

Case Study

Evolution of the U.S. Rail System

The railroads have experienced what is likely a typical life cycle for infrastructure-based systems, from revolutionary to dominant to mature to declining to decommissioning. The rail industry's evolution over a period of nearly 200 years therefore provides insights into the types of problems that are encountered – or are likely to be encountered – by other infrastructure-based systems.

Overview

In the mid-19th century, the rail industry in the United States consisted of hundreds of tiny companies. Over a century and a half, these companies slowly consolidated into today's coordinated system that is dominated by four mega-carriers. Regulation and government support, initially required to avoid overdevelopment and monopolistic excess, eventually was required to help the industry reduce its network, recover from bankruptcies, and abandon large segments of business that were better served by other modes of transportation. Today, while railroads clearly have advantages over highway and airline competitors in terms of fuel efficiency and emissions, these advantages do not necessarily mean that railroads will capture more traffic. Technological advances have been critical in allowing the railroads to remain competitive – and even dominant – in some markets. Understanding where the industry retains clear advantages has allowed the railroads to segment their markets and focus on the most promising areas: intermodal traffic and bulk traffic. Effective public policy and continuing public support may be needed to sustain the rail system, especially for passenger transportation.

Introduction of Railroads in the Early 19th Century¹

The introduction of railroads provided an incredible improvement in mobility and a dramatic reduction in the cost of moving freight. Cheap transportation plus the rapid advances of the industrial revolution spurred economic growth in the early 19th century. In the US, railroads were instrumental in opening up vast areas for development, both in terms of making land available for farmers and ranchers and providing access to new hotels in prime locations for rich tourists.

“The steam engine, the railroad locomotive, the transatlantic steamship, the telegraph, and the camera together virtually completed the conquest of nature by the go-ahead age. What followed were in effect refinements. ... Even the increasingly anticipated conquest of the air would, in essence, be no more than an added convenience. Its effect was simply to turn days into hours. It was the shortening of months into days by the railroads that was the basic revolution in transportation.”

Page Smith, *The Nation Comes of Ages, A People's History of the Ante-Bellum Years*, p. 819

State and local governments at first tried to hold off the railroads, as they wanted to protect their investments in canals. Over time, the legal impediments to railroad building were struck down by courts or repealed by state legislatures, and by the middle of the 19th century, the railroads had an irresistible momentum. Small lines constantly consolidated in an effort to increase their access to capital and improve their service. New lines were established, and as soon as they proved themselves (or went bankrupt) they were taken up by larger lines and incorporated into a "system." Boston entrepreneurs, who had no serious opportunities for building canals, financed railroads to compete with New York City's advantageous Erie Canal route to the Northwest Territories. By 1850, Boston had links as far as Ohio and throughout New England. Three thousand miles of rail line were built for \$70 million, and it was profitable.

¹ The history of the rail industry is well-documented. The facts in this sub-section were obtained from Page Smith, *The Nation Comes of Ages, A People's History of the Ante-Bellum Years*, pp. 271-277.

The emphasis quickly shifted from trying to prevent to trying to promote railroad development, especially in the Mississippi Valley region, where vast expanses of lands were unsold and unsettled because of their distance from markets. Illinois gave the Central Illinois RR 2.6 million acres of land to help finance construction, because costs had run \$10 million over budget. This land was initially worth \$0.16 per acre (i.e. about \$430 thousand). Five years later, it was worth \$10/acre; 10 years after that it was worth \$30 an acre and a total of \$78 million total. It was possible to get mortgages on the land in order to finance the construction of the railroads.

General economic trends were at times driven by and at times disastrous for the railroads. Construction of new lines led to a surge in demand for timber, iron, and coal. General cycles of boom and bust rapidly followed one upon the other. In the latter part of the 19th century, two thirds of the years were severe recessions or depressions. Competition among railroads was fierce, and bankruptcies were common. Potential problems such as air pollution from the coal-burning locomotives or the destruction of pristine areas and the division of cities did not impede the progress of the railroads.

Problems Emerge: Accidents, Greed, and Corruption

Railroading was a dangerous occupation, as there were many injuries resulting from collisions, derailments, and mistakes in switching cars in yards. Over time, improvements in brakes, in coupling systems, in signaling and communications, in track materials and vehicle design all contributed to dramatic reductions in the risks associated with rail operations.

Rail lines that were built to open up new regions to development could not be justified in terms of the revenues that would be received from operations. Before the railroad was built, there was little or no development, and until there was development, there would be little or no traffic. For this reason, government funds, loans, guarantees of railway bonds and land grants were used to finance the many lines in the Midwest and also the first transcontinental rail line. The government investment was justified by the potential social and economic benefits of development and, especially in the case of the transcontinental railroad, the strategic need to link California and with the rest of the country. The financial logic was that the railroad company could use the loans, mortgage the land or sell the bonds to obtain the cash required to build the rail line. Once the rail line was built, the railroad could repay the loans from land sales, operating profits, or by carrying government officials and freight at a discount. After completion of the railroad, although the government had given away large quantities of land, the remaining land was far more valuable.

The railroads that built the transcontinental railroad received land valued at \$392 million as of 1880, after the railroad was built. The government's land alongside the rail route had presumably appreciated by nearly that much. The railroads had been allowed to issue government-back bonds with a face-value of \$63 million, and they paid back that amount plus \$105 million in interest. Thus, the government's investment in the venture turned out to be very profitable.²

Unfortunately, rapid expansion of the rail network and access to vast amounts of public money led to various types of fraud: misuse of the funds intended for rail construction, construction of rail lines to too high or low a standard, and construction of very expensive lines along questionable routes. In developing the railroads in the northeast, the profitability of railroads attracted unscrupulous investors and politicians eager to capture their share of the bonanza. Deals involving railroad barons such as the Goulds and politicians such as the Tweeds in New York City were infamous, as were the battles and stock manipulations of rival financiers. As the rail network moved into the west, the need for public support was much greater than it had been in the east. And the opportunity for corruption was much greater.

The greatest scandal of the scandalous Grant administration (1869-1877) involved the construction of the transcontinental railroad. The Union Pacific and the Western Pacific railroads received construction grants from the US government plus land grants along the right-of-way to help finance the construction of the first transcontinental

² Ambrose, **Nothing Like It in the World**, p. 377

railroad. They were able to mortgage the land prior to construction based upon the value of the land after the construction in order to raise capital for construction. The UP owners did this through a French bank, Credit Mobilier, which they controlled. The bank declared as dividends the great majority of the funds deposited by the UP owners, who in effect defrauded the railroad and the government. Many US officials, including the Vice President, were implicated in the scandal.

Another type of fraud was to construct lines that were unnecessarily expensive to build, in order to provide larger profits to the contractors. Mark Twain captured the essence of this strategy in his marvelously cynical portrayal of “The Gilded Age:”

Beautiful Road. Look at that, now. Perfectly straight line - straight all the way to the grave. And see where it leaves Hawkeye - clear out in the cold, my dear, clear out in the cold. That town's as bound to die as - well if I owned it I'd get its obituary ready, now, and notify the mourners. Polly, mark my words - in three years from this, Hawkeye'll be a howling wilderness. You'll see. And just look at that river - noblest stream that meanders over the thirsty earth! - calmest, gentlest artery that refreshes her weary bosom! Railroad goes all over it and all through it - wades along on stilts. Seventeen bridges in three miles and a half - forty-nine bridges from Hark-from-the-Tomb to Stone's Landing altogether - forty-nine bridges, and culverts enough to represent them all - but you get an idea - perfect trestle-work of bridges for seventy-two miles. Jeff Thompson and I fixed all that, you know; he's to get the contracts and I'm to put them through on the divide. Just oceans of money in those bridges. It's the only part of the railroad I'm interested in, - down along the line - and it's all I want, too. It's enough, I should judge.

Mark Twain, **The Gilded Age**, Chap. 27

Monopolistic Excess and Regulation of Railroads

Fraud, monopolistic excesses in pricing, fatal accidents and cut-throat competition eventually created a situation in which it was both necessary and possible to regulate the railroads.³ So long as the railroads were unregulated, they were able to charge what the market could bear, which led to high prices and shipper complaints during periods of economic growth and bankruptcy for the railroads and loss of railroad jobs during recessions.

Initial attempts to regulate railroads were driven by several factors: inflation during the Civil War (1861-1865), declining agricultural prices during the depression of the 1870s, rapid settlement of the west, and decline in demand for grain overseas. Between 1871 and 1874, Illinois, Iowa, Wisconsin, and Minnesota enacted the so-called “Granger Laws”. These laws, though struck down in 1878 by the Supreme Court as unconstitutional, provided some examples that were followed in subsequent regulations of railroads:

- Establishment of maximum rates
- Creation of state railroad commissions to prescribe maximum rates
- Requiring pro rata rates (proportional to mileage) for the same class of goods
- Restrictions on mergers

Regulation of the railroads was finally adopted at the federal level by the Interstate Commerce Commission (ICC) Act of 1887. The ICC was given the power to regulate rates, which were required to be “just and reasonable” and non-discriminatory. Rates were required to be published, so that everyone could see whether or not they were fair. Additional legislation was needed to correct defects and omissions in the ICC Act to further protect the shipper

³ For an excellent discussion of the economic and political factors that led to regulation, plus a detailed description of the first 75 years of rail regulation, see D. Philip Locklin, “Economics of Transportation,” 6th edition, Richard D. Irwin, Inc., Homewood, IL, 1966, which is the source of the information on regulation presented in this section.

The financial zenith of the rail industry was reached in the late 19th and early 20th century. The railroads basically had a monopoly on intercity transportation, and people and companies were willing and able to pay rail fares and freight rates. Regulation had eliminated discrimination in rates, but it had not generally resulted in lower rates.

However, the glitter was coming off the rail industry. Roads were being improved so as to allow rapidly improving automobiles and trucks to cut into the railroad's monopoly. The U.S. involvement in World War I brought about a period of very intensive use and very little maintenance of the rail system. In order to coordinate operations and to maximize the efficiency of the system, the federal government took control of the railroads from December 28, 1917 until March 1, 1920.⁴ By the time that the railroads were returned to private operation after the war, they were in very poor physical shape, and many lacked the financial resources needed to recuperate. It was evident that there was a "strong railroad - weak railroad" problem. The strong railroads were more efficient, had better routes and served more customers. Competition among the strong railroads established the rate structure in many markets; weak railroads, with higher costs or second-rate routes, could not compete. With competition among the railroads driving prices down to levels where some railroads could not make any profits, the government recognized a need to help the industry. The Transport Act of 1920 provided some financial assistance to the railroads, established minimum rates as a way to avoid mutually destructive rate wars, and revised regulations related to rates and operations.

Over the next 15 years, the fortunes of the rail industry continued to decline, and the industry began to face serious problems that would persist for decades. The weak railroad problem remained unsolved, and many railroads went into bankruptcy. Truck competition captured some of the industry's most profitable freight traffic, and automobiles and airlines sharply cut the railroads' passenger traffic. Although the network was clearly overbuilt, with too many yards and lines, it was very difficult to consolidate facilities and the public challenged most attempts to abandon lines.

With declining profits and bankruptcy, railroads had increasing difficulty in raising capital to upgrade equipment and facilities. Operating efficiency was hampered by work rules, many of which had been negotiated with the unions at a time when the industry had been much more profitable, with different types of traffic, and more labor-intensive technology. Labor agreements made it very difficult to modify wages or work rules.

World War II provided a brief period in which the railroads once again became the dominant transport mode, as the federal government limited the use of gasoline and rubber for private travel. However, the trends toward trucks, automobiles, and air travel continued after the war, and the problems that had become evident during the depression remained unsolved, leading to pressure for further government intervention in the rail industry. The bankruptcy of the Penn Central in 1969 precipitated what was known as the Northeast Rail Crisis. The Penn Central had been formed only a few years earlier by the merger of two of the largest railroads, the New York Central and the Pennsylvania, and even on the eve of its bankruptcy it was viewed as a financially solid company. When it declared bankruptcy, it sent shock waves throughout the rail industry and the financial community. According to the Penn Central, the causes of their problems were four-fold: excessive labor costs because of union work rules and pay scales that reflected an era when railroads were dominant and operations were more labor intensive; inability to abandon unprofitable light density lines; losses in providing passenger service; and maximum rate regulation.

In the early 1970s, further bankruptcies, spectacular accidents involving hazardous materials, equipment shortages and disputes over light density lines highlighted the need for federal action to preserve the industry. The federal government faced three options for dealing with the crisis: nationalization of the bankrupt railroads, government funded rationalization of the system, and liquidation. Most in Congress were afraid of nationalization, because of the high cost of acquiring the railroads, while railroads and their customers feared political interference, especially with respect to consolidating lines and terminals and abandoning light density lines. Congress, railroads, customers, and local government officials were all afraid of liquidation, because nobody knew what would happen.

Congress eventually passed legislation that led to the government's acquisition of most of the lines owned by the Penn Central and several smaller bankrupt carriers, which were then merged into a new railroad called Conrail. Congress

⁴ Locklin, p. 225

was able to act because rail labor and rail shippers strongly supported providing help to the industry. The government invested several billion dollars in upgrading Conrail's equipment and facilities in addition to paying several billion for the lines that were incorporated into Conrail.

Congress also dealt with the other problems highlighted by Penn Central by shifting passenger operations in 1971 to a new entity called Amtrak, relaxing regulation, instituting new procedures for line abandonment, and providing mechanisms to assist in gradual reduction of the labor force.

Deregulation of the Railroads

While congress was still grappling with the Northeast Rail Crisis, the rail problems spread to the mid-west. In the mid-1970s, Congress was being urged to do something to respond to the collapse of the granger roads - Milwaukee Road, Illinois Central Gulf, Rock Island, and other, smaller roads serving the region. There was some support for re-doing the Conrail process by creating a "FARMRAIL", but this was rejected as too expensive. Conrail was clearly going to cost the government more than \$5 billion, and Congress had had enough of such spending.

A labor strike on the Rock Island precipitated a crisis. Instead of intervening to keep the railroad operating, the government allowed the Rock Island to cease operation. The railroad sold its best assets to other railroads, which turned out to be quite a good way to break up a railroad. The big losers in this were the union members who lost their jobs when the road went out of business.

The Carter Administration was, in general, pushing for deregulation as a way to end protection of major industry and to lower prices for the consumer. Allowing railroads to have pricing freedom was viewed as better than loss of service, by both shippers and local governments.

The end result was the passage of the Staggers Act in 1980, which eliminated much of the regulation of the rail industry. This act eliminated rate regulation for most types of rail shipments, allowed contract rates, and created new regulations aimed at expediting line abandonments and mergers. Deregulation, depending upon one's perspective, promoted innovative marketing by the railroads or led to discriminatory abuses such as those seen in the 19th century. Even railroad executives who normally claimed the former perspective sometimes admitted to the latter:

*"The best source I have for pricing ideas is in the court cases concerning pricing abuses prior to the creation of the ICC."*⁵

Technological Innovation

Deregulation was one of several factors that allowed the railroads to remain profitable at the end of the 20th century. A second factor included negotiations with unions that allowed trains to be operated with two or three crew members rather than four or more, as well as other changes in union agreements that allowed more productive use of employees. A third major factor was technological improvement, including the remarkable advances in telecommunications and computers as well as improvements in railroad technology. Introduction of computers and advanced communications enabled the railroads to centralize their administrative activities, eliminate vast number of clerical positions, and increase the ability of managers to control operations over larger networks. Advances in rail technology included continuing improvements in materials and design for both track and vehicles, as well as intensive development of two types of rail services:

- **Unit trains** are used to transport large quantities of coal, ore, grain or other bulk commodities directly from origin to destination. Unit trains provide the cheapest of rail transportation, because they are very efficient

⁵ Mark Hodak, Conrail marketing executive, explaining to my class on Freight Transportation Management how he studied rail rate discrimination in the 19th century to understand how his railroad could benefit from the deregulation of most rail freight rates in 1980.

in terms of fuel, equipment utilization, and labor requirements. By capitalizing on what railroads do best, unit trains enable railroads to compete very effectively with barges moving on the inland waterway system and with heavy trucks operating on limited access highways.

- **Intermodal operations** involve the transportation of trailers or containers by rail, truck, and ocean carrier. By using a trailer or container, it is possible to transfer freight very easily from one mode to another, so that it is possible to take advantage of each mode's capabilities. Trucks are best at moving freight short distances to and from customers. Railroads are best at moving trainloads of freight long distances; and ocean carriers are best at moving freight long distances across the oceans. A major breakthrough in intermodal operations came about in the 1980s when the ocean shipping lines and the railroads developed the double-stack container train, which allowed twice as many containers to be carried at about half the cost per container. This dramatic reduction in cost was possible only if intermodal terminals used expensive lift equipment at terminals and service could only be provided on routes that had sufficient clearances for the much higher trains (Figure 1). The potential for lower costs sparked a great many projects to build new intermodal terminals and to increase clearances on most of the major rail routes in the country. Double-stack trains made it possible for railroads to handle rapidly growing amounts of international freight as well as domestic freight such as that moved by UPS.



Figure 1 A double stack container train entering Union Pacific's Terminal in North Platte, Nebraska.

The containers were loaded in Asia, shipped across the Pacific by American President Lines, and transferred to Union Pacific at a west coast port. They would ultimately be delivered by trucks to customers in the eastern portion of the country.

- **Heavy Haul Railroading:** In 1985, the rail industry initiated a long-term research program aimed at reducing life-cycle costs for heavy freight operations. The program included laboratory testing, and monitoring of track deterioration at various locations on railroads around the country and the operation of a test track in Pueblo, Colorado known as the Facility for Accelerated Service Testing (FAST). The results of the tests enabled researchers to quantify the effects of heavier loads and better suspension systems on the deterioration rates and life cycle costs of the track structure.⁶ Operating trains with heavier cars allows

⁶ Hargrove, Michael B., Thomas S. Guins, and Carl D. Martland. *Economics of Increased Axle Loads – Fast/HAL Results*. Report No. LA-007. Association of American Railroads, October 1996.

railroads to save money related to fuel, crews, and equipment by moving more freight in each train. The AAR research program concluded that these operating benefits were greater than the added costs for the track infrastructure, and the industry decided to increase the maximum allowable axle loads from 33 to 36 tons. The heavier limits allow fewer trains to handle the same traffic, which not only reduces operating costs, it also reduces congestion in moving trains in and out of the most active coal mining regions, notably the Powder River Basin in Wyoming.

Summary

This case study provides an overview of the evolution of the rail industry in the United States. Portions of the rail system have gone through all of the stages of evolution of infrastructure systems, from initial testing of new technologies, to uncoordinated expansion, to consolidation, to retrenching and obsolescence. The system that remains today is far different from the one that dominated both passenger and freight transportation during the 19th century. Most of the smaller shipments and short-distance freight has been diverted to truck, and many once profitable rail lines have been abandoned or converted to rail trails. Many rail yards and terminals have been converted to other uses. Faced with competition from other modes, the railroads had to invest in the portions of their systems where they had the chance to remain competitive. Because of investment in new types of freight cars, better locomotives, improved signal systems, and more durable track structures, railroads remain the most economical way to move large shipments of bulk commodities such as grain or coal. Railroads also work with truckers and ocean carriers to move containers around the country and around the world, a type of transportation that is dependent upon investment in new types of container ships and terminals where automated equipment can be used to transfer containers from one mode to another.

The rail industry has great promise for selected services, including high speed passenger service, heavy haul freight and intermodal. Continuing advances in communications, control and materials are likely to provide further improvements in productivity, thereby helping the financial sustainability of the industry. Increasing public interest in the environmental benefits of rail may help ensure the public support necessary to maintain and expand rail service.

Lessons from the History of Railroads

Some of the lessons that can be learned from the experience of the railroads are as follows:

- New technology may enable a proliferation of new products that will be implemented without sufficient consideration of what will ultimately be recognized as the best system design.
- Competition is likely to arise for any technology and for any system. Who prospers in a competitive environment will be whoever best serves the customers within the existing regulatory framework. Just because a technology is more fuel-efficient, requires less land, or has a lower impact on the environment does not mean that the technology will prosper.
- Careful analysis can help determine what kinds of system improvements will be most helpful and how best to implement new technologies.
- Government regulation is a very important factor for infrastructure-based systems, both because of the high-fixed costs and the longevity of such systems. Government regulation of prices may be necessary to avoid destructive competition, and government funding may be necessary to allow a system with clear public benefits to be constructed or enhanced over time. Government support and regulation may also be helpful in allowing a gradual restriction of service over a slowly diminishing network rather than a collapse of service that would cause tremendous socio-economic problems for users and communities.
- As a system ages, it may be necessary to abandon facilities and services that previously were profitable in order to continue to be able to maintain and operate facilities and services that remain profitable.

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