How many think rail transport is obsolete in the US?

US rail freight traffic

![Graph showing the increase in US rail freight traffic from 1920 to 2000. The y-axis represents Ton-Miles (billions) and the x-axis represents Year.]
Rail is the principal means of economically moving large, heavy freight long distances overland.
Rail uniquely combines speed and energy efficiency
Railroad Network
System operation affects efficiency and service reliability

Line & Terminal Operation
Timely and efficient train operation and use of equipment & personnel

Rail Cars
Design and size affect operating efficiency

Locomotive
Efficient conversion of energy into tractive force to pull train

Brake System
Safe stopping distance affects train spacing and line capacity

Track System
Structure & condition affects speed and maintenance requirements

Wheel/Rail Interface
Complex dynamics affect stability & speed
Q: What country has the best rail transportation system in the world?

A: It depends!

Passenger or freight?

Passenger: Probably Japan or one of the western European countries

Freight: U.S. (and Canada) are virtually undisputed leaders
North American freight transportation volume by mode

Source: AAR from Eno Foundation for Transportation
So who cares about freight transportation?

Everyone should!
Why is railroad freight transport so important now, and even more so in the future?

• Lets consider the alternatives for inland transport
• truck, water, air, pipeline, conveyor belt
Truck Pros and Cons

- **Pros:** Speed, reliability, network coverage
- **Cons:** Energy efficiency, safety, land use, pollution, cost, congestion (because of shared use of infrastructure truck transport affects auto safety and congestion as well)
The highway network is increasingly congested
Truck Congestion
Waterways Pros and Cons

- Pros: Energy efficiency, low cost, low pollution, safety, capacity
- Cons: Speed, limited network
US Waterway Freight Flows
Major (Class 1) Freight Railroads

...also over 500 short line & regional railroads
Major freight railroads

- Two in east: CSX & NS
- Two in west: BNSF & UP
- Two in north: CN & CP
- One in middle: KCS

(From Vantuono 2000)
Note the importance of the “gateways” Chicago, St. Louis, Kansas City, Memphis, New Orleans

U.S. Railroad Network Showing Freight Traffic Volume

Gateways are where large amounts of freight are interchanged between western and eastern railroads

Railroad freight density
(million gross tons—mgt)
- Under 5 mgt
- 5 to 9.9 mgt
- 10 to 19.9 mgt
- 20 to 39.9 mgt
- 40 to 59.9 mgt
- 60 to 99.9 mgt
- 100 and over mgt

NOTE: Alaska and Hawaii are not shown here as they have no railroad networks.

SOURCE: US Dept. of Transportation, Federal Railroad Administration

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Basics of freight railcar weight and capacity

• The nominal capacity of a typical, 4-axle railcar today is 110 tons (formerly was 100 ton)
• Maximum Gross Rail Load (GRL) of a 110 ton, 4-axle railcar is 286,000 lbs. (weight of car + contents or “lading”)
• Nominal capacity = 220,000 lbs. or 110 tons
• Often referred to as a “110 ton” car or a “286K” car

Load or “lading”

Nominal capacity
approx. 220,000 lbs.
= 110 tons

Light weight or “tare” approx. 66,000 lbs. = 33 tons

Carbody
Trucks or "bogies"

220,000 lbs.
+ 66,000 lbs.

286,000 lbs.

Gross Rail Load (GRL)

(actual light weight will vary somewhat depending on car size, consequently the weight-carrying capacity will vary inversely, i.e. lighter car larger capacity)
Freight train size & gross tonnage

- Typical freight train is about 100 cars (generally range from 50 to 150 cars)
- $100 \times 110 = 11,000$ tons of lading
- GRL = 286,000 lbs.
- $100 \times 286,000$ lbs. = 28,600,000 lbs = 14,300 gross tons
- Plus the weight of two locomotives, ca. 300,000 lbs each = 150 tons each
  $= 14,300 + 2 \times 150 = 14,600$ gross tons per train
- One train per day for a year = $14,600$ tons $\times 365 = 5,329,000$ tons
  $= 5.329$ million gross tons (MGT)
- One train moving 100 miles equals = $14,600$ tons $\times 100$ miles
  $= 1,460,000$ gross ton-miles (GTM)
Types of freight cars

- **Flatcar**

![Flatcar Image]

- **Gondola**

![Gondola Image]

- **Hopper**

![Hopper Image]

- **Covered Hopper**

![Covered Hopper Image]

- **Boxcar**

![Boxcar Image]

- **Tank Car**

![Tank Car Image]

- **Auto Rack Car**

![Auto Rack Car Image]

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Number of Freight Cars of Different Types

- 1.5 million freight cars operating in North America
- Railroads own about half the freight car fleet
- Covered hoppers are the most abundant,
  - used for grain, plastic pellets, and some chemicals
- Tank cars second most common,
  - used for liquid products
  - about half of these are hazardous materials
- How much are these cars worth?
  - ca. $70,000 each to replace
  - 1.5 million x $70,000 = $105 BILLION!
  - Imperative that these assets be well utilized

---

**FREIGHT CAR OWNERSHIP - 2005**

<table>
<thead>
<tr>
<th>Railroads</th>
<th>Class 1</th>
<th>Other</th>
<th>Car Companies &amp; Shippers</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>156,140</td>
<td>7,105</td>
<td>27,783</td>
<td>191,028</td>
</tr>
<tr>
<td>Mexico</td>
<td>18,938</td>
<td>7,002</td>
<td>6,751</td>
<td>32,691</td>
</tr>
<tr>
<td>United States</td>
<td>473,773</td>
<td>120,169</td>
<td>693,978</td>
<td>1,287,920</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>648,851</strong></td>
<td><strong>134,276</strong></td>
<td><strong>728,512</strong></td>
<td><strong>1,511,639</strong></td>
</tr>
</tbody>
</table>

*For Canada and Mexico, "Class I" railroads exceed the revenue threshold and would be Class I railroads if they were U.S. railroads.*

Canadian-owned U.S. railroads are included in the Canadian figures. Some railroads may possess additional freight cars that are unregistered.
Railroad Traffic Mix: 2005

- **Coal was King!**
  - In terms of tons originated, it is the leading commodity transported by rail, followed by chemicals, non-metallic minerals & farm products.
  - Notice that revenue is not directly correlated with tons originated ... Why not?
    - Different commodities tend to be shipped different distances (longer distance more revenue).
    - Different commodities command different rates (more valuable commodities can bear higher shipping rates, but tend to require better service too).

- What are “Misc. mixed shipments”?

<table>
<thead>
<tr>
<th>Commodity Group</th>
<th>Tons Originated (000)</th>
<th>% of Total</th>
<th>Gross Revenue (million)</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>804,139</td>
<td>42.4 %</td>
<td>$9,393</td>
<td>20.1 %</td>
</tr>
<tr>
<td>Chemicals &amp; allied products</td>
<td>167,199</td>
<td>8.8 %</td>
<td>5,509</td>
<td>11.8 %</td>
</tr>
<tr>
<td>Non-metallic minerals</td>
<td>145,697</td>
<td>7.7 %</td>
<td>1,293</td>
<td>2.8 %</td>
</tr>
<tr>
<td>Farm products</td>
<td>140,441</td>
<td>7.4 %</td>
<td>3,628</td>
<td>7.8 %</td>
</tr>
<tr>
<td>Misc. mixed shipments*</td>
<td>119,835</td>
<td>6.3 %</td>
<td>6,998</td>
<td>15.0 %</td>
</tr>
<tr>
<td>Food &amp; kindred products</td>
<td>102,191</td>
<td>5.4 %</td>
<td>3,253</td>
<td>7.0 %</td>
</tr>
<tr>
<td>Metallic ores</td>
<td>59,941</td>
<td>3.2 %</td>
<td>485</td>
<td>1.0 %</td>
</tr>
<tr>
<td>Metals &amp; products</td>
<td>57,851</td>
<td>3.0 %</td>
<td>1,789</td>
<td>3.8 %</td>
</tr>
<tr>
<td>Petroleum &amp; coke</td>
<td>55,611</td>
<td>2.9 %</td>
<td>1,424</td>
<td>3.0 %</td>
</tr>
<tr>
<td>Stone, clay &amp; glass products</td>
<td>55,231</td>
<td>2.9 %</td>
<td>1,505</td>
<td>3.2 %</td>
</tr>
<tr>
<td>Lumber &amp; wood products</td>
<td>47,603</td>
<td>2.5 %</td>
<td>2,278</td>
<td>4.9 %</td>
</tr>
<tr>
<td>Waste &amp; scrap materials</td>
<td>47,345</td>
<td>2.5 %</td>
<td>1,070</td>
<td>2.3 %</td>
</tr>
<tr>
<td>Pulp, paper &amp; allied products</td>
<td>38,242</td>
<td>2.0 %</td>
<td>1,953</td>
<td>4.2 %</td>
</tr>
<tr>
<td>Motor vehicles &amp; equipment</td>
<td>35,585</td>
<td>1.9 %</td>
<td>3,796</td>
<td>8.1 %</td>
</tr>
<tr>
<td>All other commodities</td>
<td>21,810</td>
<td>1.1 %</td>
<td>2,369</td>
<td>5.1 %</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,898,721</strong></td>
<td><strong>100.0 %</strong></td>
<td><strong>$46,743</strong></td>
<td><strong>100.0 %</strong></td>
</tr>
</tbody>
</table>

* Miscellaneous mixed shipments (STCC 46) is mostly intermodal traffic. Some intermodal traffic is also included in commodity-specific categories. STCC 46 accounts for over two thirds of intermodal tonnage.
Class 1 railroad freight revenue - 2004

- Intermodal* - $8.8
- Coal - $8.4
- Chemicals - $5.1
- Motor vehicles & parts - $3.7
- Farm products (mainly grain) - $3.2
- Food - $2.9
- Lumber & wood - $1.9
- Pulp & paper - $1.7
- Primary metal products (e.g., steel) - $1.5
- Stone, clay & glass products (e.g., cement) - $1.3
- Nonmetallic minerals (e.g., sand, gravel) - $1.1

- Amounts shown in $billions
- Intermodal revenues exceeded coal for the first time in 2004
Intermodal freight

Intermodal **Transportation by more than one means of conveyance, as by truck, ship and/or rail**
Growth over the past decade has been entirely in containers on flatcar (COFC), trailer on flatcar (TOFC) declined through 1990s but now beginning to pickup.
Where are all these containers coming from?

Container ships from Pacific rim countries
Rail movement of intermodal traffic in US

• Rail lines serve as a “land bridge” for Pacific rim goods destined for the east coast and Europe
• All of the west coast ports are important, but the dual ports of Los Angeles and Long Beach (San Pedro Bay) in Southern California are by far the dominant
**Problem:** Rail infrastructure was inadequate to handle the dramatic growth in intermodal traffic.
Solution: Build a new rail line below grade to connect the ports to the main rail lines near downtown Los Angeles.
Finished “trench”, trackage, and new junction under construction
New bridge construction as part of Alameda Corridor Project

In addition to the new trackage, several new bridges were constructed to provide grade separation to reduce interference between rail and highway traffic.
Completed Alameda Corridor

- Opened April 2002 - on time and on budget.
Q: Where is all this freight traffic headed?

A: CHICAGO!!!
Q: How many freight cars pass through Chicago per day?

A: 1998 - 28,500
    2003 - 37,500

How many expected in 2023?

67,000!

How can they handle this traffic?
Is this a case of:
“If we build it will they come?”

NO!!!

• They are coming!
• We had better build it!
Chicago CREATE Plan

- Creation of 5 new corridors
  - Central
  - Western Avenue
  - Beltway
  - East-West Connector
  - Passenger Express
- New trackage
- New connections
- New signaling
- Grade crossing eliminations
- 6 Year, $1.5 billion project
Major railroad stock price increases over the past four years

Wall Street has noticed, So should you!
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Presentation Author
Chris Barkan
Professor
Railroad Engineering Program
Civil & Environmental Engineering Department
University of Illinois at Urbana-Champaign
1203 Newmark Civil Engineering Lab, MC-250
Urbana, IL 61801
(217) 244-6338
<cbarkan@uiuc.edu>

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