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Railroad-related work injury fatalities

The setting for a fatal injury rate more than double the rate for all workers, railroads are hazardous workplaces, especially for brake, signal, and switch operators; rail vehicles pose hazards even to workers in nonrailroad occupations

Dino Drudi

U.S. railroads transport a third of the Nation's freight ton-miles,[1] including large products such as automobiles and bulk products such as grain, coal, and concrete.[2] Railroads also transport about 1 percent of intercity passengers[3] and 2 percent of urban commuters.[4] Railroads employ more than 92 percent of all rail transportation workers. The rest work primarily for local governments as subway and streetcar operators and for mining, manufacturing, and marine cargo-handling operations operating their own locomotives and dinkeys that shuttle railcars containing ore, coal, and other bulk materials.[5] With a fatal injury rate more than twice the all-industry rate, the railroad industry is hazardous—especially for railroad brake, signal, and switch operators. Rail vehicles pose hazards even to workers in nonrailroad occupations.

The fatality experience in railroad transportation highlights the industry's hazardousness. Although the number of fatalities varies considerably from year to year, the boxed table on page 18 shows that the industry's fatality rate[6] is consistently considerably higher than the rate for the total private sector.[7] The substantial drop in the fatality rate during the latter half of the 10-year study period (from 12.3 fatalities per 100,000 employed for 1993–97 to 8.0 for 1998–2002) suggests that the industry is becoming safer.

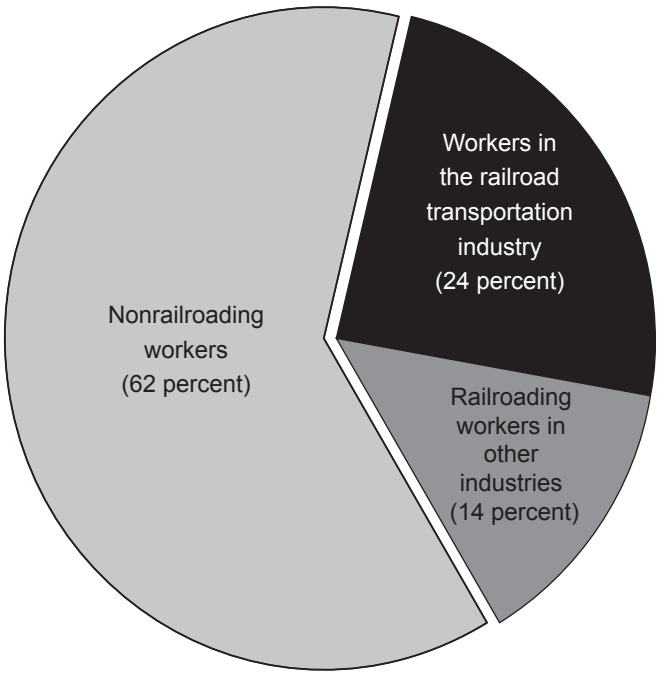
This article analyzes many aspects of railroad-related work fatalities, beyond only those in the railroad industry (Standard Industrial Classification (SIC) 40, railroad transportation); that is, also included are railroading workers outside of SIC 40, such as those working in subways and on commuter trains in SIC 411 (local and suburban passenger transportation), in contract railroad construction, and in rail-related transportation services—all captured by the Census of Fatal Occupational Injuries' (CFOI's) broad scope and rich database.[8]

The article also analyzes rail transportation occupations and the hazards posed by rail vehicles themselves. For example, one-twelfth of fatalities in rail transport occupations are scattered through various industries other than railroading; indeed, accidents involving rail vehicles claim the lives of many more *non*railroading workers than railroading workers.

There were 460 fatal railroad-related work injuries within railroading and another 761 fatal railroad-related work injuries involving workers entirely outside railroading, for a total of 1,221 fatal railroad-related work injuries during 1993–2002. As chart 1 shows, railroading fatalities accounted for less than two-fifths of the 1,221 fatal railroad-related work injuries, while nonrailroading fatalities, such as those happening to workers in rail transportation occupations outside railroading or to truckdrivers in other industries who perish in at-grade crossing collisions with trains, accounted for more than three-fifths of railroad-related work fatalities. Chart 1 also shows how fatalities within railroading

Dino Drudi is an economist in the Office of Safety, Health and Working Conditions, Bureau of Labor Statistics, Washington, DC. E-mail: Drudi.Dino@bls.gov

Chart 1. Workplace fatalities related to railroads, 1993–2002



Total fatalities = 1,221

are divided between those in the railroad transportation industry (SIC 40) and those in other industries.

Railroading

Because fatalities are relatively rare events and railroading is a small activity, the work fatality data presented here cover the entire 1993–2002 decade.[9] The following tabulation illustrates how work-related railroading fatalities were distributed among the various industry subcategories during that decade (numbers may not add to totals because some categories are not shown separately):[10]

Subcategory	*Fatalities*
Total	460
SIC 40, railroad transportation	293
Line-haul operating railroads	209
Railroad switching and terminal establishments	48
SIC 411, local and suburban passenger transportation	62
SIC 15–17, construction	58
SIC 47, transportation services	29
Other	18

Reflective of the industry's employment pattern, wage and salary workers and men accounted for almost all the railroading worker fatalities. A total of 83 fatalities involved workers 34 years and younger, whereas workers 35 to 44 years incurred 130 fatalities, workers 45 to 54 years experi-

Occupational fatalities per 100,000 employed, railroad transportation industry, 1993–2002

Year	Railroad transportation	Total private sector
1993	14.7	5.5
1994	11.1	5.7
1995	13.6	5.1
1996	11.0	5.1
1997	11.3	5.0
1998	6.0	4.8
1999	10.7	4.8
2000	8.5	4.6
2001	6.9	4.5
2002	8.0	4.3

NOTE: Employment figures are taken from the Current Population Survey (CPS), a monthly survey of households conducted by the Census Bureau for the Bureau of Labor Statistics. The CPS provides a comprehensive body of data on the labor force, employment, unemployment, and persons not in the labor force.

enced 160 fatalities, and workers 55 years and older suffered 87 fatalities. This distribution is consistent with an industry in which employment was declining due to restructuring and productivity gains[11] and in which older workers were being given retirement incentives.[12] For example, employment in railroad transportation (SIC 40), which accounts for the majority of railroading fatalities, declined from 684,000 in 1970, to 575,000 in 1980, to 265,000 in 1996. Then railroad transportation industry employment stabilized and recovered, so that employment numbered 307,000 in 2000.[13] The Bureau projects employment in the industry to decline by 10 percent over the 2002–12 period.[14]

Whites accounted for three-quarters of railroading fatalities, blacks for one-seventh. What is particular about railroading fatalities involving blacks is that a third of the fatalities were in local and suburban passenger transportation, an industry in which blacks suffered almost as many fatal injuries as whites. In the rest of railroading, whites suffered more than 7 times as many fatalities as blacks.[15]

Not surprisingly, transportation accidents accounted for about two-thirds of railroading fatalities. As the following tabulation shows, more than two-fifths of these transportation accidents involved pedestrian workers struck by railway vehicles, and a third were railway vehicle-only crashes or falls in, on, or from railway vehicles, including accidents in which the decedent fell from and was struck by the railway vehicle (numbers may not add to totals because some categories are not shown separately):

Type of accident	*Railroading fatalities*
Total	460
Transportation accidents	320
Railway accidents	138
Railway vehicle-only crashes	78
Railway-nonrailway vehicle collisions	31
Falls in, on, or from railway vehicles	24
Pedestrian workers struck by vehicle	146
Pedestrian workers struck by railway vehicle	132
Highway crashes not involving trains	25
Falls, except from railway vehicles	26
Homicides	19
Electrocutions	19

More than three-quarters of fatal work injuries in railroading occurred on railway lines, railway yards, or similar locations.

More than two-fifths of railroading fatalities involved rail transportation occupations such as locomotive operators; conductors; yardmasters; and brake, signal, and switch operators, with maintenance-of-way workers (nonconstruction laborers) and construction trades workers each accounting for one-tenth. Electricians and electric power line installers accounted for three-fifths of railroading's construction trades worker fatalities, with half of those working for passenger railroads, in which direct electric propulsion is more common than in freight railroads. Typical of overall employment, railroading's number of construction trades fatalities is about double that of its construction laborer fatalities.

The 460 railroading cases were further categorized exhaustively into 110 cases involving principally passenger operations and 342 cases involving principally freight operations.[16] (In 8 cases, no determination could be made as to whether they involved passenger or freight operations.) The fatal work injury experience differs markedly between these two types of transportation.

The following tabulation compares fatal work injuries between passenger and freight operations during 1993–2002 (a dash indicates either that no data were reported or that the data in question do not meet publication criteria, also numbers may not add to totals because some categories are not shown separately):

	Passenger		*Freight*	
	Number	*Percent*	*Number*	*Percent*
Total	110	100	342	100
Transportation accidents	62	56	255	75
Railway accidents	24	22	114	33
Railway vehicle-only crashes	13	12	64	19
Railway-nonrailway vehicle collisions	8	7	23	7
Falls in, on, or from railway vehicles	—	—	23	7
Pedestrian workers struck by vehicle	36	33	108	32
Pedestrian workers struck by railway vehicle	34	31	96	28
Highway crashes not involving trains	—	—	23	7
Falls, except from railway vehicles	10	9	16	5
Homicides	17	15	—	—
Electrocutions	9	8	9	3
Vehicular and transportation operations	40	36	192	56
Operating, riding, boarding trains	24	22	102	30
Construction	42	38	72	21

Even though freight operations accounted for nearly 3 times as many overall *railroading* fatalities as did pas-

senger operations, due primarily to railway vehicle-only crashes and falls in, on, or from railway vehicles in operation, freight operations accounted for nearly 5 times as many fatalities in *railway accidents* as did passenger operations. Freight operations also accounted for virtually all the fatal highway vehicle crashes involving workers in the railroad industry. Railway-nonrailway vehicle collisions and pedestrian worker fatalities occurred at about the same frequency for freight and passenger operations, but on passenger railways such collisions were more likely to involve mobile construction equipment in the railroad right-of-way than in freight operations, in which such collisions were quite rare. The more prominent role that construction and maintenance plays in passenger operations, in which speed, passenger safety, and ride quality are at more of a premium than in freight operations, is reflected in the fact that passenger rail systems accounted for twice as many railroad worker fatalities while workers were performing these activities than while they actually were operating, riding, or boarding trains. Passenger railroad systems, being much more likely than freight railroads to run on electricity and rely on catenary, third rails, tunnels, and elevated trackage, accounted for about as many falls and electrocutions as did freight railroads. Also, presumably because of more intimate contact with the public and the primarily retail nature of their transactions, passenger operations accounted for virtually all the homicides.

Subways, elevateds, and trolleys accounted for about half of the fatalities involving passenger railroading, while standard passenger trains and commuter trains each accounted for about a quarter.[17]

The nine jurisdictions within the continuous urbanized area from Washington to Boston accounted for two-thirds of the passenger railroading worker fatalities, with half of those coming from New York. These statistics reflect the fact that many of the country's extensive rail transit and commuter railroad systems and intercity rail hubs are located in that area. Thus, even though New York accounted for fewer freight fatalities than Nebraska, because New York is so high in passenger system worker fatalities it had slightly more total railroading worker fatalities than any other State.

Freight fatalities are more widely dispersed than passenger fatalities, except that sizable clusters appear in several small States with a large amount of freight operations. Nebraska, New Mexico, and even Wyoming, the State with the smallest workforce, each had more freight fatalities than New Jersey and more than all six New England States combined. Texas, with about three dozen, had 3 times as many freight fatalities as Michigan and 4 times as many as Pennsylvania.

Illinois, a freight and passenger rail hub with extensive rail transit and commuter railroad systems, is high in both passenger and freight railroading worker fatalities. Illinois' nearly four dozen total railroading worker fatalities were second only to New York and more than Texas, the State with the third-highest number. California, with extensive freight and passenger rail operations, has the fourth-highest number of railroading worker fatalities.

Railroad construction workers

Of the 460 railroading fatalities, 122 involved workers performing maintenance of way and other railroad construction activities. Freight railroading accounted for 74 of these workers' fatalities, passenger railroading for 45. (In 3 cases, no determination as to whether the fatality was passenger or freight related could be made.) Although freight railroading construction worker fatalities outnumbered passenger railroading construction worker fatalities, railroad construction worker fatalities are more heavily concentrated in passenger operations, where more intensive maintenance is needed to ensure speed, passenger safety, and ride quality. Passenger railroading's 45 construction worker fatalities accounted for two-fifths of passenger railroading's 110 overall fatalities, whereas freight railroading's 74 construction worker fatalities accounted for only one-fifth of freight railroading's 342 overall fatalities.

The following tabulation presents the distribution of the 122 total railroad construction worker fatalities during the 1993–2002 period (numbers may not add to totals because some categories are not shown separately):

Highway accidents	10
Incidents involving railway vehicles	45
Railway accidents	8
Pedestrian workers struck by railway vehicle	37
Typical construction site incidents	62
Pedestrian workers struck by highway or construction vehicle	11
Nonhighway accidents	5
Falls (includes drownings pursuant to falling into a body of water)	13
Electrocutions	10
Contact with objects	20
Struck by falling objects	8

Hazardous situations

For analytical purposes in this section, railroading workers are combined with nonrailroading workers involved in railroad-related work fatalities. As the following tabulation shows, trucking and warehousing accounted for one-fifth of the nonrailroading workers killed in railroad-related accidents during 1993–2002 (numbers may not add to totals because some categories are not shown separately):

Activity	*Fatalities*
Total	1,221
Railroading	460
Transportation, except railroading	168
Trucking and warehousing	148
Services and public administration	137
Manufacturing	124
Wholesale and retail trade	103
Construction, except railroading	91
Agriculture, forestry, and fishing	75
Mining and oil and gas extraction	36
Communications and electric, gas, and sanitary services	19

Although railroading accounted for nine-tenths of fatalities to workers in rail transportation occupations, a few were scattered through other industries, such as manufacturing and mining, that operate their own railroad equipment. Accidents involving nonrailroading workers were primarily at-grade crossing collisions between trains and highway vehicles.

Transportation accidents

Transportation accidents made up seven-eighths of worker fatalities for railroading and nonrailroading workers combined who were involved in railroad-related fatalities. The following tabulation examines the kinds of vehicles that were involved in such accidents during 1993–2002 (numbers may not add to totals because some categories are not shown separately):[18]

	Number	*Percent*
Total transportation accidents	979	100
Accidents involving railway vehicles only	353	36
Pedestrian workers struck by railway vehicle	199	20
Railway-vehicle-only accidents	154	16
Railway vehicle collisions, derailments	97	10
Onboard falls, and falls from railway vehicles under operation	41	4
Railway vehicle collisions with nonvehicular objects	16	2
Railway-nonrailway vehicle collisions	565	58
Motorized highway vehicles	490	50
Trucks	398	41
Delivery	22	2
Dump	54	6
Pickup	76	8
Tractor-trailer	147	15
Sport utility vehicle and other	54	6
Vans	34	3
Automobiles	58	6
Tractors	24	2
Mobile heavy equipment	29	3
Road grading/surfacing equipment	15	2
Accidents involving other land vehicles, mobile heavy equipment only	59	6
Land-vehicle-only crashes	44	4
Pedestrian workers struck by land vehicle, mobile heavy equipment	15	2

Although railway vehicles were involved in nine-tenths of all fatalities involving transportation accidents suffered by railroading and nonrailroading workers in this study, in only about a third of the fatalities were they the sole kind of vehicle involved. Most fatalities that befell these workers involved collisions between a rail vehicle and some other kind of vehicle, usually a motorized highway vehicle. Crashes between rail and motorized highway vehicles during 1993–2002 accounted for almost two-fifths of the fatalities in transportation accidents—with trucks making up four-fifths of the motorized highway vehicles involved in these fatalities.

The railroad crossbuck, devised in an era when trains were the usual mode of long-distance land travel for both people and goods, is the oldest road sign. It serves as a reminder of the hazards associated with at-grade crossings. Only 10 workers on trains died in railway-nonrailway vehicle collisions, compared with nearly 500 who were in the highway vehicles involved in these accidents.

Rail vehicles

Rail vehicles were involved in approximately 1,000 fatal occupational injuries during the 1993–2002 period. Freight and passenger trains, principally, plus trolleys, streetcars, and subways accounted for almost all of these cases. Drivers or occupants of highway vehicles in collisions with trains constituted nearly half the worker fatalities involving trains. In one-sixth of the cases involving rail vehicles, the decedent was a worker on the ground, while in only one-seventh of the cases was the decedent riding on the train.

There were a number of fatalities involving other kinds

of rail vehicles: amusement park rail vehicles, 20; mine railroad cars, 20; and industrial railroad cars, 9. Amusement park rail vehicles typically are used for amusement and recreation services, mine railroad cars in underground mining, and industrial railroad cars in primary iron and steel manufacturing.

At-grade crossing accidents

Worker fatalities from at-grade crossing accidents[19] totaled 517, thus averaging about 1 per week during 1993–2002. Although the year-to-year number varied somewhat, the overall trend was toward a moderate reduction, as the following tabulation shows:

Year	*Number*
1993	64
1994	58
1995	57
1996	47
1997	65
1998	46
1999	39
2000	52
2001	48
2002	41

During the period examined, the industry and Federal regulators emphasized improving warning devices, raising awareness, and enforcing at-grade crossing restrictions more strictly. In the first half of the 10-year timeframe, there were 56 at-grade crossing worker fatalities per year, whereas the last half of the period saw an average of 45.[20] Over the entire period, 7 onboard train personnel died in at-grade crossing accidents, as did 510 workers in the kinds of vehicles or mobile heavy equipment listed in the following table (numbers may not add to totals because some categories are not shown separately):

Kind of vehicle or equipment	*Number of fatalities*
Highway vehicles	471
Trucks	377
Tractor-trailer	137
Pickup	71
Dump	53
Delivery	21
Sport utility vehicle and other	50
Automobiles	54
Vans	30
Mobile heavy equipment	19
Tractors	18

The decedent was driving or operating the vehicle or equipment in nine-tenths of the cases and was a passenger riding in the vehicle in the remaining one-tenth.

Deadly jobs

Because the number of fatalities in rail transportation occupations is typically small, BLS does not publish fatality rates for these occupations on a consistent basis. However, by aggregating 5 and 10 years of data, the Bureau can publish rates to illustrate the level of danger faced by workers in these occupations. The following tabulation shows rail transportation occupational fatality rates per 100,000 workers, based on the Current Population Survey for 1993–2002 (numbers may not add to totals because some categories are not shown separately):

Occupation	*1993–97*		*1998–2002*		*1993–2002*
	Number of fatalities	*Fatality rate*	*Number of fatalities*	*Fatality rate*	*Fatality rate*
Rail transportation occupations	139	25	83	15	20
Locomotive operators	41	17	20	8	12
Conductors and yardmasters	49	24	33	14	19
Brake, signal, and switch operators	43	50	28	68	56

The fatality rate for railroad occupations improved from 1993–97 to 1998–2002, declining from 25 to 15. The number of fatalities fell from 139 to 83, a two-fifths drop during a time when employment was stable. Nevertheless, a rate of 15 fatalities per 100,000 employed is nearly 4 times the fatality rate for overall employment.

Assessing occupational risk for occupations with small numbers of fatalities and employment raises methodological concerns about volatility associated with small numbers. So these occupations require an alternative methodology to mitigate year-to-year fluctuations and ensure a sufficiently meaningful measure of on-the-job fatality risk. The 5-year aggregations shown in the preceding tabulation provide such a measure and clearly demonstrate that railroad occupations are hazardous.

Other occupations primarily involving vehicle operation also are hazardous. Airplane pilots unfailingly are among the 10 occupations with the highest fatality rates, and truckdrivers sometimes are. The following tabulation shows 2002 fatality rates for selected occupations that in-

volve the operation of nonrailroad vehicles:

Occupation	*2002 fatality rate*
Fishers, including captains and officers of vessels	71
Airplane pilots and navigators	70
Water transportation occupations	47
Driver-sales workers	38
Grader, dozer, and scraper operators	25
Truckdrivers	25
Taxicab drivers and chauffeurs	15

In 2002, all of these occupations had fatality rates several times higher than the overall employment rate of 4 fatalities per 100,000 employed. But the data also suggest that train transport is less fatality prone than competing modes such as water and truck. In addition, the data might suggest that, to the extent feasible, shifting freight from water or truck to train could reduce overall work fatalities because water transportation occupations, with 47 fatalities per 100,000 employed in 2002, and truckdrivers, with 25 fatalities per 100,000 employed in 2002, have higher fatality rates than rail transportation occupations, with 20 fatalities per 100,000 employed during the entire study period. Although units of freight are not necessarily one-for-one modally substitutable, because some kinds of freight might inherently lend themselves better to a particular mode of transport, to the extent that freights *are* modally substitutable, shifting freight from water or truck to train would shift it from modes with higher occupational fatality rates to one with a lower rate.

There is, however, a wide disparity of fatality risk within rail transportation occupations. Even though locomotive operators, with 12 fatalities per 100,000 workers during the 1993–2002 period, faced a fatal injury rate 3 times the overall rate in 2002, their risk was much lower than that for conductors and yardmasters, with 19 fatalities per 100,000 workers during the 1993–2002 period. But brake, signal, and switch operators faced a particularly acute fatality rate of 56 per 100,000 workers. Although locomotive operator employment is expected to grow slowly, employment in the more dangerous rail transportation occupations is expected to decline due to technological advances.[21]

The following tabulation lists the principal fatal events for rail transportation occupations from 1993 to 2002 (numbers may not add to totals because some categories are not shown separately):

Occupation	*Total*	*Pedestrian struck by railway vehicle*	*Accident onboard railway vehicle*
Rail transportation occupations	222	76	114
Locomotive operators	61	8	43
Conductors and yardmasters	82	27	43
Brake, signal, and switch operators	71	35	26

As the tabulation shows, locomotive operators, who are rarely involved with trainside work, were infrequently fatally injured as a result of being struck by a railway vehicle. More than two-thirds of locomotive operator fatalities resulted from onboard accidents such as train collisions and derailments.

Railroad brake, signal, and switch operators perform the bulk of trainside work, traditionally operating track switches to route cars to different sections of yards, setting warning signals, signaling locomotive drivers, helping couple and uncouple cars to make up or break up trains, and inspecting couplings, airhoses, and handbrakes.[22] Such tasks often put them in harm's way between cars and out of locomotive operators' sight, trusting only hand signals and radio communication with the locomotive operator, who might be at the front of the train, which could be a quarter mile away. Nearly half of railroad brake, signal, and switch operator fatalities resulted from being struck by a railway vehicle.

Although trainside work is not the principal function of conductors and yardmasters, their fatal injury experience was between that of locomotive operators and railroad brake, signal, and switch operators. Onboard accidents accounted for more than half of conductor and yardmaster fatalities, but only a third of the occupation's fatal accidents involved being struck by a railway vehicle.

Another way to view this phenomenon is to note that onboard fatalities ranged from being the overwhelming majority of fatalities for locomotive operators, whose jobs usually involve being on board trains, to being less frequent for brake, signal, and switch operators, whose jobs often involve being on the ground rather than on trains. In contrast, fatalities to workers on the ground who are struck by railway vehicles ranged from being very frequent for brake, signal, and switch operators, whose trainside duties are greatest, to being infrequent for locomotive operators,

whose trainside duties are least.

There were 33 cases involving coupling, which is a particularly illustrative case study of the hazards confronting workers at trainside. Typically in these kinds of accidents (27 of the 33 cases), workers hooking up freight cars are crushed between the couplers of two cars being joined or are run over by the moving section of train being joined to or separated from the remaining cars. Alternatively, workers involved in the coupling operation and hanging off the car being coupled or decoupled may fall and be run over (the remaining 6 cases). Railroad brake, signal, and switch operators were involved in 18 of these 33 accidents, while conductors and yardmasters were involved in 14. For these two occupations, coupling accidents accounted for about two-fifths of the fatalities in which a pedestrian was struck by a railway vehicle.

THE DATA PRESENTED IN THIS ARTICLE suggest a number of interesting conclusions:

- The railroad transportation industry's fatality rate is consistently considerably higher than the overall private-sector rate, but is steadily improving.
- Transportation accidents account for two-thirds of railroading fatalities.
- More than two-fifths of railroading fatalities involve rail transportation occupations.
- More than three-quarters of fatal work injuries in railroading occur on railway lines, railway yards, or similar locations.
- Most work fatalities involving trains happen to workers in activities outside railroading, usually from trains colliding with highway vehicles in at-grade crossing accidents.
- Although railway vehicles alone are involved in nearly half the fatalities suffered by railroading workers, nonrailroading workers are frequently fatally injured in collisions between a rail vehicle and some other kind of vehicle, usually a motorized highway vehicle.
- The number of workers killed in at-grade crossing accidents seems to be declining.
- The fatality rate for rail transportation occupations has improved, but is 3 times that for workers overall, even though it is still less than the rate for workers in other modes of freight transportation.
- The fatality rate for brake, signal, and switch operators is much higher than the rates for other rail transportation occupations, but employment in this occupation is expected to decline.
- Workers with primarily trainside duties are more likely to be fatally injured by being struck on the ground by railway equipment, while workers with primarily onboard duties are more likely to be fatally injured in onboard accidents.
- For conductors and yardmasters and railway brake, signal, and switch operators, coupling accidents account for about two-fifths of the fatalities in which a pedestrian is struck by a railway vehicle. □

Notes

ACKNOWLEDGMENT: I thank my colleagues Samuel Meyer and Mark Zak, economists in the Office of Safety, Health and Working Conditions, for their welcome assistance with data development.

[1] Table 1–46b: U.S. Ton-Miles of Freight (BTS Special Tabulation) (U.S. Department of Transportation, Bureau of Transportation Statistics), on the Internet at **www.bts.gov/publications/national_transportation_statistics/2005/html/table_01_46b.html**, last visited Dec. 20, 2006.

[2] Association of American Railroads, "RR Industry Info: The North American Railroad Industry," on the Internet at **www.tomorrowsrailroads.org/AboutTheIndustry/AboutTheIndustry.asp**, last visited Dec. 21, 2006.

[3] Long-distance file (U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, Federal Highway Administration, National Household Travel Survey, 2001).

[4] Table QT-P23. Journey to Work, 2000, Census 2000 Summary File 3—Sample Data (U.S. Department of Commerce, U.S. Census Bureau, 2000).

[5] *Occupational Outlook Handbook*, Bulletin 2540 (Bureau of Labor Statistics, 2002–03), pp. 579–82.

[6] The fatality rate represents the number of fatal occupational injuries per 100,000 employed workers and is calculated as

$$(N/W) \times 100{,}000,$$

where N is the number of fatal work injuries and W is the number of employed workers, based on annual average CPS estimates of employed civilians 16 years and older. For a discussion on calculating occupational fatality rates, see Guy A. Toscano and Janice A. Windau, "Profile of Fatal Work Injuries in 1996," *Compensation and Working Conditions*, spring 1998, pp. 37–44.

[7] The comparison is made with the total private sector because virtually all employment in railroad transportation, Standard Industrial

Classification (SIC) 40, is in that sector. Industry data presented in this article are based on the *Standard Industrial Classification (SIC) Manual, 1987* (Office of Management and Budget, 1987). Data on fatal work injuries are from the 1993–2002 BLS Census of Fatal Occupational Injuries (CFOI). This program, which has collected occupational fatality data nationwide since 1992, uses diverse data sources to identify, verify, and profile fatal work injuries. Information about each workplace fatality (occupation and other worker characteristics, equipment being used, and circumstances of the event) is obtained by cross-referencing source documents such as death certificates, workers' compensation records, and reports to Federal and State agencies, a method which ensures that counts are as complete and accurate as possible. CFOI data do not include fatal work illnesses. More information on the CFOI is available at **www.bls.gov/iif/oshfat1.htm**. Starting with 2003 data, the CFOI began using the *North American Industry Classification System (NAICS) Manual, 2002* (Office of Management and Budget, 2002).

[8] See note 7 for a description of the CFOI. Some CFOI data were reclassified for purposes of the analyses presented in this article.

[9] The 10-year time span from 1993 to 2002 was chosen to ensure a sufficient pool of consistently classified data to perform robust analysis. Starting with 2003, the Bureau introduced the North American Industry Classification System (NAICS). Although not comparable to SIC, NAICS reorganizes some aspects of the railroad industry in a way that might facilitate future analyses once enough years' worth of data become available. For example, NAICS 4882, support activities for rail transportation, comprises railroad switching and terminal operations (grouped in SIC together with short-line railroads); railroad car rental; and car loading and unloading, cleaning ballast, contract dining and sleeping car operations, and contract maintenance-of-way (grouped in SIC together with miscellaneous transportation services, along with nonrail-related transportation services such as horse-drawn carriages, stockyards, and nongovernment spaceflight operations, all of which the analysis presented here had to manually identify and exclude).

[10] Because employment data cannot be disaggregated into data associated with rail transit operations and data associated with nonrail transit operations such as city buses, an industry rate calculation cannot be made for the rail-only portion of SIC 411, local and suburban passenger transportation. Similarly, employment data cannot be disaggregated for railroad construction, which is a very small portion of overall construction. Consequently, industry rate discussions must be confined to SIC 40, railroad transportation. Unless otherwise noted, all other railroading analysis covers the 460 cases listed in the tabulation on page 18.

Work fatalities associated with line-haul operating railroads operating suburban passenger transportation services under contract classified under line-haul operating railroads are included in SIC 40.

[11] *Occupational Outlook Handbook*, p. 581.

[12] The railroad transportation industry experienced a retirement spike late in the study period, primarily because the Railroad Retirement and Survivors' Improvement Act of 2001 (1) lowered the retirement age from 62 to 60 years for all those covered by railroad retirement and with 30 years of service and (2) halved the vesting period from 10 to 5 years.

[13] The numbers of employed workers are based on 1970, 1980, 1990, and 2000 CPS annual average estimates of employed civilians 16 years and older. CPS employment is preferred for this analysis because it is used as the denominator in rate calculations. Railroad transportation industry employment reached its nadir of 265,000 in 1996 before recovering.

[14] Michael W. Horrigan, "Employment projections to 2012: concepts and context," *Monthly Labor Review*, February 2004, pp. 3–22. Although this projection is based on NAICS, railroad transportation in that system is roughly comparable to what it is in SIC. The decline is less than that previously projected (Howard N Fullerton, Jr., and Mitra Toossi, "Labor Force Projections to 2010: Steady Growth and Changing Composition," *Monthly Labor Review,* November 2001, pp. 21–38), because output is projected to be considerably higher, reflecting improved operations that have arrested the loss of business to truck transportation.

The 2002–12 projection was chosen because 2002 coincides with the last year of the fatality data study period. Although more recent projections are available, they do not essentially alter the trends described in this article.

[15] Because of the limitations cited in note 10, a straightforward comparison of work fatalities by race with employment is not feasible.

[16] Freight operations include such operations in maritime railroads. There was insufficient information to categorize the remaining 8 cases with respect to passenger or freight operations.

[17] Monorails such as those used at airports also were involved in a small number of cases.

[18] The category "onboard falls, and falls from railway vehicles under operation" includes incidents in which the decedent fell from and was run over by the railway vehicle. The category "other land vehicles, mobile heavy equipment" includes mainly railroading workers traveling by highway to rendezvous with a train and nonrailroading workers involved in highway or nonhighway fatal accidents in which the presence of the railroad might have played some role, such as instances in which the decedent's truck ran off the road and overturned on the railroad embankment running alongside the road or crashed through the bridge rail and fell onto the railroad tracks below.

[19] At-grade highway-rail crossings exclude (1) access lanes running at trackside through many railroad rights-of-way, (2) farm crossings, and (3) industrial yards without distinctly indicated crossing points.

[20] Even controlling for the abberational year 1997, this trend still holds true.

[21] *Occupational Outlook Handbook*, p. 580.

[22] *Ibid*., pp. 579–80.