Presentation Outline

• Importance of freight transportation systems and role of rail
• Introduction to US freight railroads
• Railroad freight transportation metrics
• Importance of economies of scale to rail transport efficiency
• US freight traffic, cars and trains
• Railroad intermodal traffic: types and growth
• Summary and concluding remarks
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
Elements of Railway Engineering

Railroad Network
System operation affects efficiency and service reliability

Traffic Control System
Safe, efficient operation of many trains on same tracks

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

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US has an extensive freight railroad network with heavy traffic on many routes

Outside Northeast and a few other corridors, most passenger routes have only one train per day
Why is railroad freight transport so important now, and even more so in the future?

- Consider the pros and cons of each alternative mode of overland transport of freight
- truck, water, air, pipeline, conveyor belt

![Truck](image1)
![Water Transport](image2)
![Air Freight](image3)
![Pipeline](image4)
![Conveyor Belt](image5)
US surface freight flows by highway, rail & waterway

Mode
- Interstate Highways
- Non-Interstate Highways
- Railroad
- Inland Waterway

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North American freight railroads transport large volumes of cargo - efficiently and profitably
Distribution of Intercity Revenue Freight Ton-Miles by Mode

![Bar chart and pie chart showing the distribution of freight ton-miles by mode: Rail, Truck, Pipeline, Water, Air.]

**Source:** AAR from Eno Foundation for Transportation
### Tons of freight originated and value, by mode

<table>
<thead>
<tr>
<th>Mode</th>
<th>Tons Originated (billions)</th>
<th>Value ($trillions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Truck</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Rail</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Water</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Air</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>International</td>
<td>0.5</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Source: 1998 data from US DOT FHWA

- In general, railroads tend to transport high mass, low value commodities traveling a long distance
- But, increasingly high-value freight being moved via rail intermodal
Projected growth in US freight shipments

- Domestic and international freight volumes in 2020 are expected to be 67 percent and 85 percent higher, respectively, compared to 1998

http://www.ise.msstate.edu/ncit/Research/ncitdec04/TrustworthyData.htm
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, pollution, safety, capacity
- **Cons**: Speed, limited network
US Waterway Freight Flows
Pipelines and Conveyor Belts

- **Pros:** High volume, continuous transport possible, no vehicles needed, low labor requirements
- **Cons:** Highly constrained types of commodities, limited product flexibility, speed and network
Major US Pipelines

- Different colors indicate different products (excluding natural gas)
• US railroad freight traffic has grown steadily since the mid-20th century, and this trend has continued into the 21st
Rail uniquely combines speed, low cost and energy efficiency in a broad network of overland transport.
It is the principal means of economically moving large, heavy freight long distances overland in the US.
Surface Transportation Board classification of US railroads

• What are some ways that we might classify railroads?
  – Miles of road, miles of track
  – Amount of traffic
  – Type of traffic
  – Revenue
  – Ownership

• US Freight railroads are classified by the Surface Transportation Board into “Classes” according to their annual operating revenue*
  – Class I $\geq$ $433.2$ million
  – Class II $\geq$ $34.7$ million, $< $433.2 million
  – Class III $< $34.7 million

*Thresholds adjusted annually to account for inflation, these figures are for the year 2011
AAR Classification of Railroad Companies

The Association of American Railroads (AAR) also classifies railroads using a modification of the STB system in which “Regionals” have annual revenue between $40 million and the Class I threshold, and/or operate 350 or more miles of track. Shorter railroads, and switching and terminal roads, are categorized as “Local”.

<table>
<thead>
<tr>
<th>Type of Railroad</th>
<th>Number</th>
<th>Miles Operated</th>
<th>Employees</th>
<th>Freight Revenue (billions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I</td>
<td>7</td>
<td>95,387</td>
<td>158,623</td>
<td>$65.0</td>
</tr>
<tr>
<td>Regional</td>
<td>21</td>
<td>10,355</td>
<td>5,443</td>
<td>1.4</td>
</tr>
<tr>
<td>Local</td>
<td>539</td>
<td>32,776</td>
<td>11,874</td>
<td>2.6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>567</td>
<td><strong>138,518</strong></td>
<td><strong>175,940</strong></td>
<td><strong>$68.9</strong></td>
</tr>
</tbody>
</table>

Class I railroads account for 67% of mileage, 89% of employees, and 93% of revenues of the US railroad industry.

Source: AAR Facts 2012 Edition
More rail industry statistics available at: http://www.aar.org/
Major (Class 1) Railroads

...and over 550 short line & regional railroads
• Seven large (Class 1) freight railroads
• CSX & NS in eastern US
• BNSF & UP in west
• CN & CP in Canada & central US
• KCS is a medium-sized railroad in central US
• 500 Short-line and Regional railroads
• Amtrak operates passenger trains throughout the US
• Outside the Northeast Corridor these are primarily on freight railroad trackage
• Commuter rail operations in many large cities
Four Largest US Railroads

BURLINGTON NORTHERN SANTA FE

CSX

UNION PACIFIC

NORFOLK SOUTHERN

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

Note the importance of the “gateways” Chicago, St. Louis, Kansas City, Memphis, New Orleans

SOURCE: TRAINS Magazine
Major Railroad Organizations

ASSOCIATION OF AMERICAN RAILROADS

RAIL INC

TICTI Transportation Technology Center, Inc.

ASLRRRA

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Other Railroad Organizations
Government Organizations
Railroad Freight Transportation Metrics

Introduction to Some Basic Measurements of Rail Freight Transport
Railroad transportation efficiency

• Railroads produce “output” more efficiently than their principal competition: trucks

• What is transportation “output”?  
  – *Ton-miles* of freight  
  – *Passenger-miles* of people

• In order to quantify this efficiency, we must measure transportation output
Diesel-electric freight locomotive (GE Dash9 C44CW)

4,400 horsepower, 392,000 lbs = 196 tons

Typical North American freight cars

Freight cars of two capacities are most common today:

- 263,000 lbs GRL = 131.5 tons
  “Nominal* 100 ton” or 263K
  33-ton axle load

- 286,000 lbs GRL = 143.0 tons
  “Nominal* 110-ton” or 286K
  36-ton axle load

Multi-unit, double-stack container car

End truck 27.5-ton axle load
Middle truck 39-ton axle load
Basics of freight railcar weight and capacity

- Nominal capacity of a typical, 4-axle railcar today is 110 tons.
- Nominal = “in name only”, e.g. “100-ton” car may have an actual capacity that is more than, or less than, 100 tons.
- 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 of lading
- Often referred to as a “110 ton” car or a “286K” car

![Diagram of railcar weight and capacity]

Load or Lading

- **Nominal Capacity**
  - Approx. 220,000 lbs = 110 tons
- **Gross Rail Load (GRL)**
  - 66,000 lbs. + 220,000 lbs = 286,000 lbs

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

- Carbody
- Trucks or "bogies"

(Actual light weight will vary somewhat depending on car size, consequently the weight-carrying capacity will vary inversely, i.e. lighter car, larger capacity.)
North American freight car capacity

- More than 85% of the cars in service are 100-ton or 110-ton capacity cars

<table>
<thead>
<tr>
<th>Maximum GRL</th>
<th>Nominal Capacity</th>
<th>Number of Cars in Service</th>
<th>Percentage of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>220,000 lbs.</td>
<td>70 ton</td>
<td>178,961</td>
<td>11.9%</td>
</tr>
<tr>
<td>263,000 lbs.</td>
<td>100 ton</td>
<td>595,680</td>
<td>39.2%</td>
</tr>
<tr>
<td>286,000† lbs.</td>
<td>110 ton</td>
<td>700,896</td>
<td>46.2%</td>
</tr>
<tr>
<td>315,000 lbs.</td>
<td>125 ton</td>
<td>1,653</td>
<td>0.1%</td>
</tr>
<tr>
<td>All Other*</td>
<td></td>
<td>41,459</td>
<td>2.73%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td><strong>1,474,800</strong></td>
<td></td>
</tr>
</tbody>
</table>

† Includes 64,284 cars with maximum GRL = 268,000 lbs.
* Primarily cars of higher capacity with more than 4-axles
Freight train size and tonnage

- Typical freight train is about 100 cars (generally range from 50 to 150 cars)
  ___ cars x ___ tons lading per car = ______ tons of lading

- Railcar Gross Rail Load = _______ lbs. $GRL$ (= ____ tons)
  _____ cars x _______ lbs. = ___________ lbs = ______ gross tons

- Plus the weight of two locomotives, about 300,000 lbs each
  = ___ tons each x 2 = ____ tons of locomotives
  __+ ______ tons in consist = ______ gross tons per train
Freight train size and tonnage

• Typical freight train is about 100 cars (generally range from 50 to 150 cars)

\[100 \text{ cars} \times 110 \text{ tons lading per car} = 11,000 \text{ tons of lading}\]

• Railcar Gross Rail Load = 286,000 lbs. \textit{GRL} (= 143 tons)

\[100 \text{ cars} \times 286,000 \text{ lbs.} = 28,600,000 \text{ lbs} = 14,300 \text{ gross tons}\]

• Plus the weight of two locomotives, about 300,000 lbs each

\[= 150 \text{ tons each} \times 2 = 300 \text{ tons of locomotives}\]

\[+ 14,300 \text{ tons in consist} = 14,600 \text{ gross tons per train}\]
Intercity ton-miles is a common metric for measuring freight traffic

- **1 ton-mile** = ___ ton of freight moved ___ mile

- Typical railcar weighs about ____ tons and can transport about ____ tons of lading

- So how many ton-miles does one *fully loaded* freight car generate when it moves one mile?
  
  ____ *revenue ton-miles* = weight of lading x miles
  
  ____ *gross ton miles* = (weight of lading + railcar) x miles

- How many does an *empty* car generate?

  ____ *revenue ton-miles*
  
  ____ *gross ton miles*

- One train per day for a year (including two locomotives) = _______ tons x ____ days = __________ tons = _____ million gross tons (MGT)

- One train moving 100 miles equals = _______ tons x ____ miles
  
  = __________ gross ton-miles (GTM)
Intercity ton-miles is a common metric for measuring freight traffic

- **1 ton-mile** = 1 ton of freight moved 1 mile
- Typical railcar weighs about 33 tons and can transport about 110 tons of lading
- So how many ton-miles does one *fully loaded* freight car generate when it moves one mile?

  110 revenue ton-miles = weight of lading x miles

  143 gross ton miles (GTM) = (weight of lading + railcar) x miles

- How many does an *empty* car generate?

  0 revenue ton-miles
  33 gross ton miles

- One train per day for a year (including two locomotives) = 14,600 tons x 365 days = 5,329,000 tons = 5.329 million gross tons (MGT)

- One train moving 100 miles equals = 14,600 tons x 100 miles = 1,460,000 gross ton-miles (GTM)
Class 1 Railroad Gross Ton Miles Have Increased: 1960-2010

![Graph showing the increase in Class 1 Railroad Gross Ton Miles from 1960 to 2010. The data points are as follows:

- 1960: 572 billion ton-miles
- 1970: 765 billion ton-miles
- 1980: 919 billion ton-miles
- 1990: 1,034 billion ton-miles
- 2000: 1,466 billion ton-miles
- 2010: 1,691 billion ton-miles]
But, while rail traffic has increased, track miles have decreased.

How is this possible?

![Graph showing the decrease in miles of track from 1960 to 2010](graph.png)
Increase in Capacity of Freight Cars 1900-2000

- Freight Cars In Service
- Freight Cars Ordered

Year

Average Capacity (tons)

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Rail freight traffic in Chicago has grown over the 30 years from 1971-1980.

More traffic is being routed through Chicago and it has been consolidated on fewer lines.
By consolidating traffic on fewer lines, they can invest more resources in the remaining lines and still save money overall.

This is an example of "economy of scale".
Economy of Scale

- Average cost per unit of output declines as the number of units produced increases.
- Economic principle that is particularly important for rail transportation.

Total Cost = Fixed Cost + Variable Cost

Cost per Unit = Total Cost / Number of Units
Railroad mergers also improve economies of scale and produce greater efficiencies

- Two basic types of railroad mergers:
  - Parallel mergers: Railroads tend to serve many points in common (improve economy of density)
  - End-to-end: Railroads serve different regions but connect and interchange traffic (improve economy of size)

- Some mergers may combine elements of each
- Different types of economies of scale achieved through these two types of merger

![Diagram of parallel and end-to-end mergers]
MAKING THE BIG FOUR

A series of mergers over the past 50 years has led to the creation of four freight rail behemoths that now control 90% of all business. Below, some of the notable deals along the way.

Norfolk Southern Railroad
Southern
Central of Georgia
Wabash Nickel Plate
Pittsburgh & WVa.
Norfolk & Western
Atlantic & Danville
Akron Canton & Youngstown
Illinois Terminal
Pennsylvania
New York Central

Chicago South Shore & South Bend
Chesapeake & Ohio
Baltimore & Ohio
Western Maryland
Atlantic Coast Line
Seaboard Air Line
Louisville & Nashville

Minneapolis & St. Louis
Chicago & North Western
Chicago Great Western
Missouri-Kansas-Texas
Union Pacific
Western Pacific
Missouri Pacific

Chicago & Eastern Illinois
Texas & New Orleans
Southern Pacific
Pacific Electric
Denver & Rio Grande Western

Atchison Topeka & Santa Fe
Chicago Burlington & Quincy
Great Northern
Northern Pacific
Spokane Portland & Seattle
St. Louis-San Francisco

Norfolk Southern Railway
CONRAIL
Chessie System
Seaboard Coast Line

1960
1970
1980
1990
2000

SOURCE:
COMPANY WEBSITES.
TRAINDIGRAZINE
Freight traffic, cars and trains

- So far we have considered tonnage, routes and railroads
- But not what makes up freight traffic, the type of railcar or the trains used to transport it
Types of freight cars

Flatcar

Gondola

Hopper

Covered Hopper

Boxcar

Tank Car

Auto Rack Car
Distribution of Freight Car Types

- Nearly 1.3 million freight cars operating in North America
- Railroads own about 60% of the fleet, but Class 1 railroads own about 30%
- Covered hoppers most common type,
  - used for grain, plastic pellets, and some chemicals
- Tank cars second most common,
  - used for liquid products
  - about half of these are for hazardous materials
- How much are these cars worth?
  - avg. $98,000 each to replace
  - 1.3 million x $98,000
  = $127 BILLION!
  - Imperative that these assets be well utilized
Railroad Traffic Mix: 2012

- **Coal was** King!
  - In terms of tons originated, it is the leading commodity transported by rail, followed by chemicals, farm products & non-metallic minerals

- 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”?

**Type of Freight Carried for Year 2012**

<table>
<thead>
<tr>
<th>Commodity Group</th>
<th>Tons Originated</th>
<th>% of Total</th>
<th>Gross Revenue</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>727,094</td>
<td>40.2 %</td>
<td>$14,717</td>
<td>21.6 %</td>
</tr>
<tr>
<td>Chemicals &amp; allied prod.</td>
<td>189,263</td>
<td>10.5 %</td>
<td>9,216</td>
<td>13.5 %</td>
</tr>
<tr>
<td>Farm products</td>
<td>143,537</td>
<td>7.9 %</td>
<td>5,309</td>
<td>7.8 %</td>
</tr>
<tr>
<td>Non-metallic minerals</td>
<td>132,169</td>
<td>7.3 %</td>
<td>2,646</td>
<td>3.9 %</td>
</tr>
<tr>
<td>Misc. mixed shipments*</td>
<td>115,399</td>
<td>6.4 %</td>
<td>8,803</td>
<td>12.9 %</td>
</tr>
<tr>
<td>Food &amp; kindred products</td>
<td>107,734</td>
<td>6.0 %</td>
<td>5,413</td>
<td>8.0 %</td>
</tr>
<tr>
<td>Metallic ores</td>
<td>75,352</td>
<td>4.2 %</td>
<td>748</td>
<td>1.1 %</td>
</tr>
<tr>
<td>Metals &amp; products</td>
<td>51,533</td>
<td>2.9 %</td>
<td>2,730</td>
<td>4.0 %</td>
</tr>
<tr>
<td>Petroleum &amp; coke</td>
<td>46,232</td>
<td>2.5 %</td>
<td>2,269</td>
<td>3.4 %</td>
</tr>
<tr>
<td>Stone, clay &amp; glass prod.</td>
<td>43,921</td>
<td>2.4 %</td>
<td>1,725</td>
<td>2.5 %</td>
</tr>
<tr>
<td>Waste &amp; scrap materials</td>
<td>42,568</td>
<td>2.4 %</td>
<td>1,284</td>
<td>1.9 %</td>
</tr>
<tr>
<td>Pulp, paper &amp; allied prod.</td>
<td>32,077</td>
<td>1.8 %</td>
<td>2,181</td>
<td>3.2 %</td>
</tr>
<tr>
<td>Lumber &amp; wood products</td>
<td>27,203</td>
<td>1.5 %</td>
<td>1,582</td>
<td>2.3 %</td>
</tr>
<tr>
<td>Motor vehicles &amp; equip.</td>
<td>22,948</td>
<td>1.3 %</td>
<td>4,877</td>
<td>7.2 %</td>
</tr>
<tr>
<td>All other commodities</td>
<td>50,683</td>
<td>2.8 %</td>
<td>4,546</td>
<td>6.7 %</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,806,613</strong></td>
<td><strong>100.0 %</strong></td>
<td><strong>$68,067</strong></td>
<td><strong>100.0 %</strong></td>
</tr>
</tbody>
</table>

* Miscellaneous mixed shipments (STCC 46) is almost all intermodal traffic. Some intermodal traffic is also included in commodity-specific categories. STCC 46 accounts for about two thirds of intermodal tonnage.

** Gross Revenue is not adjusted for absorption (incentive rebates etc.) or correction.
## Typical North American Freight Trains

<table>
<thead>
<tr>
<th>Manifest</th>
<th>Unit</th>
<th>Intermodal</th>
</tr>
</thead>
<tbody>
<tr>
<td>70 cars</td>
<td>115 cars</td>
<td>90 cars</td>
</tr>
<tr>
<td>4,550’</td>
<td>6,325’</td>
<td>6,300’</td>
</tr>
<tr>
<td>7,700 tons</td>
<td>16,445 tons</td>
<td>8,100 tons</td>
</tr>
<tr>
<td>2 SD70 4,300 HP Locomotives</td>
<td>3 SD70 4,300 HP Locomotives</td>
<td>4 SD70 4,300 HP Locomotives</td>
</tr>
<tr>
<td>1.12 HP/Trailing Ton</td>
<td>0.78 HP/Trailing Ton</td>
<td>2.12 HP/Trailing Ton</td>
</tr>
<tr>
<td>Max Speed: 60 mph</td>
<td>Max Speed: 50 mph</td>
<td>Max Speed: 70 mph</td>
</tr>
</tbody>
</table>
Manifest Freight Trains

- Mix of cars, commodities, origins and destinations
- Operate from one classification yard to the next, then train is broken up and cars resorted into new trains bound for their respective destinations
- 0.9 to 1.2 HPT
- Operates up to 60 mph
- Typical weight: 6,000 - 8,000 tons
Locals & Road-switchers

• An essential adjunct to the manifest, as they pick up and set out of cars from customers
• Work out and back from a terminal serving customers in a region
• Typical length: up to 35 cars (but can be more)
• Distance traveled typically not more than 60 miles from home terminal
Unit Freight Trains

- Entire trainload of bulk commodity freight (coal, grain, minerals, petroleum, alcohol)
- Moves as a unit from origin to destination
- Powered for ruling grade
- Maximum speeds around 45 mph
- Typical weight: 12,000 - 15,000 tons
Intermodal Freight Trains

- Domestic and international **containers** and **trailers**
- **Special type of unit train**, generally an entire train of intermodal cars moves from their origin terminal to their destination
- Powered for speed (≥ 2 HPT)
- Maximum speed: 60 - 70 mph
- Typical length: 6,000’ - 8,500’
Intermodal growth has been entirely in containers since the mid-1990s.

- Trailer on flatcar (TOFC) traffic peaked in 1994 and has generally declined since then.
Dramatic shift in intermodal traffic from trailers to containers

Containers and Trailers as a Percentage of U.S. Rail Intermodal Traffic: 1989-2013*

*2013 is year to date  Source: AAR
Summary

• Railroads’ unique ability to provide, low-cost, high capacity rail freight is essential to a thriving economy

• Learned the basic metrics to measure rail freight productivity, gross rail load (GRL), gross tonnage (MGT) and ton miles (GTM), and how to calculate them

• Consolidation of resources on fewer rail lines and fewer railroads, led to greater economies of scale and consequent better performance and more efficient freight transportation

• Railroads able to extract greater value from their infrastructure by increasing railcar size, capacity and corresponding axle loads

• Intermodal has begun to eclipse certain traditional bulk freight, notably coal, that has been the basis of rail traffic for over a century

• Intermodalism, especially use of containers, has experienced dramatic growth as the US participates more and more in the global economy
Questions?
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Appendix 1: Unit conversion

Most units are expressed in English, not Metric units

- 1 mile (mi) = 1.6 km
- 1 pound (lb) = 0.45 kg
- 1 ton = 0.9 metric tonnes (t)
- 1 gallon (gal) = 3.8 liters (l)
Appendix 2: LCL and Intermodal Freight
Miscellaneous Mixed Shipments: *Then*
YOU are a railroad shipper!
Yards full of boxcars then... replaced by yards full of trailers & containers now!
### Intermodal revenues exceeded coal for the first time in 2004

<table>
<thead>
<tr>
<th>Category</th>
<th>Revenue ($ billions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intermodal*</td>
<td>$8.8</td>
</tr>
<tr>
<td>Coal</td>
<td>$8.4</td>
</tr>
<tr>
<td>Chemicals</td>
<td>$5.1</td>
</tr>
<tr>
<td>Motor vehicles &amp; parts</td>
<td>$3.7</td>
</tr>
<tr>
<td>Farm products (mainly grain)</td>
<td>$3.2</td>
</tr>
<tr>
<td>Food</td>
<td>$2.9</td>
</tr>
<tr>
<td>Lumber &amp; wood</td>
<td>$1.9</td>
</tr>
<tr>
<td>Pulp &amp; paper</td>
<td>$1.7</td>
</tr>
<tr>
<td>Primary metal products (e.g., steel)</td>
<td>$1.5</td>
</tr>
<tr>
<td>Stone, clay &amp; glass products (e.g., cement)</td>
<td>$1.3</td>
</tr>
<tr>
<td>Nonmetallic minerals (e.g., sand, gravel)</td>
<td>$1.1</td>
</tr>
</tbody>
</table>

- Since 2004, relative revenue from intermodal and coal have fluctuated, but the long-term trend is clear - intermodal will continue to increase and coal will stabilize.

* Amounts shown in $billions
• Sears was one of over a half dozen companies in the home kit business

• Kits would arrive in one or two boxcars to be unloaded and assembled
Intermodal Definition

- **Intermodal shipment**: a freight shipment that moves between origin and destination using two or more modes of transportation

- Two types of intermodalism:
  - **Bulk** (transfer of bulk product from a vehicle of one mode to another mode)
  - **Unitized** (trailers & containers)

- Growth of unitized intermodal shipments has been a spectacular trend in transportation

- Domestic and internationally standardized designs for containers
Examples of bulk intermodalism

- Many products are moved in bulk quantities
- Sources of supply and consumption may have access to different transport modes
- Intermodal transport provides flexibility and options for more economical transport

Grain transfer from railcar to truck

Taconite transfer from boat to train

Asphalt transfer from railcar to truck
Railroad unit intermodalism is part of a multi-modal global freight transportation system.
Unitized intermodal freight

**Trailers**

**Containers**
What is a “TEU”? 

• **TEU** = “twenty-foot equivalent unit”
• An inexact unit of cargo capacity often used to describe the capacity of container ships and terminals.
• Based on volume of a 20-foot-long (6.1 m) intermodal container
• No standardization regarding height, but the most common is 8’ 6” inches (2.59 m)
Basic types of unitized intermodal equipment & service

- Railroad intermodal transportation is typically either:
  - **Trailer on flatcar (TOFC)**
  - **Container on flatcar (COFC)**

- **Double-Stack**, containers are stacked on top of one another in specially designed “well cars”, designed to reduce overhead clearance requirement

- **“RoadRailer”**, is a system in which a container can ride directly on either a highway or railroad wheel assembly, without any railcar required