov/public/do/eoDownloadDocument?pubId=&eodoc=true&documentID=1014.

24 Kevin Smith, "Rise of the machines: Rio Tinto breaks new ground with AutoHaul," *International Railway Journal* (9 Aug. 2019). https://www.railjournal.com/in_depth/rise-machines-rio-tinto-autohaul.

25 Ibid.

Fully automated freight train operations like those of Rio Tinto's AutoHaul are unlikely to occur in the U.S. in the near term. However, policymakers should begin considering the necessary changes to enable such automated operations in the future, which is discussed in Section 3.2.

2.3 AUTOMATION IN COMPETING TRANSPORTATION MODES

Interest in transportation automation has grown across all modes. This section discusses automation development underway for both trucking and waterborne transportation, which could significantly alter the freight transportation competitive landscape in the years ahead.

2.3.1 ROAD FREIGHT AUTOMATION

During the last decade, automated road vehicles have captivated the public with the prospect of self-driving taxis and last-mile delivery robots improving safety and convenience. Much of the popular coverage has focused on these passenger and small cargo use cases, but development has also been ongoing in the heavy-duty truck market segment.

> *"For oceangoing vessels, the International Maritime Organization is examining the integration of Maritime Autonomous Surface Ships (MASS) into the global fleet."*

Waymo, formerly the Google Self-Driving Car Project, is developing fully automated long-haul trucks under its Waymo Via brand that are currently being tested on highways in the southwestern U.S.[26] Other companies, such as Peloton Technology, are developing automated platooning systems that would allow trucks to automatically follow the

[26] John Fisher, "Waymo AV trucks to move J.B. Hunt freight in Texas," *Fleetowner*.com, FleetOwner, 10 June 2021. https://www.fleetowner.com/technology/autonomous-vehicles/article/21166675/waymo-av-trucks-to-move-jb-hunt-freight-in-texas (accessed 10 June 2021).

direction of a leading truck and create a road train, saving fuel through reduced aerodynamic drag and potentially labor costs if drivers in following trucks—and perhaps eventually leading trucks—can be eliminated.[27]

These technologies remain under development, and wide-scale deployment is likely many years away. However, eventual deployment of highly or fully automated heavy-duty trucks coupled with platooning capabilities is expected to significantly reduce road freight transportation costs and impact competition between trucks and rail.

2.3.2 WATER FREIGHT AUTOMATION

Waterborne transportation today offers cost advantages over rail when the volume of freight being moved is high, customers are willing to tolerate longer travel times, and most importantly, where the geography supports such movements by water. As such, there has been less interest in automating waterborne transportation in the U.S. compared to other modes. But some recent water transportation automation development activities in Europe suggest these technologies may eventually enter service in the U.S.

> *Waymo, formerly the Google Self-Driving Car Project, is developing fully automated long-haul trucks under its Waymo Via brand that are currently being tested on highways in the southwestern U.S.*

For oceangoing vessels, the International Maritime Organization is examining the integration of Maritime Autonomous Surface Ships (MASS) into the global fleet.[28] This work includes developing standardized definitions of automation levels for MASS, which are tentatively demarcated as: Degree One, automated assistance features for crewed vessels;

27 John Fisher, "One driver, two trucks? Paving the way to public automation acceptance," *Fleetowner.com*, FleetOwner, 18 June 2020. https://www.fleetowner.com/technology/autonomous-vehicles/article/21134374/one-driver-two-trucks-paving-the-way-to-public-automation-acceptance (accessed 14 May 2021).

28 "Autonomous shipping," *IMO.org*, International Maritime Organization. https://www.imo.org/en/MediaCentre/HotTopics/Pages/Autonomous-shipping.aspx (accessed 14 May 2021).

Degree Two, remotely controlled crewed vessels; Degree Three, remotely controlled uncrewed vessels; and Degree Four, fully autonomous vessels.[29]

For inland waterways, especially narrower waterways, barges are typically towed by tugboat. This market segment may not lend itself as well to automation compared to open ocean maritime operations, although Belgian ship management company Seafar is currently developing self-propelled fully automated barges.[30] Even absent full vessel automation, partial automation onboard vessels at Degrees 1-3, crane automation, and the automation of rail and road vehicles at ports could prove as (or even more) revolutionary to waterborne transportation as containerization was in the second half of the 20th century.

29 Ibid.

30 GPS World Staff, "Belgian company Seafar pioneers barge automation technology," *GPSWorld.com*, GPS World, 18 Nov. 2020. https://www.gpsworld.com/belgian-company-seafar-pioneers-barge-automation-technology/ (accessed 14 May 2021).

PART 3

POLICY BARRIERS TO FREIGHT RAIL AUTOMATION AND PROPOSED SOLUTIONS

Even if the freight rail industry continues developing automation technologies, public policy may threaten deployment opportunities in the future. This part examines policy barriers to freight rail automation and makes recommendations for policymakers.

3.1 INFRASTRUCTURE INSPECTION AUTOMATION

Federal regulations require that all track inspections be visually performed by designated track inspectors at various intervals depending on the class and type of track.[31] In July 2020, BNSF submitted a petition for waiver to the Federal Railroad Administration (FRA) seeking to augment visual track inspection with automated geometry inspection while reducing required visual track inspections on some categories of track.[32]

31 49 C.F.R. § 213.233.

32 *BNSF Railway Company Petition for Waiver of 49 C.F.R. 213.233 to Allow for the Implementation of Automated Track Inspection Technologies to Supplement Visual Track Inspections*, Federal Railroad Administration, Docket No. FRA-2020-0064 (28 July 2020).

In January 2021, FRA granted in part and denied in part BNSF's request.[33] BNSF is now authorized to supplement visual track inspections with automated geometry inspection over two territories of track—the Powder River Division, centered around Wyoming's coal country, that was the site of BNSF's earlier pilot program; and the Southern Transcon route from Los Angeles to Chicago—rather than system-wide as the railroad had requested. BNSF's request for a seven-year waiver was also denied, with the board limiting this waiver to five years.

In April 2021, Norfolk Southern petitioned FRA for a similar waiver to replace conventional visual track inspections with a combination of automated and visual inspections.[34] Public comments were due on June 28, 2021, and FRA has yet to render its decision on Norfolk Southern's petition. Similar waiver requests from other railroads are expected.

"Congress should direct FRA to begin a rulemaking to allow for full deployment of automated track geometry inspections system-wide as part of normal and safe operations"

While temporary relief may be appropriate at this early stage of deployment, discretionary waivers are inappropriate for incentivizing railroad safety innovation and wide-scale deployment over the long run. Congress should direct FRA to begin a rulemaking to allow for full deployment of automated track geometry inspections system-wide as part of normal and safe operations.

[33] Email from Karl Alexy, FRA Chief Safety Officer, to Travis Owsley, BNSF Assistant General Attorney, confirming the FRA Railroad Safety Board's decision granting in part and denying in part BNSF's July 2020, petition for waiver, Federal Railroad Administration, Docket No. FRA-2020-0064 (19 Jan. 2021). https://www.regulations.gov/document/FRA-2020-0064-0011 (accessed 2 June 2021).

[34] Petition for Waiver of Compliance, *Notice*, Federal Railroad Administration, Docket No. FRA-2021-0044, 86 Fed. Reg. 26,127 (12 May 2021).

3.2 TRAIN AUTOMATION

At present, freight train automation is not explicitly prohibited in the U.S. However, during the past decade, federal and state policymakers have pursued minimum crew-size rules for railroads operating in their jurisdictions, which would reduce or eliminate the business case for investing in various train automation systems in the future.

In 2016, FRA proposed a rule that would have required trains operating on the national rail network to be staffed by at least two crewmembers unless railroads successfully petitioned for a special exemption to operate a train with fewer than two crewmembers.[35] FRA's notice of proposed rulemaking conceded that "FRA cannot provide reliable or conclusive statistical data to suggest whether one-person crew operations are generally safer or less safe than multiple-person crew operations."[36]

This admission of FRA's lack of data to support its proposed rule did not originate from FRA. Rather, it came from the White House Office of Management and Budget's Office of Information and Regulatory Affairs (OIRA), which is the executive branch's regulatory watchdog. The draft notice of proposed rulemaking that FRA originally sent to OIRA for review instead incorrectly claimed, "Studies show that one-person train operations pose increased risks by potentially overloading the sole crew member with tasks."[37]

Despite OIRA's efforts to correct FRA's error and salvage the agency's rulemaking proceeding, the general conclusion that FRA was attempting to act in the absence of safety evidence led to the notice of proposed rulemaking's subsequent withdrawal by FRA in 2019.[38] While this debate played out at the federal level, a number of states have attempted to impose their own minimum crew-size laws. These state laws are currently being challenged, although railroads seeking to overturn state crew-size laws suffered a legal setback in February 2021 when a three-judge panel of the U.S. Court of Appeals for

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35 Train Crew Staffing, *Notice of Proposed Rulemaking*, Federal Railroad Administration, Docket No. FRA-2014-0033, 81 Fed. Reg. 13,917 (15 March 2016).

36 Ibid. 13,919.

37 NPRM Crew Staffing OIRA Edits, Federal Railroad Administration, Docket No. FRA-2014-0033 (15 March 2016). 7. https://www.regulations.gov/document?D=FRA-2014-0033-0003 (accessed 2 June 2021).

38 Train Crew Staffing, *Notice of Proposed Rulemaking; Withdrawal*, Federal Railroad Administration, Docket No. FRA-2014-0033, 84 Fed. Reg. 24,735 (29 May 2019).

the Ninth Circuit vacated FRA's state preemption order that accompanied its 2019 withdrawal of the proposed crew-size rule.[39]

The spring 2021 *Unified Agenda of Regulatory and Deregulatory Actions* was published in June 2021. This biannual document from OIRA provided the first glimpse at the Biden administration's regulatory priorities. It indicated that FRA plans to publish a new proposed rule on train crew sizes in November 2021.[40] It is unknown at this time how closely this new proposed rule will resemble FRA's 2016 crew-size minimum proposed rule.

"Organized labor is behind this effort to mandate minimum train crew sizes."

Organized labor is behind this effort to mandate minimum train crew sizes. Railroad employee unions that promote these laws have two primary motivations. First, the unions fear that train automation technologies will, over time, replace their dues-paying members. Second, they would like to have a government edict preempt a matter that is normally subject to collective bargaining negotiations between the union and railroad management. On the latter, it is quite rational for unions to lobby for government favoritism in labor-management relations. But on the former, forcing railroads to shoulder above-market labor costs in perpetuity may prove short-sighted and ultimately backfire on union members by reducing rail's long-term competitiveness in the transportation sector.

In addition to federal regulators and state legislatures, Congress has considered mandating two-person crew-size minimums since 2013.[41] To date, these legislative attempts have failed to garner sufficient support, but the crew-size mandate was recently introduced as

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39 "Federal appeals court overturns FRA decision on crew size," *Trains.com*, Trains, 23 Feb. 2021. https://www.trains.com/trn/news-reviews/news-wire/federal-appeals-court-overturns-fra-decision-on-crew-size-updated/ (accessed 2 June 2021).

40 "Train Crew Staffing," Federal Railroad Administration, RIN: 2130-AC88, *Reginfo.gov*, Office of Information and Regulatory Affairs (11 June 2021). https://www.reginfo.gov/public/do/eAgenda ViewRule?pubId=202104&RIN=2130-AC88 (accessed 24 June 2021).

41 As standalone legislation, the Safe Freight Act was introduced in the 113th, 114th, 115th, and 116th Congresses.

part of House Democrats' initial proposal on multiyear surface transportation reauthorization.[42] Given the lack of safety evidence supporting these proposals, Congress and regulators should reject minimum crew-size requirements as a matter of sound policy. Instead, Congress should seek to strengthen FRA's national rail safety policy and protect the flow of interstate commerce by clearly preempting states on train crew-size regulation without prescribing a minimum crew size.

3.3 RETURN ON INVESTMENT

This brief primarily focuses on the interaction between FRA safety regulatory authorities and automation technologies. However, economic regulation of freight railroads is also likely to play a role in the development and deployment of automation systems. The survey of railroad managers and transportation engineers on freight rail automation that was discussed in Section 2.2.2 also highlighted "significant concern that the industry will be unable to fund the development of new technology."[43]

As noted in Section 2.1, the Interstate Commerce Commission's (ICC's) regulatory power over freight railroads was greatly curtailed by the Staggers Act. In the years following its enactment, ICC commissioners adopted a more cautious approach to railroad regulation, preferring markets over dictates. In 1995, Congress abolished the ICC and created the Surface Transportation Board (STB) to administer the remaining ICC economic authorities.[44] Like the ICC for its last 15 years following the Staggers Act, the STB has been largely conservative in the wielding of its economic regulatory power. However, in recent years, some large industrial shippers have stepped up their efforts to have the railroads re-regulated.

The STB is currently considering several re-regulatory proposals that include making it easier to force competing Class I railroads to interchange each other's traffic and impose price controls.[45] When rail carriers petitioned the STB to adopt the same type of benefit/cost analysis for economically significant regulations that has long been required of

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[42] INVEST in America Act, H.R. 3684, 117th Cong., 1st Sess., § 9506(a) (2021).

[43] James D. Brooks, et al. "Survey of Future Railroad Operations and the Role of Automation." 17.

[44] ICC Termination Act of 1995, 109 Stat. 803, Pub. L. 104–88 (29 Dec. 1995).

[45] Petition for Rulemaking To Adopt Revised Competitive Switching Rules; Reciprocal Switching, *Notice of Proposed Rulemaking*, Surface Transportation Board, Docket No. EP 711 (Sub-No. 1), 81 Fed. Reg. 51,149 (3 Aug. 2016)

departmental agencies of the federal government, these shippers expressed strong opposition.[46]

As an independent agency, the STB is not required to adhere to Executive Order 12866's regulatory review provisions like FRA, but it could adopt internal processes mirroring those of E.O. 12866. Both the Federal Communications Commission and Securities and Exchange Commission have in recent years independently chosen to implement robust economic analysis for major rules, and the STB should follow suit.[47]

> *The STB is currently considering several re-regulatory proposals that include making it easier to force competing Class I railroads to interchange each other's traffic and impose price controls.*

Another concern, in light of a report from the STB's Rate Reform Task Force, is that the STB could turn revenue adequacy accounting on its head in a way Congress never intended.[48] A railroad is considered by the STB to be "revenue adequate" when an estimated return on net investment equals or exceeds the estimated cost of capital for the industry.[49] Initially created by Congress under the Staggers Act as an imperfect way to gauge the health of railroads in response to deregulation, recent regulatory proposals may transform revenue adequacy into a revenue ceiling.

Union Pacific, Norfolk Southern, and Canadian National have suggested revising revenue adequacy determinations to better reflect economic reality. To that end, two University of Chicago economists have proposed an alternative revenue adequacy methodology to increase the financial performance and capital cost estimate accuracy and consider other

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46 *Association of American Railroads Petition for Rulemaking*, Surface Transportation Board, Docket No. EP 752 (14 March 2019).

47 Jerry Ellig, "Why and How Independent Agencies Should Conduct Regulatory Impact Analysis," *Cornell Journal of Law and Public Policy* 28 (2018). 1–34.

48 Rate Reform Task Force, "Report to the Surface Transportation Board" (25 April 2019). https://prod.stb.gov/wp-content/uploads/Rate-Reform-Task-Force-Report-April-2019.pdf (accessed 10 June 2021).

49 49 U.S.C. § 10704(a); *Railroad Revenue Adequacy—2019 Determination*, Surface Transportation Board, Docket No. EP 552 (Sub-No. 24) (1 Oct. 2020).

economic sectors. This would avoid the circuitous calculation problems inherent in STB's current revenue adequacy accounting.[50]

In Executive Order 14036 from July 2021, President Biden encouraged the STB to pursue a number of economic re-regulatory measures. This should be understood as a political pressure campaign rather than a policy dictate, given the STB's status as an independent agency that is under no obligation to honor requests from the White House. It must follow the law made by Congress, and President Biden's personal policy preferences as expressed in E.O. 14036 with regard to the economic regulation of freight rail are both imprudent and, in some cases, arguably unlawful.

"Rather than increasing economic regulatory burdens on railroads that will deter investment in innovative technologies and practices, policymakers should reject re-regulatory proposals and work to identify and remove any remaining impediments to modernization."

Congress and railroad regulators should avoid their past missteps. The transportation sector as a whole is undergoing rapid change, with new automation technologies, alternative fuels, and other innovations promising to reduce costs and improve service for customers. Rather than increasing economic regulatory burdens on railroads that will deter investment in innovative technologies and practices, policymakers should reject re-regulatory proposals and work to identify and remove any remaining impediments to modernization.

3.4 POTENTIAL CONSEQUENCES OF POLICY BARRIERS

As suggested in Section 2.2.1, failure to modernize federal policy to allow for expanded automated infrastructure inspection could have serious long-run consequences for railroad safety and network performance by limiting the identification of track defects and putting more track inspectors in harm's way. However, the potential consequences of unresolved

[50] *Joint Petition for Rulemaking—Annual Revenue Adequacy Determinations*, Surface Transportation Board, Docket No. EP 766 (1 Sept. 2020).

(or additional) policy barriers that negatively impact train operations and long-run railroad investment are even more serious.

Policies such as the train crew-size minimum mandate discussed in Section 3.2 offer no documented safety benefits while creating a permanent artificial floor on labor costs. Economic regulations discussed in Section 3.3 that would negatively impact railroads' returns on investment would reduce their incentive to invest in automation research, development, and deployment. As competing freight modes are anticipated to increasingly automate and reduce labor costs—and thus total operating costs—such barriers would disadvantage railroads relative to their competitors by incentivizing customers to shift traffic from rail to highway trucks.

Among other consequences, such a modal shift would increase the air pollution emissions intensity of freight transportation. As Table 3 shows, when compared to freight rail on a ton-miles basis, the U.S. Environmental Protection Agency estimates that trucks emit approximately 10 times as much carbon dioxide (CO_2), two-and-a-half times as much nitrogen oxides (NO_X), and more than three times as much fine particulate matter ($PM_{2.5}$).[51]

TABLE 3: EMISSIONS ACROSS MODES OF U.S. FREIGHT TRANSPORTATION

Freight Mode	CO_2 (grams/ton-mile)	NO_X (g/ton-mi)	$PM_{2.5}$ (g/ton-mi)
Barge	17.48	0.4691	0.0111
Rail	20.7	0.29	0.0082
Truck	210.0	0.74	0.0270

Source: U.S. Environmental Protection Agency, *2020 SmartWay Shipper Company Partner Tool: Technical Documentation.*

51 U.S. Environmental Protection Agency, *2020 SmartWay Shipper Company Partner Tool: Technical Documentation*, Tables 10 and 11, EPA-420-B-20-049 (Oct. 2020). https://nepis.epa.gov/Exe/ZyPDF.cgi/P101031Z.PDF?Dockey=P101031Z.PDF (accessed 22 June 2020).

PART 4

CONCLUSION

Automation development and deployment in the freight rail industry may lag automation development activities in competing modes, but there are reasons to be optimistic about future progress in freight rail automation. However, policymakers should avoid interventions that could threaten innovation, including:

- **Unduly Limiting Automated Track Inspection:** As more data are collected and analyzed to support the expansion of automated track geometry inspection vehicles, policymakers should allow for expansive system-wide waivers as they modernize regulations to enable automated inspections as part of normal operations.
- **Imposing Inflexible Train Crew-Size Mandates:** Regulators have conceded they possess no statistical evidence supporting the claim that two-person minimum crews are safer than trains operating with one crewmember. As technology will potentially allow for fully automated train operations in the future, any crew-size regulation unsupported by the evidence should be rejected nationwide.
- **Economic Re-Regulation:** Reversing the undeniable progress enabled by the Staggers Act ought to be off the table. Rather than imposing new, utility-style economic regulations for some industrial shippers' narrow perceived benefit, policymakers should modernize economic regulations and require new, significant regulations be subject to robust economic analysis. These measures would ensure railroads remain healthy and on solid footing to innovate and compete with other modes into the future.

Automation in freight rail could produce large benefits in the 21st century, both private and social. Going forward, there will be much more policymaking and fine-tuning of existing policies to better match the technological, economic, and social challenges that may arise from automation technology deployment. But at this stage of early development, policymakers today should safeguard modernization by identifying and removing barriers, rather than imposing new burdens that will undermine railroads' incentive to innovate.

ABOUT THE AUTHOR

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Scribner's work focuses on a variety of public policy issues related to transportation, land use, and urban growth, including infrastructure investment and operations, transportation safety and security, risk and regulation, privatization and public finance, urban redevelopment and property rights, and emerging transportation technologies such as automated road vehicles and unmanned aircraft systems. He frequently advises policymakers on these matters at the federal, state, and local levels.

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