Chapter

HISTORICAL INDUSTRY AND SAFETY OVERVIEW

Chapter IV
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Federal concern for railroad safety has occurred primarily in two phases. The first phase takiing place during the early part of this century with the enactment of a series of safety laws designed to address specific problems of the times. The second phase occurred in this decade with the enactment of several laws granting broad regulatory and administrative authority to Federal executive agencies to address all areas of railroad safety.

The nature and dimensions of the railroad satety problem evolved from the earlier period to the present. A combination" of factors within the industry and in the society have both caused and resulted in the evolution of safety. Among these factors are: railroad economics and the changing nature of the U.S. economy and the transportation system; the physical plant and the technology utilized by the industry; railroad employment trends and labor-management relations; and the various levels of legal and regulatory structures affecting the industry.

This chapter presents a brief, historical overview of the evolution of and factors impacting railroad safety. It provides a general summary of how the early safety problems were addressed by Federal laws.

EARLY PHASE OF RAILROAD SAFETY ACTIVITY

During the early phase of railroad safety history, the casualty problem dominated Federal and public concern. According to the data contained in the in the Interstate Commerce Comminssion (ICC) Accident Bulletins from 1902 to 1911, the casualty problem for both passengers and employees was quite severe. During the 9-year period at the turn of the century, a total of 33,761 employees and 4, 146 passengers were killed, and 403,259 employees, * and 113,410 passengers were injured. Table 8 reflects the casualty problem for 1902-11.

Several factors were probable contributors to the excessive railroad casualty problem in the early 1 900's.

- Railroads were the predominant mode of "modern" intercity transportation at the turn of the century. Railroads provided both freight and passenger transportation services which were rapidly expanding at the time. By 1900, over 190,000 miles 01 track were in operation and another 47,000 miles had been laid by 1910.1 In 1890 over 520,400 passengers were carried by rail [1]. By 1922, this number had expanded to over 537,300,000 passengers. [2]
- Around the turn of the century, rail road employment was steadily rising. In 1890, there were approximately 750,000 railroad employees; in 1900, there were 1,0 18,000;

*In 1910, reporting requirements for employee injuries changed, making the previous data incompatible with that collected from 1910 forward. The figure listed shows total employees injured during 1902-03.

[1] *The Railroads: the Nation's First Big Business.* Edited by Alfred D. Chandler, Jr. (Harcourt, Brace: World, Inc., New York; 1965) p. 13-14.

[2] Ibid., p. 14 and *Railroad Transportation, A Statistical Record 1921-1963.* Association of American Railroads, 1965 p. 24.

Table 8.—Railroad Casualty Data: 1902-11

	Employess			% of total work force		Passengers	
Year	Killed	Injured	Total work force a	% Killed	% Injured	Killed	Injured
1902	2,793	35,790	1,189,000	.23	3.01	271	6,323
1903	3,520	42,568	1,313,000	.27	3.24	442	7,855
1904	3,053	42,094	1,296,000	.24	3.25	526	9,002
1905	3,588	51,170	1,382,000	.26	3.70	369	10,514
1906	4,132	59,244	1,521,000	.27	3.90	539	12,112
1907	4,218	64,930	1,672,000	.25	3.88	571	14,324
1908	2,514	49,537	1,436,000	.18	3.45	337	11,643
1909	2,843	57,926	1,503,000	.19	3.85	333	13,593
1910	3,778	(b)	1,699,000	.22	..	441	12,766
1911	3,322	(b)	.	.-	-.	317	15,278
Total	33,761	403.259	..	..	.-	4.146	'1 13.410

a Alfred Chandler, *Railroads. The Nation First Big Business.*

b Reporting requirements for employee injuries changed in 1910, making date incompatible with 1902-09 time period.

SOURCE: Interstate Commerce Commission Accident Bulletins: 1902-11.

and in 1910, there were 1,699,000 employees .[3] As evidenced by the passage in **1907** of the Hours of Service Act, railroad employees were working extended consecutive hours at the turn of the century.[4]

- Railroad technology, as well as specific technologies which would improve safety, were evolving at the time and were not fully in place. As early as 1879, it was noted that certain technologies such as interlocking and electric signal systems, the Westinghouse brake, and new forms of car design would improve safety and were available. [5] However, it was not until later, in part as a result of Federal laws, that these and other improved technologies were universally adopted. Moreover, though the technologies utilized in rail operations were evolving, they were less than optimum from a safety perspective. Hence, a serious time lag existed in the application of safety technologies.

These factors describe several characteristics of the railroad system at the turn of the century which contributed to the casualty problem. While the severity of the casualty problem served as a dramatic, if not psychological, catalyst to stimulate public and congressional concern, other factors may have facilitated adoption of the early laws:

- At the turn of the century, the railroad labor movement was gaining voice and influence in the political and social system. Railroad labor unions, as national organizations, were formed between the 1860's and the 1890's. Although early efforts to form a unified railroad labor organization failed in the late 1800's, by the early 1900's railroad labor unions were becoming clear economic and political forces in the railroad system.'
- The Interstate Commerce Commission (ICC) was already established and functioning as a Government regulatory agency with specific authority for railroad economic regulation, While the ICC was responsible for railroad rate regulation, they were also aware of the status of rail-

[3] Chandler, p. 16.

'*Interstate Commerce* Commission *Activities: 1887-1937,* Superintendent of Documents, Washington, DC, 1937. p. 121.

'Charles Francis Adams, *Railroad Accidents,* (G. P. Putnam's Sons; New York, 1879). p. vi.

'Chandler, p. 129-132.

road safety problems and had initiated some accident data gathering as early as 1888.[7]

Therefore, as a result of the severity of the casualty problem, growing public and labor concern, and the availability of Government mechanisms, and technological and other solutions, Congress enacted a series of safety laws during the first part of this century.

From 1893 to approximately 1921, a number of railroad safety laws were adopted. These laws were limited in scope, and were drafted to address particular known aspects of the casualty problem at the time with specific measures or remedies. The ICC was given responsibility for the implementation and enforcement of these laws.

The scope of the early railroad safety laws covered a range of areas and problems and essentially created a system of addressing many phases of the safety problem. Examples of the early laws are:

—The Accident Reports Act, which established the system of collecting accident data on injuries and fatalities and documenting accident causes. The system today is essentially that established in 1900;

—The Hours of Service Act, which established the maximum number of allowable hours of service for two classes of employees: those engaged in or connected with the movement of trains (with a maximum of 16 consecutive hours of service in a 24-hour period); and those connected with train dispatching and train ordering (with a maximum of 9 to 13 hours on duty in a 24-hour period); [8]

—The Ash Pan Act, which prohibited use of locomotives equipped with ash pans that could not be dumped without employees going under the locomotive for that purpose;

—The Safety Appliances Act and amendments, which instituted mandatory requirements for the, then available, improved brake systems and automatic couplers, and which required standardization of the location and specifications for appliances such as handholds and grab irons necessary for employees' use.

—The Block Signal Act, Safety Testing Authorization, and the Signal Inspection Act, which allowed for the research and which later required the implementation of automatic signaling systems, interlocking and other devices which would promote safety in operations;

—The Locomotive (Boiler) Inspection Acts, which required railroads and Government to inspect and test locomotives to avoid over-running of the locomotives and boiler explosions resulting from low water levels in the steam engine boilers;

—The Transportation of Explosives and Hazardous Materials Act, which revised the 1866 law;' and,

—The Federal Liability Act, which addressed the employee injury, disability, and claims problem where industry negligence was proven.

Several significant observations and conclusions can be made from these laws. First, the focus of most of these laws was usually upon a limited, well-defined safety problem, and the grant of authority was intended to deal with the particular problem. Several examples were:

—The Hours of Service Act, which dealt with the problem of overworked railroad employees and the safety hazard they presented to themselves and others by their excessive work;

–The Ash Pan Act, which was prompted by the serious injuries and deaths incurred by employees emptying and cleaning ashes from locomotives not equipped with ash pans; and

[7] *ICC Activites,* p. *125,*
[8] Ibid, p. 121-122.
[9] Ibid, p. 12-12.

—The Safety Appliances Act, which focused on problems resulting from the lack of standardization and uniformity of railroad equipment. These laws authorized the ICC to issue rules prescribing the specifications for application of safety appliances such as handholds or grab irons. These laws also required standardization and implementation of updated brakes and couplers.

A second observation regarding the earlier laws is that Congress often found the solution to a particular safety problem in available technology and mandated the use of that technology by all carriers. The Safety Appliances Act, for example, prescribed the use of automatic couplers which reduced the likelihood of employee injuries caused by coupling. The Signal Inspection Law authorized the ICC to prescribe particular types of devices to help reduce train collisions.

A third observation is that these early laws basically relied on the same enforcement mechanism—monetary civil fines plus, in most cases, inspect ion and /or reporting requirements. Most of the laws carried a penalty of $100 to $200 per violation and several of the early laws had criminal penalty provisions. Several laws required inspections and, in some cases, reports to or for the Government of the carriers' inspection activity (Locomotive Inspection Act) or of accidents or equipment failures (Locomotive Inspection Act, Accident Reports Act, Signal Inspection Law).

Another observation about the early safety laws is the approach used in the laws for granting authority to the Government, In comparison to the more recent safety laws, the early laws are narrowly drawn. This was consistent with the focus of Congress on specific safety problems at the time.

Finally, it should be noted that each of these laws was applicable only to "common carriers" as that term is used in the Interstate Commerce Act. This was to be expected since that Act had originally established the scope of the Government's regulation of rail transportation. However, by using the term "common carrier, " these laws are not applicable to certain forms of rail transportation, such as industrial railroads and rapid-transit systems.

Table 9 shows the dates of enactment of these early laws and their amendments. Although not a precise measure, the fatality rate for employees and passengers (table 10) showed a marked decline by the *1920's.* * This reduction appeared to be, in large part, due to the requirements and activities resulting from the early safety laws.

Table 9.—Early Safety Laws and Amendments

Year	Law	Citation
1893	Safety Appliances Act. .	45 U.S.C. 1-7
1903	Safety Appliances Act. .	45 U.S.C. 8-10
1906	Block Signal Systems . .	45 U.S.C. 35
1907	Hours of Service Act . . .	45 U.S.C. 46-66
1908	Federal Employer's Liability Act.	45 U.S.C. 51-60
1908	Ash Pan Act.	45 U.S.C. 17-21
1908	Safety Devices Testing Authorization	45 U.S.C. 36-37
1908	Transportation of Explosives.	18 U.S.C. 831-835
1909	Transportation of Explosives and Other Hazardous Materials .	—
1910	Accident Reports Act. . .	45 U.S.C. 13-60
1910	Safety Appliances Act. .	45 U.S.C. 38-42
1911	Locomotive Inspection Act	45 U.S.C. 22-34
1920	Signal Inspection Law. .	49 U.S.C. 26

Between 1920 and 1968, there were only a few important enactments concerning railroad safety. First, in 1937, the Signal Inspection Law was largely rewritten to broaden the ICC's powers concerning the systems and devices covered by this law. Second, there was the 1958 amendment to the Safety Appliances Act regarding adoption of the Association of American Railroad's rules for inspection, maintenance, and testing of power brakes. A third significant

*Due to the *1910* change in employee injury reporting requirements, the injury figures are not compatible with the earl, data.

Table 10.— Railroad Fatalities 1923-31

	Employees			Passengers
Year	Killed	Total work force	% of total killed	Killed
1923	1,836	1,879,770	.10	102
1924	1,367	1,777,391	.08	121
1925	1,437	1,769,099	.08	139
1926	1,502	1,805,780	.08	130
1927	1,395	1,760,999	.08	56
1928	1,166	1,680,187	.07	59
1929	1,269	1,686,769	.08	72
1930	882	1,510,688	.06	38
1931	615	1,278,175	.05	30
Total	11,469	15,148,858	0-.08	747

SOURCE Railroad *Transportation A Statistical Record, 1921-63 P. 33*

amendment was the 1960 revision of the Transportation of Explosives Act, which became known by its U.S. Code designation "Explosives and Other Dangerous Articles." This revision broadened the law significantly by expanding (a) the types of materials covered by the Act to include radioactive materials and etiological agents and (b) the types of carriers covered by the Act to include private-contract and for-hi re carriers. It also centralized the authority for regulation of the transportation of such materials in the ICC. The fourth important amendment was the 1960 amendment to the Accident Reports Act, which led in the following year to certain revisions in the requirements for reporting an accident.

In 1965 and 1966, all of the various railroad safety functions that had been vested over the years in the ICC were transferred to the Department of Transportation. This primarily occurred by means of the Department of Transportation Act, which centralized all transportation safety functions, among other things, in one executive department—thereby splitting the safety and economic regulation of each mode.

Several amendments to the early laws were enacted prior to the more recent Federal railroad safety activity. Table 11 shows the chronology of Federal railroad safety activity and the ancillary laws which impacted railroad safety problems.

Table 11 .—Chronology of Railroad Safety Legislation and Related Laws

Year	Law
1893	**Safety Appliances Act**
1903	**Safety Appliances Act**
1906	**Block Signal Systems**
1907	**Hours of Service Act**
1908	**Federal Employer's Liability Act**
1908	**Ash Pan Act**
1908	**Safety Devices Testing Authorization**
1908	**Transportation of Explosives**
1909	**Transportation of Explosives and Other Hazardous Materials**
1910	**Accident Reports Act**
1910	**Safety Appliances Act**
1911	**Locomotive Inspection Act**
1920	**Signal Inspection Act**
1937	**Signal Inspection Amendments**
1958	**Safety Appliances Amendment**
1960	**Explosives and Other Dangerous Articles**
1966	**Federal Claims Collection Act**
1969	**Hours of Service Amendments**
1970	**Railroad Safety Act and Hazardous Materials Act**
1970	**Occupational Safety & Health Act**
1972	**Noise Control Act**
1973	**Highway Safety Act**
1973	**Passenger Assistance Act**
1974	**Transportation Safety Act**
1976	**Railroad Revitalization and Regulatory Reform Act**
1976	**Railroad Safety Authorization Act**
1976	**Highway Safety Act Amended**

RECENT RAILROAD **SAFETY ACTIVITY**

The recent phase of Federal concern for railroad safety has occurred largely within this decade. The characteristics of today's safety problem and the industry factors surrounding it are different from the problems at the turn of the century, As contrasted to the earlier phase, today's railroad casualty problem is of smaller dimensions and of a different type, yet of no less

significant concern. However, the other recent predominant problem area is the increasing property and lading loss and damage resulting from train accidents. This is of significant concern to industry and Government, given the current economic condition of the industry.

A number of factors both internal and external to the industry occurred throughout the century which directly and indirectly impacted the shift and evolution of the railroad safety problem. Chief among these is the change in the industry's economic health. Among the factors which have impacted the changes in the safety problem are:

- Over time, the railroad's dominance in intercity passenger transportation has eroded. As a result of the introduction of the automobile and the airplane, a dramatic reduction in passenger travel by rail has occurred. Today, only 6 percent of intercity passenger traffic is by rail (table 12). Hence, rail passenger traffic, no longer constitutes a large percentage of persons exposed to the railroad environment.
- The introduction of the automobile and increased automobile usage have resulted in the shift in the casualty problem, as evidenced by the level of grade-crossing accidents.
- As a result of the economic decline of the industry and the increased efficiency of technology, railroad employment has declined dramatically since the early *1900's.* As previously indicated, railroad employment in 1910 was 1,699,000, whereas in 1975, it was 487,789. From 1929 to the present, employment declined by approximately 71 percent and total man-hours worked decreased by approximately 79 percent (table 13). During 1950-75, employment declined by approximately 60 percent and total man-hours worked decreased by about 67 percent. However, labor wages as a percent of operating revenues remained relatively constant over the 25-year period (table 14). The net effect of the reduction in employment and total hours worked was a decrease in the exposure of railroad employees to the railroad environment, a factor which may have resulted in a decline in the absolute number of casualties (injuries and fatalities).
- Another factor which has impacted the potential for casualties is the increase and changes in the hazardous materials shipped by rail. At the turn of the century, the hazardous materials problem was characterized almost solely by weapons and other

Table 12.—Volume of Intercity Passenger Traffic

Millions of Revenue Passenger-Miles and Percentage of Total (except private)

Year	Rail-roadsa	%	Buses	%	Air carriers	%	Inland water-ways	%	Total (except private)	Private automo-biles	Private airplane	Total (in-eluding private)
1929	33,965	77.1	6,800	15.4		-	3,300	7.5	44,065	175,000	—	219,065
1939	23,669	67.7	9,100	26.0	' = 3	2.0	1,466	4.3	34,938	275,000	—	309,938
1944	97,705	75.7	26,920	20.9	2,177	1.7	2,187	1.7	128,989	181,000	1	309,990
1950	32,481	47.2	26,436	38.4	8,773	12.7	1,190	1.7	68,860	438,293	1,299	508,472
1960	21,574	28.6	19,327	25.7	31,730	42. ?	2,668	3.6	75,319	706,079	2,228	783,626
1970	10,903		25,300	74.3	109,499	77.7	4,000	2.3	149,702	1,026,000	9,101	1,184,803
1974	10,475	; : ;	26,700	15.1	135,469	76.7	4,000	2.3	176,644	1,143,440	11,000	1,331,044
1975b	10,075		25,000	14.2	136,432	77.7	4,000	2.3	175,507	1,164,000	11,500	1,351,007
1976b	11,000	; : :	25,000	13.2	150,000	78.9	4,000	2.1	190,000	1,236,000	13,000	1,439,000

a Railroads of all classes, including electric railways, Amtrak and Auto-Train.

b These are preliminary estimates and are subject to frequent adjustments.

NOTE: Air carrier data from reports of CAB and TAA; Great Lakes and rivers and canals from Corps of Engineers and TAA; some figures for 1974, 1975, and 1976 are partially estimated by AAR and TAA.

SOURCE: AssociatiorJ *ot~n?erlcan /?ai/roads Factbook,* 1977 edition, p. 36.

Table 13.—Railroad Employment Characteristics

Year	Average number employees	Total hours worked (straight and overtime) (000's)	Average annual compensation per employee	Average hours worked per employee, per year
1929	**1,686,769**	4,411,490	$ 1,743	2,610.4
1939	**987,943**	2,489,689	1,886	2,514.8
1950	**1,220,784**	2,877,495	3,785	2,358.6
1955	**1,058,216**	2,503,418	4,719	2,361.7
1960	**780,494**	1,840,590	6,270	2,359.7
1965	**639,961**	1,319,582	7,490	2,061.8
1966	**630,895**	1,294,928	7,734	2,055.4
1967	**610,191**	1,224,800	8,085	2,007.9
1968	**590,536**	1,200,506	8,654	2,034.8
1969	**578,277**	1,173,501	9,274	2,023.3
1970	**566,282**	1,146,445	10,086	2,047.2
1971	**544,333**	1,082,642	11,023	2,004.9
1972	**526,061**	1,051,771	12,213	1,984.5
1973	**520,153**	1,041,214	13,627	2,002.3
1974	**525,177**	1,042,119	14,235	1,966.3
1975	**487,789**	947,279	15,324	1,933.2
Decline in the number of employees: 1929-75 = 719'o 1950-75 = 60%		Decline in man-hours worked: 1929-75 = 79% 1950-75 = 67%		

SOURCE: *Railroad Transportation.' A Statistical Record, 1921063,* p. **32;** *Statistical Record Addendum, 1965-75.*

Table 14.—Employment Costs and Railroad Operating Revenues (in millions)

Year	Operating revenues ($000,000)	Labor cost* ($000,000)	% of laborcost to total operating revenues
1929	**6,280**	**2,674**	**42.3**
1939	**3,995**	**1,762**	**44.1**
1950	**9,473**	**4,379**	**46.2**
1955	**10,106**	**5,064**	50.1
1960	**9,514**	**5,126**	**54.0**
1965	**10,208**	**5,122**	**50.1**
1966	10,655	5,258	49,3
1967	10,366	5,345	51.6
1968	10,855	5,583	51.4
1969	11,450	5,838	51.0
1970	11,992	6,250	52.1
1971	**12,689**	**6,488**	**51.3**
1972	**13,410**	**7,047**	**52.6**
1973	**14,770**	**7,881**	**53.4**
1974	**16,923**	**8,597**	**50.8**
1975	**16,402**	**8,583**	**52.3**

*Includes wage compensation, health and welfare benefits, payroll taxes. Excludes pensions.

SOURCE: *Railroad Transportation: A Statistical Record 1921-63,* p. *20;* and *Addendum for Years 1965-75,* p. 12.

types of explosives. Today, the types of hazardous commodities shipped have changed dramatically, in addition to the amounts shipped (see chapter X).

Of more recent concern is the significance of the property and lading loss and damage problem. The primary factor contributing to the increase in this problem is the economic condition of the industry. Several factors have led to the economic decline and thereby have influenced the property safety problem.

- Over this century, the amount of freight transported by railroads has increased. However, the introduction and growth of the trucking industry and the increased usage of water carrier for freight shipments effectively reduced railroad dominance in the transportation system. In 1929, railroads carried 75 percent of the freight, whereas today they carry only 37 percent (table 15). Moreover, restrictive Govern-

Table 15.—Intercity Freight Transportation Characteristics
Millions of Revenue Freight Ton-Miles and Percentage of Total (including mail and express)

Year	Rail-roadsa	0/0	Trucks	70	Great Lakes	'/0	Rivers & canals	%	Oil pipe-lines	70	Air	'/0	Total
1929	454,800	74.9	19,689	3.3	97,322	16.0	8,661		26,900	4.4	3		607,375
1939	338,850	62.4	52,821	9.7	76,312	14.0	19,937	;:?	55,602	70.2	12		543,534
1944	746,912	68.6	58,264	5.4	118,769	10.9	31,386	2.9	132,884	12.2			1,088,266
1950	596,940	56.2	172,860	16.3	11,687	10.5	51,657	4.9	129,175	12.1	3;:		1,062,637
1980	579,130	44.1	285,483	21.7	99,468	7.6	120,785	9.2	228,626	17.4	778		1,314,270
1970	771,168	39.8	412,000	21.3	114,475	5.9	204,085	10.5	431,000	22.3	3,295	0.2	1,936,023
1974	855,582	38.6	495,000	22.3	107,451	4.9	247,431	11.2	506,000	22.8	3,580	0.2	2,215,044
1975b	759,000	37.3	443,000	21.7	99,171	4.9	243,039	11.9	488,000	24.0	3,430	0.2	2,035,640
1976b	796,000	36.7	490,000	22.6	102,000	4.7	250,000	11.6	525,000	24.2	4,000	0.2	2,167,000

aRai [roads of ali classes including electric railways, Amtrac, and Auto-Train.
bThese are pre[iminary estimates and are subject to frequent adjustments.
SOURCE: *Association of American Rai/roads, 1977 Factbook, p.36.*

ment regulatory policy interfered with the railroads ability to effectively compete with the other freight transportation modes.

- Railroads' rate of return on net investment has generally declined in recent times, although it has varied by ICC districts (the southern and western regions have a higher rate of return than the eastern district (table 16). By 1975, the rate of return was only 1.2 percent, compared with 5.3 percent in **1929.** The low rate of return, when combined with increased competition, restrictive Government economic policy, and noninnovative management practices resulted in the industry's inability to generate needed external or internal sources of funds. As a result, railroads have had to look for means of reducing expenses. One such method adopted by the industry was the reduction in track and roadway maintenance. Estimates of industry-deferred maintenance (in 1975 dollars) have been approximated between **$6** billion and $7

Table 16.—Railroad Rate of Return

Year	Net investment (millions)	Net railway operating income (millions)	Rate of return (total)	Net income* (milllons)	Rate of return Eastern District	Rate of return Western District	Rate of return Southern District
1951	25,055.2	942.5	3*76%	693.2	3.47	3.76	4.74
1955	26,760.9	1,128.0	4.22	927.1	4.19	3.86	5.45
1960	27,452.5	584.0	2.~3	444.6	1.80	3.15	4.17
1985	26,040.6	981.5	3.69	814.6	3.32	3.87	4.16
1970	28,049.7	485.9	1.73	226.6	clef.	3.02	4.50
1975	29,297.3	W65.2	b350.7	al.59 bl.20	a186.9 W4.4	clef.	2.65	3.98

•Ordinary Income (before extraordinary and prior period items).
aold ICC basis.
bN$_{ew}$ ICC (GAAp) basis, after provision for deferred taxes and (after 1973) including equity in undistributed (XiVIltlCJS of affiliates

SOURCE: Railroads—1977 and Beyond, A Congressional Symposium (background material), House Interstate and Foreign Corn merce Committee, December 1977. Taken from Interstate Commerce Commission Transport Statistics.

billion.l" Moreover, as stated in AAR testimony before the ICC, an estimated $14.5 billion (1975 dollars, exclusive of Conrail) is needed over the next decade for fixed facilities to achieve a normalized level of maintenance and track additions and betterments to other roadway facilities. " The net effect of lack of capital has been deferred maintenance and reduction to improvements in fixed plant.

Certain railroad technology and equipment characteristics have changed in the last 25 years. Although the diesel engine was first introduced in the late 1920's, it was not universally adopted until the early *1950's.* By 1955, there were 24,786 diesel engines in service (table 17). The introduction of the diesel had several significant impacts: it improved efficiency; and it reduced the need for the additional person in the cab, both factors having the potential for improving the economic situation of the industry. However, as previously noted in table 14, while employment declined over this same period, wages remained a relatively constant percentage of total operating revenues, thus offsetting the reduced labor force brought on by the diesel engine. Other areas for reduction of expenses and improved efficiency and productivity were sought out. One measure adopted was the gradual increase in freight car capacity, which may have been made possible by the addition of diesel power. The average freight car capacity was 53.7 tons in 1955 and 72.9 tons by 1975 (table 17). This increased to 73.5 tons in 1976. The net result of the heavier car capacity was heavier axle loadings, The gradual increase in axle-loadings combined with the practice of deferred maintenance in recent decades has had the end result of faster wear and deterioration of track and roadbed, a factor

'"Richard J. Barber Associates, The *Railroads, Coal and the National Energy Plan: An Assessment* of *the Issues, 1977, p. 52,*

11September 1977-Statement of R.E. Briggs on behalf of the AAR, before the ICC, p. *35.*

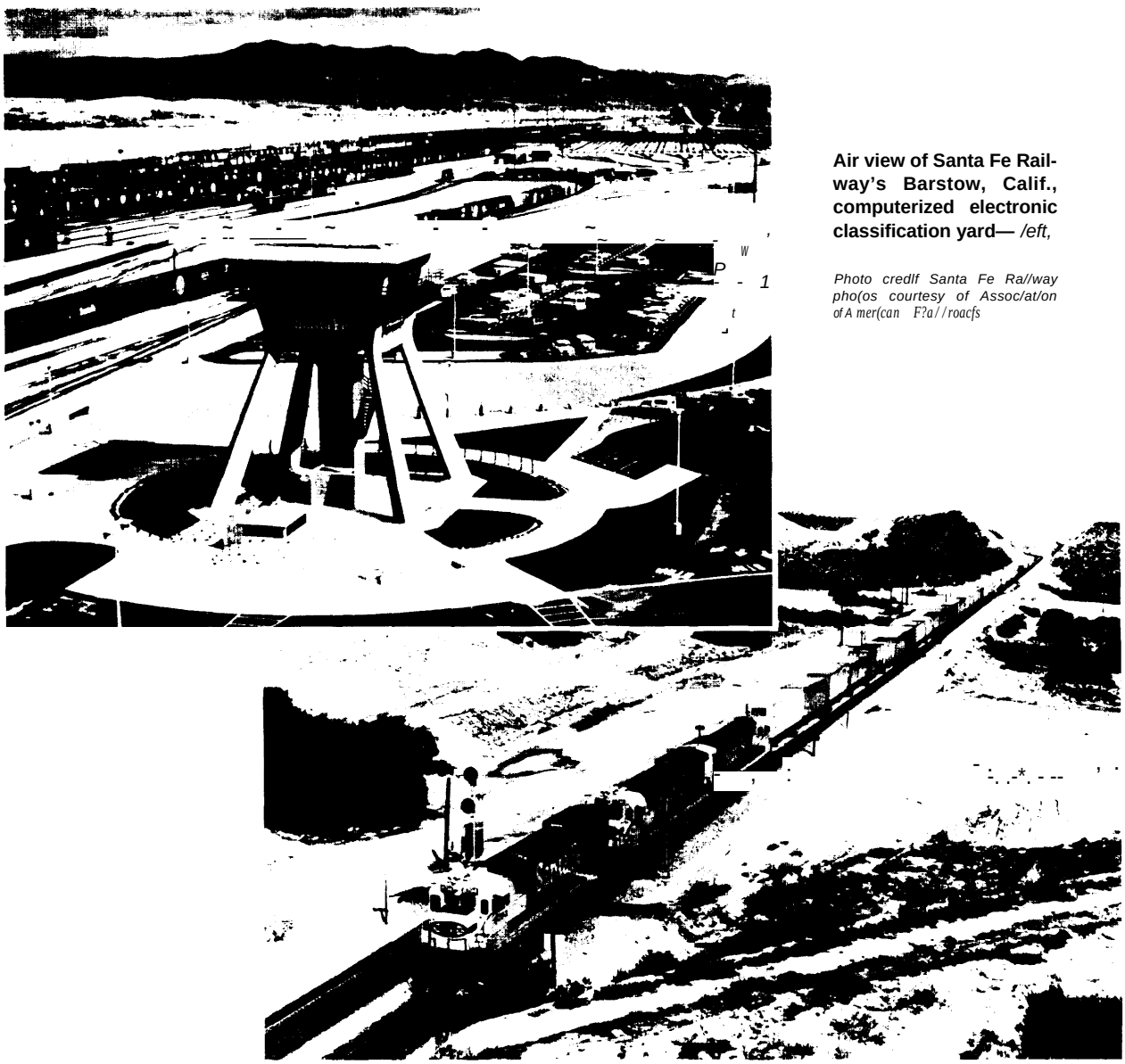
Table 17.—Railroad Technology Utilization

Year	Locomotives			Freight equipment	Average freight car capacity	Passenger cars
	Diesel	Steam	Electric			
1929	22	56,936	601	2,610,662	46.3	61,728
1939	510	41,117	843	1,961,705	49.7	45,479
1951	17,493	21,747	780	2,046,600	52.9	42,406
1955	24,786	5,982	627	1,996,443	53.7	36,871
1960	——	— .	——	——	——	——
1961				——	55.7	——
1962	28,104	51	434	1,850,688	56.3	25,566
1963	27,946	36	429	1,814,193	56.8	24,602
1964	27,837	34	393	1,796,264	58.3	23,057
1965	27,389	29	362	1,800,662	59.7	21,327
1966	27,481	25	344	1,862,499	61.4	20,016
1967	27,309	21	321	1,822,381	63.4	18,610
1968	27,019	21	305	1,800,375	64.3	15,384
1969	26,714	21	276	1,791,736	65.8	12,426
1970	26,796	13	268	1,784,181	67.1	11,177
1971	26,897	13	250	1,762,135	68.4	8,670
1972	27,070	13	252	1,716,937	69.6	7,589
1973	27,550	12	238	1,710,659	70.5	7,189
1974	27,857	12	215	1,720,573	71.6	6,848
1975	27,846	12	213	1,723,605	72.9	6,471

•Includes Amtrak's Auto-Train.
SOURCE: AAR 1977 Fact book.

which may have contributed to the rise in track-related accidents and the subsequent increase in the property damage problem.

In treating the more recent railroad safety problems, Congress has enacted laws designed to address all areas of railroad safety. Unlike the specific measures adopted at the turn of the century, the recent laws have given broad regulatory and administrative powers to the various executive agencies. Examples of these laws are the Federal Railroad Safety Act of 1970 and the Transportation of Hazardous Materials Act. (Discussion of the recent laws and regulations resulting from those laws is provided in chapter VII.) The evolution of the railroad safety problem reflects the evolution of the industry at large. As the safety problems have shifted in dimension and scope, so has treatment of the problems through the legislative and administrative processes.



Air view of Santa Fe Railway's Barstow, Calif., computerized electronic classification yard— */eft,*

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