Indiana Coal Movement

Indiana Rail Capacity/Potential

Center for Coal Technology Research
Energy Center

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Background

- Develop Methodology
  - 10 by 10 Routing Development
  - Rail Movement Parameters
- Analyze Scenarios
  - South to North Power Plant
  - South to Port of Indiana
  - Ohio River Power Plants

Findings to Date

- Transportation aspects of coal delivery by rail directly affects the amount of coal a power plant must keep on site
  - Variability of speed, congestion
  - Time(Route)
  - “Lot Size” of movement(Unit Train)

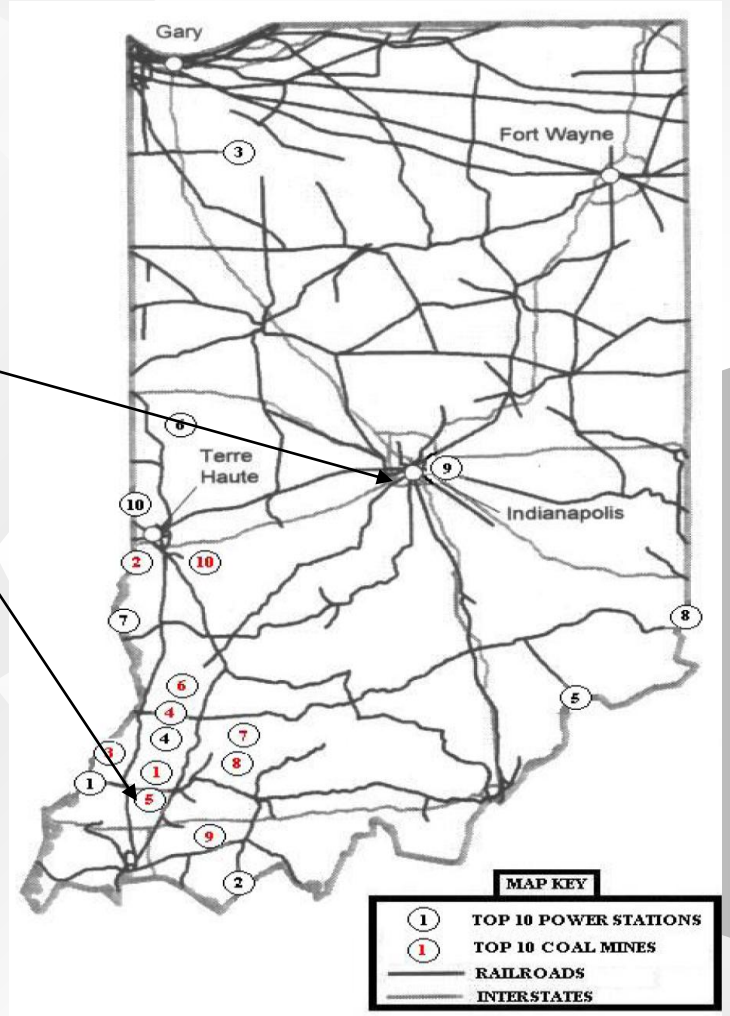
Methodology

INDIANA COAL RAILROAD TIMETABLE: ROUTE 2

STATION NAME	MILE POST	TRACK				NOTATION	INTERLOCKS
		OWNER	NUMBER	CLASS	SPEED		
READ DOWNWARD FOR SOUTHBOUND							
CP HOLT	172.5	IN, INCR	1	1	10	T	1, *CIND, CSXT*
MOORESVILLE	185.0	INCR	1	2	25		
MARTINSVILLE	199.0	INCR	1	2	25		
WHITAKER	209.0	INCR	1	2	25	P	
SPENCER	221.5	INCR	1	2	25		
WORTHINGTON	240.5	INCR	1	2	25	P,Y	
SWITZ CITY	247.5	INCR	1	2	25	A	3
BEEHUNTER	254.5	INCR	1	1	40	A	4, 6
ELNORA	260.5	INCR	1	1	40	A	5
CHAPPEL	279.5	INCR	1	2	25	M	CSXT
PETERSBURG	296.5	INCR	1	2	25		
ASHBY YARD	298.0	INCR	1	2	25	B,E,Y	
OAKLAND CITY	308.5	INCR	1	2	25	A	NS
GRAY JCT	309.5	INCR	1	2	25		
BUCKSKIN	317.5	INCR	1	2	25	T	7
STRAIGHT LINE JCT	337.5	CSXT, INCR	1	2	25		
BETWEEN STRAIGHT LINE JCT AND WANSFORD YARD CSXT TIMETABLE GOVERNS.							
WANSFORD YARD	338.0	CSXT	1	1	10	Y	CSXT
READ UPWARD FOR NORTHBOUND							

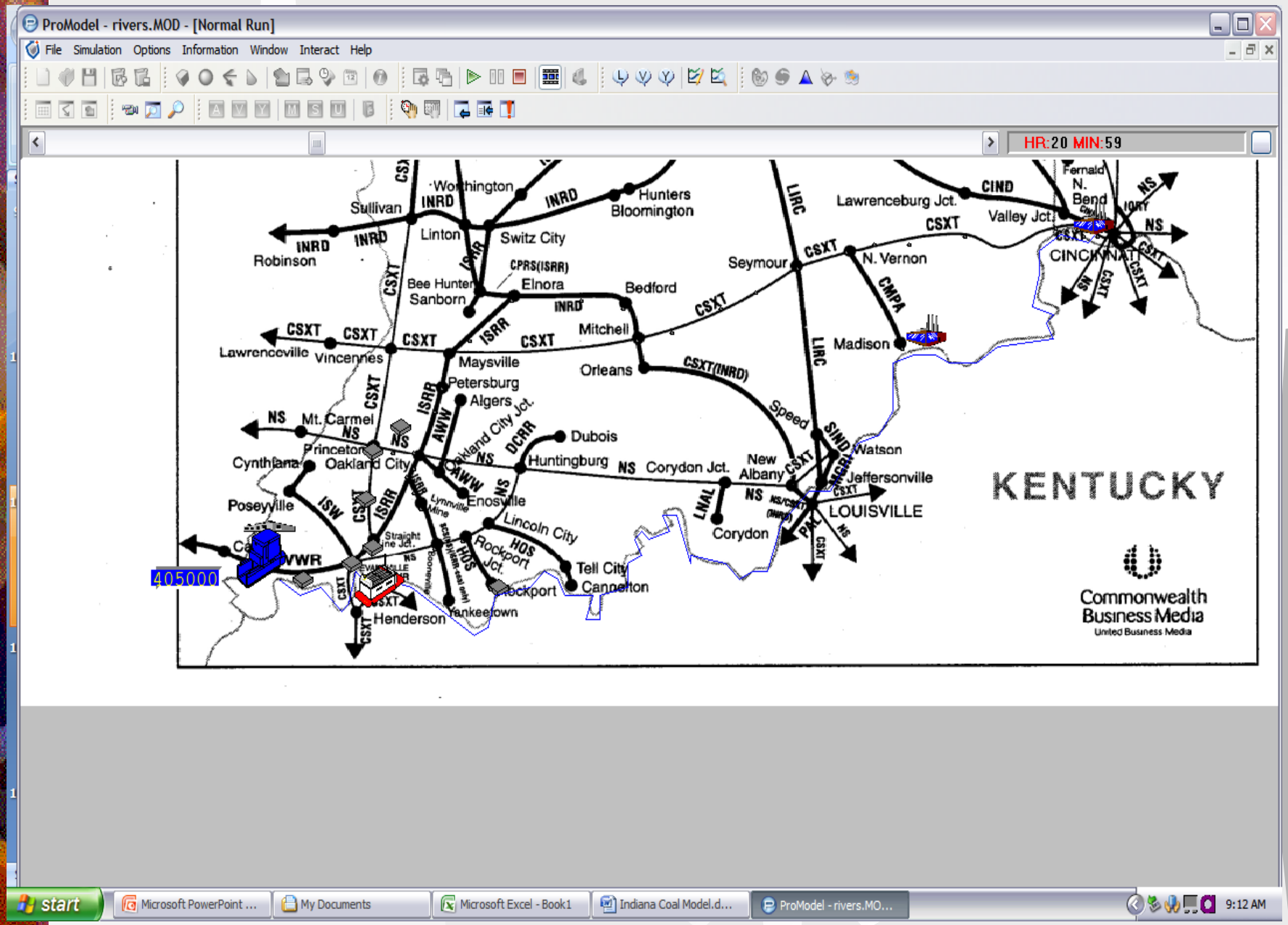
SOURCE: Comprehensive Railroad Atlas of North America; compiled by Chad Pfitzer

Parameter	Type	Location
Speed Factor		
Weather Factor		
Mechanical Delay		
Congestion Delay		
Station Delay		
Train Length		
Car Size		
Days of Supply		



Scenario Assumptions

- Move coal from southern Indiana to Tanners Creek & Clifty Falls
  - Rail only
  - Rail to Mount Vernon, barge to power plants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Sullivan
Hunters
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Fernald
N. Bend
Valley Jct.
Robinson
Linton
Switz City
Seymour
N. Vernon
CINCINNATI
Bee Hunter
Sanborn
Elnora
Bedford
Mitchell
Madison
Lawrenceville
Vincennes
Maysville
Orleans
Petersburg
Algers
Mt. Carmel
Princeton
Oakland City
Dubois
Huntingburg
Corydon Jct.
New Albany
Watson
Jeffersonville
Cynthiana
Poseyville
Enosville
Lincoln City
Corydon
LOUISVILLE
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Scenario Assumptions

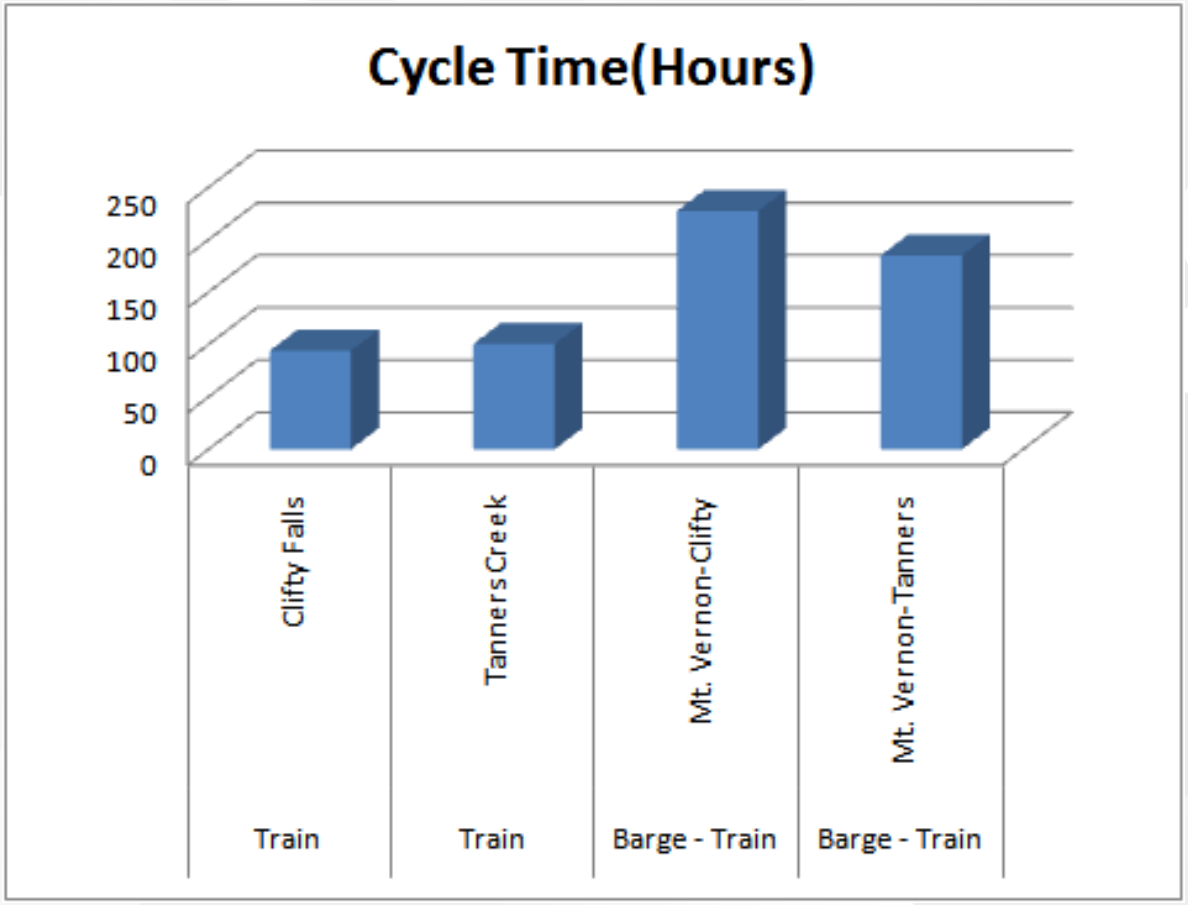
The train is composed of 105 cars with a capacity of 286,000 pounds(15,015 tons/train)
The time to load a unit train at Francisco is T(3.75, 4.0, 4.25) hours
A barge holds 30 loads @ 1500 tons each(45,000 tons/barge)
The time to load a barge at Mt. Vernon is 4,200 tons/hour
The time to unload a barge at Tanners Creek is 30 hours
The time to unload a barge at Clifty Falls is 30 hours
Mt. Vernon load time is 4200/tons per hour
Barge speed is 5mph
The initial coal inventory at Mt. Vernon is 30,000 tons
The probability of a Mechanical Delay is 5%
The time for a Mechanical Delay is T(2,5,12) hours
The probability of a Station Delay is 2%
The time for a station Delay is T(1,2,8) hours
The time for a Congestion Delay is T(.25,4,8) hours
The probability of a Congestion Delay is based on Gross Ton/Mile:

	Gross Ton	Probability
	0-4	1
	5-9	3
	10-19	3
	20-29	10
	30-39	10
	40+	25

Cycle Time Results

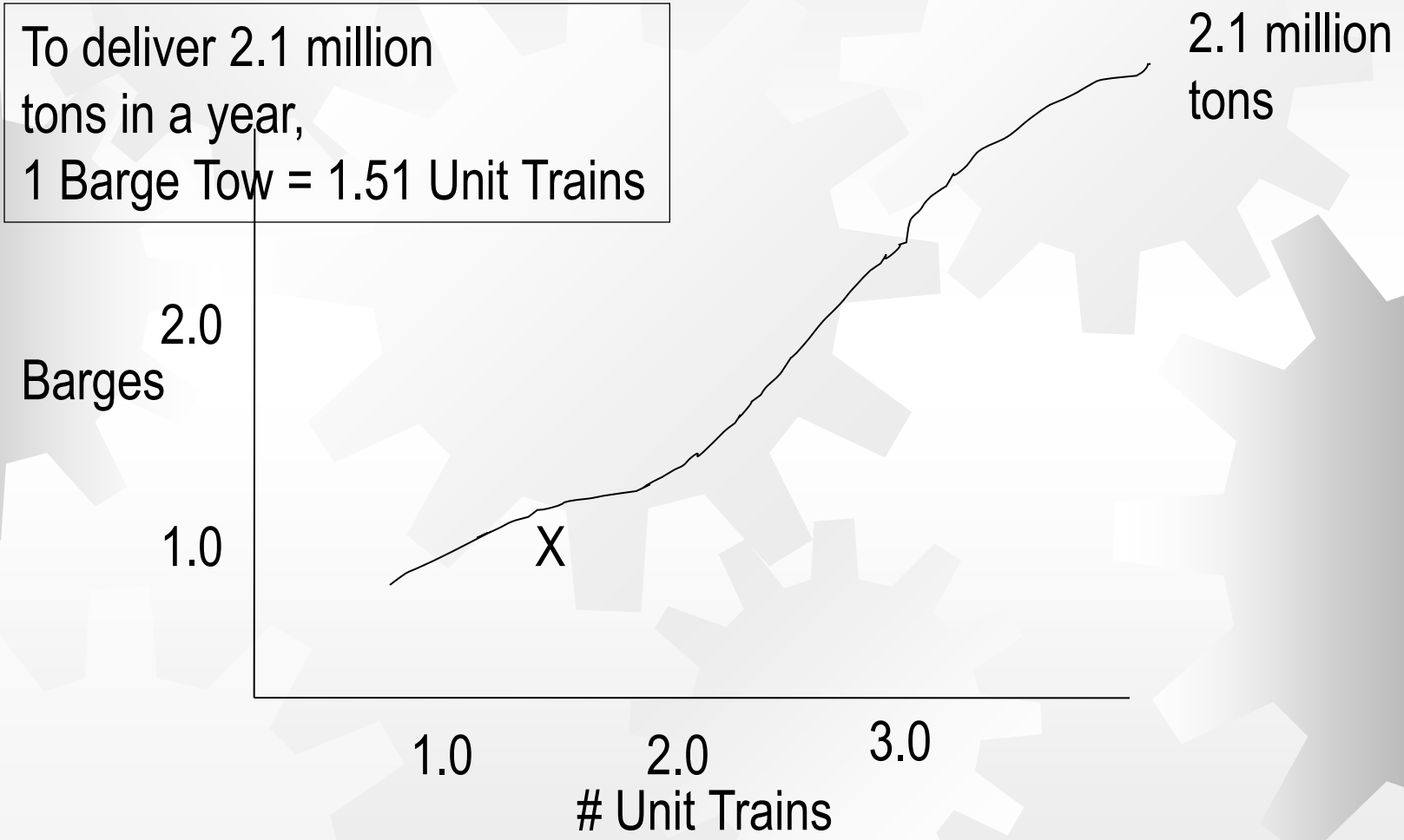
From	To	Cycle Time(Hours)
Francisco	Clifty Falls	93.9
Francisco	Tanners Creek	100.5
Francisco	Mt. Vernon-Clifty	227.4
Francisco	Mt. Vernon-Tanners	184.8

Cycle Time Results

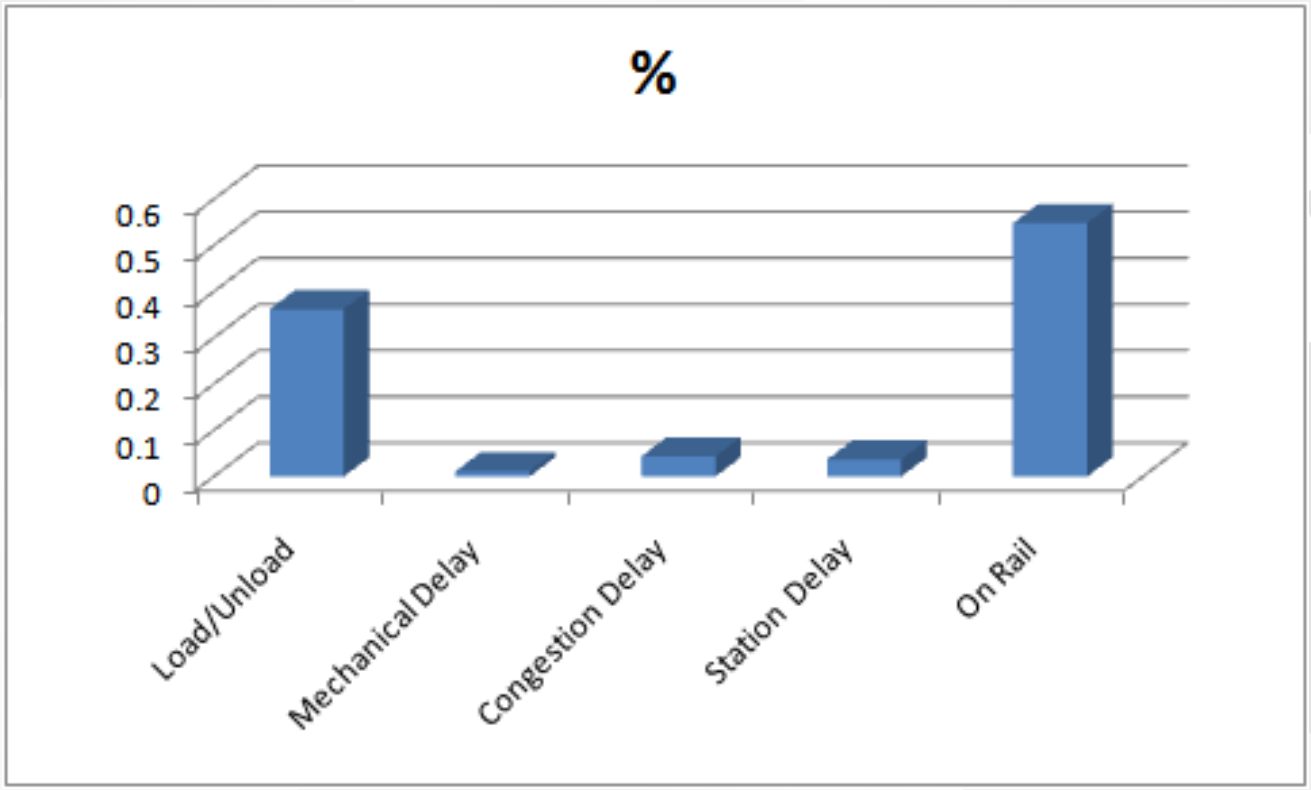


Equivalence of Barge/Rail

To deliver 2.1 million tons in a year,
1 Barge Tow = 1.51 Unit Trains



Where is the Bottleneck?



Fixing the Bottlenecks

- Load/Unload Time Reduction
  - Infrastructure
- On Rail Time
  - Routing
    - Shortest Path Problem
  - Infrastructure

Bottleneck Routing

- Select routes based on
  - Maximum Speed amongst links
  - Minimum Miles between destinations
  - Minimize Congestion

Key System Design Parameters

Minimize the total amount of coal in the system

Train

Amount at Power Plant ⟷ Delivery System

Power Plant

Port

Barge

Recommendations for Further Work

- Complete the Ohio River scenarios
- Expand the model to examine/analyze flows outside Indiana

Recommendations

- "Both the rail transportation and the electric transmission systems are complex networks in which localized disruptions can have severe and widespread impacts. Research is needed to better understand the factors that control these large and complex networks to minimize the risks of cascading system disruptions."
  - National Academy of Sciences
- Use the model to analyze Macro Scenarios
  - Reliability of Indiana rail network
  - Capacity of Indiana rail network
    - Internal vs. External capacity
- Expand scope to include transmission detail
  - Mine – transport – produce – transmit – end use