VTI Economics Model

Case Studies of Quantifying Economic Impacts of WRI

ICRI-RCF VTI Economics Group

Goals of ICRI Economics Model

1. **Third Party "Open Source" Model, but Built by Railroads**

2. **Data Available from Different Departments/Specialties**

3. **Decision Support Tool of Costs and Benefits**

Ex. of Current Economic Models

BART

7/31/17

Case Study on the Journey to a New Rail Profile

Final Cost Analysis to Grind to New Profile

	# Shifts for Intermediate		# Shifts for Final Profile	
	Curve	Tangent	Curve	Tangent
	92	128	33	58
Total Shifts	311			
	$4,200			
		2 grinders @30% efficiency		
Total Days to Complete Work	435			
Days of maintenance	300			

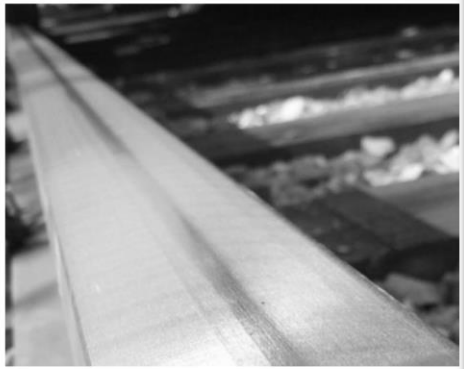
Labor Cost	
$	1,828,680.00
Maintenance Labor	
$	504,000
Maintenance Parts	
$	150,000
Overhead (20% of Maintenance and Labor)	
$	466,536
Equipment ($6M/15*3 years)	
$	1,200,000
Total Costs (excluding QC+other labor support)	
$	4,149,216

Ex. of Current Economic Models

31

Benefits of Rail Milling at Irish Rail

- Extended Rail Life
  - Rail replacement €150k per km vs. approx. €20-25k per km for milling
  - Milling can extend rail life up to 5-7 years
- Reduced rail breakages



RAIL TRANSIT SEMINAR • APRIL 30, 2018 LINMAG Rail service Iarnród Éireann Irish Rail WRI 2018

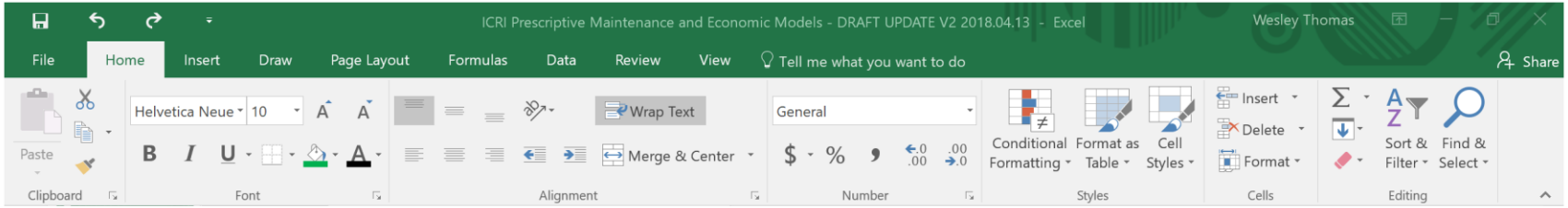
Why use ICRI Economics Model?

1. **Find <u>New Savings</u> and Innovations**

2. **Compete and <u>Protect Important Projects</u>**

3. **<u>Improve Partnerships</u> of Railroad and Supplier**

What is ICRI Economics Model?



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2	**Depreciation**	$ 239,800,000	$ -	14%	$ 34,653,179.19	$ -		
3	**Capital**	$ -	$ 333,500,000	14%	$ -	$ 48,193,641.62		
4	**Maintenance**	$ 15,600,000	$ 15,600,000	14%	$ 2,254,335.26	$ 2,254,335.26		
5	**Grinding - Corrective**	$ 16,000,000	$ 16,000,000	14%	$ 2,312,138.73	$ 2,312,138.73		
6	**Grinding - Preventive**	$ 43,000,000	$ 43,000,000	0%	$ -	$ -		
7	**Lubrication**	$ 19,300,000	$ 14,900,000	0%	$ -	$ -		
8	**Inspections**	$ 22,800,000	$ 22,800,000	0%	$ -	$ -		
9	**TOTAL**	$ 356,500,000	$ 445,800,000	11%	$ 39,219,653	$ 52,760,116		
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11	**Current Rail Life**	34.6						
12	**Desired Rail Life**	39.6						
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14	**Compliance**	$ 54,400,000						
15	**Preventive**	$ 57,900,000						
16	**Capital/Depreciation**	$ 286,650,000						

Cost to Implement	$ 100,000,000	$ 100,000,000
ROIC	39%	53%

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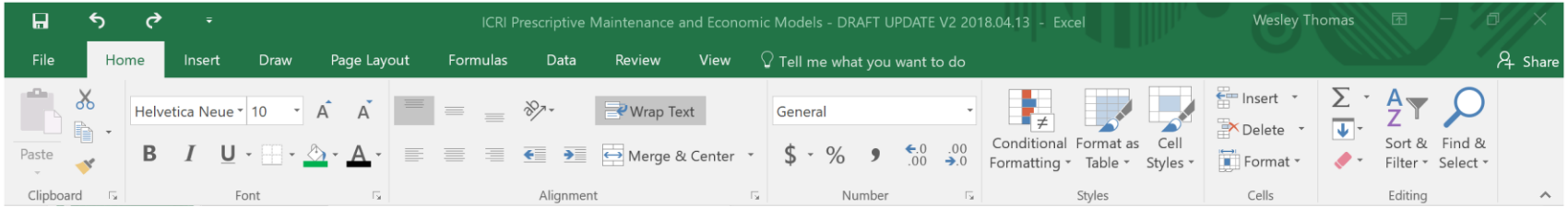

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Operating Expense = Annual Reporting
Free Cash Flow = Cash per Year

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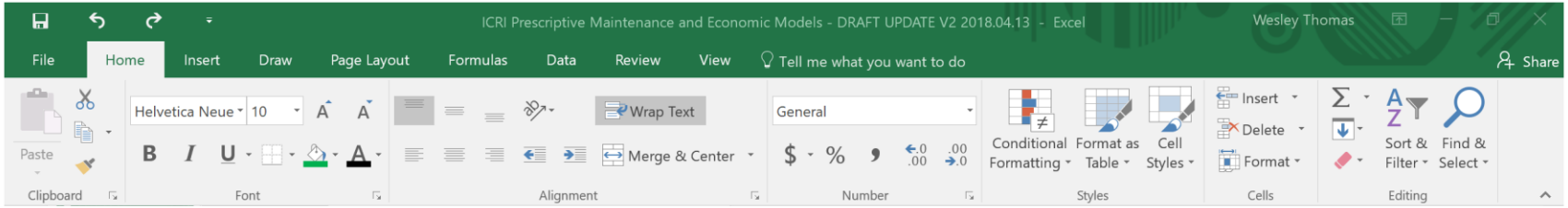

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Different Categories of Cost

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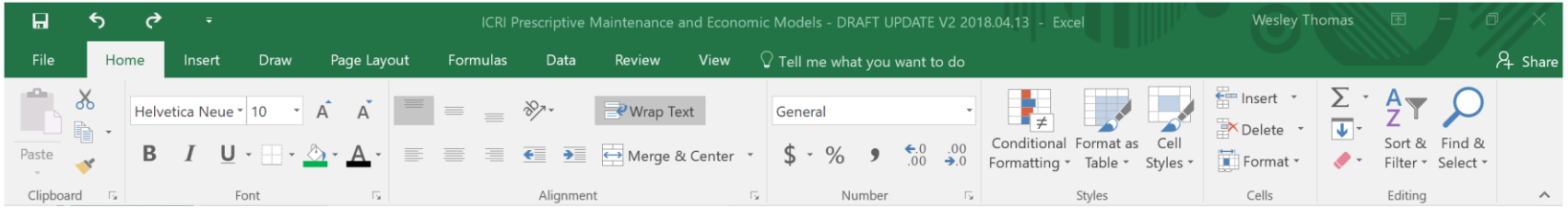

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More Detailed Model of Each Cost

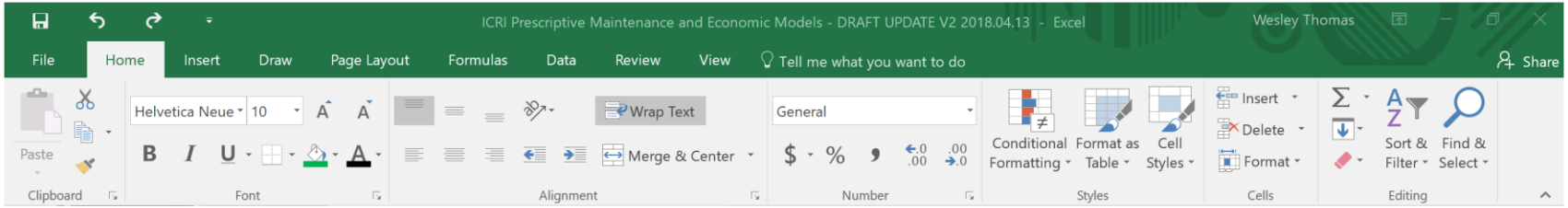
Case Studies: What Can We Learn

1. **Cost of Defect Intervention**

2. **Cost of Defects by Different Root Causes**

3. **How to Value Life Extension?**

Case Study: Cost of Intervention



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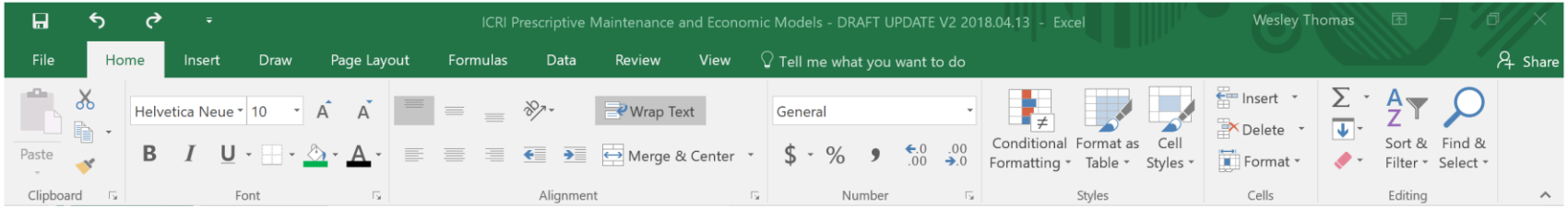

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Cost of Defects

Case Study: Cost of Intervention

REMEDIAL ACTION TABLE

Defect	Length of defect (inch(es))		Percentage of existing rail head cross-sectional area weakened by defect		If the defective rail is not replaced or repaired, take the remedial action prescribed in note
	More than	But not more than	Less than	But not less than	
Compound Fissure	.....	.....	70.....	5.....	B.
	.....	.....	100.....	70.....	A2.
	.....	.....	.....	100.....	A.
Transverse Fissure	.....	.....	25	5.....	C.
Detail Fracture	.....	.....	60	25.....	D.
Engine Burn Fracture	.....	.....	100	60.....	A2, or [E and H].
Defective Weld	.....	.....	.....	100.....	A, or [E and H].
Horizontal Split Head	.....	2.....	.....	.....	H and F.
Vertical Split Head	.....	4.....	.....	.....	I and G.
Split Web	.....	.....	.....	.....	B.
Piped Rail Head Web	.....	(1).....	.....	.....	A.
Separation					
Defective Weld (Longitudinal)	½.....	1.....	.....	.....	H and F.

FRA - 49 CFR 213.113 - Defective Rails

https://www.law.cornell.edu/cfr/text/49/213.113

Case Study: Cost of Intervention

TOTAL COST		Total Cost	$ 15,605,000
$		Cost / Spot Replacement	$ 4,529
$		Cost / Joint Bar Application	$ 1,231
$		Cost / Visual Inspection	$ 1,181
$		Cost / Internal Inspection	$ 1,381
$		Cost due to RCF/Wear	$ 6,555,406
	85%	Labor	$ 13,230,000
	15%	Material	$ 2,375,000
STRATEGY			
#		Total Route Miles	23,650
#		Total Rail Miles (2x Route Miles)	47,300
#		Total Spot Replacements	2000
#		Average Length of Spot Replacement (ft)	39
#		Total Spot Replacement (ft)	78000
#		Total Spot Replacement (miles)	14.77
#		Total Joint Bars Applied	4100
#		Visual Inspections Required	100
#		Internal Inspections Required	1000

Calculate the Cost of Different Maintenance Intervention

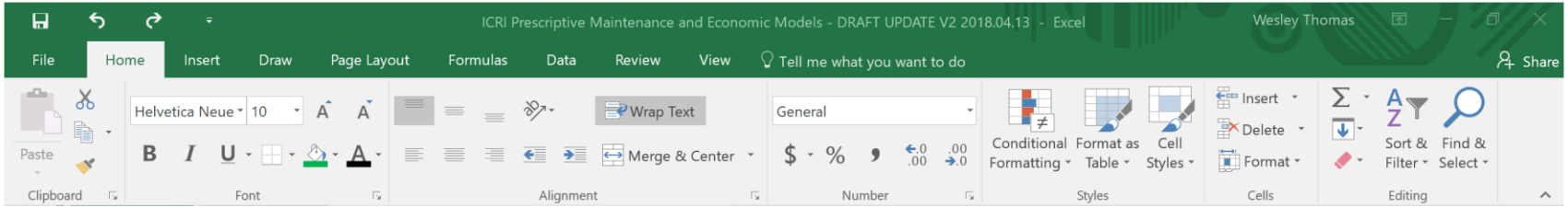
Costs Driven by Labor

Case Study: Cost of Intervention

	Grinding	Preventive + Corrective	Preventive Only
Total OPEX	Total Cost	$59,000,000	$43,000,000
	Cost / Day	$160,000	$120,000
	Cost / Work Day / Grinder	$110,000	$80,000
	Cost/Pass Mile	$2,200	$2,200
74%	Depreciation/Lease	$43,510,000	$31,770,000
13%	Labor	$7,830,000	$5,720,000
13%	Material + Inspection	$7,620,000	$5,560,000
STRATEGY			
#	Total Route Miles	23,650	23,650
#	Tangent - Preventive	16000	16000
#	Mild Curves - Preventive	3500	3500
#	Medium Curves - Preventive	0	0
#	Severe Curves - Preventive	0	0
#	Corrective	1800	0
#	Total Track Miles Ground	21300	19500
#	Total Pass Miles	26700	19500
#	Total Track Miles Ground - Preventative	19500	19500
#	Total Track Miles Ground -	1800	0

Calculate the Cost of Different Grinding Strategies

Case Study: Cost of Intervention



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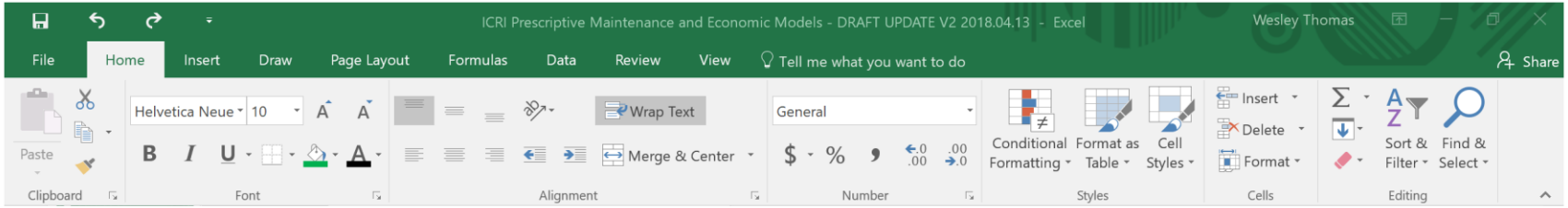
Would More Prevention Reduce defect Costs?

Case Study: Defect Root Cause

Failure Root Cause	Defect #	%	OPEX	%	Free Cash Flow	%
Rolling Contact Fatigue	6000	44%	$ 15,500,000	62%	$ 65,000,000	26%
Subsurface Fatigue	3500	26%	$ 5,500,000	22%	$ 80,000,000	32%
Weld	4000	30%	$ 4,000,000	16%	$ 45,000,000	18%
Wear	$ -	0%	$ -	0%	$ 60,000,000	24%
TOTAL	**13500**	**100%**	**$ 25,000,000**	**100%**	**$ 250,000,000**	**100%**

Where Would You Focus Your Engineering Initiatives?

Case Study: Life Extension



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Depreciation + Capital Dominates Costs

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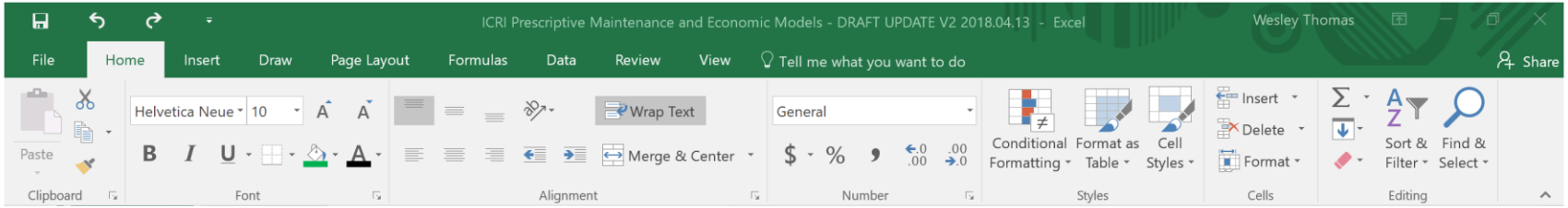

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Current Average Rail Life from Surface Transportation Board

Case Study: Life Extension

BNSF RAILWAY COMPANY DEPRECIATION RATES
TRACK PROPERTY

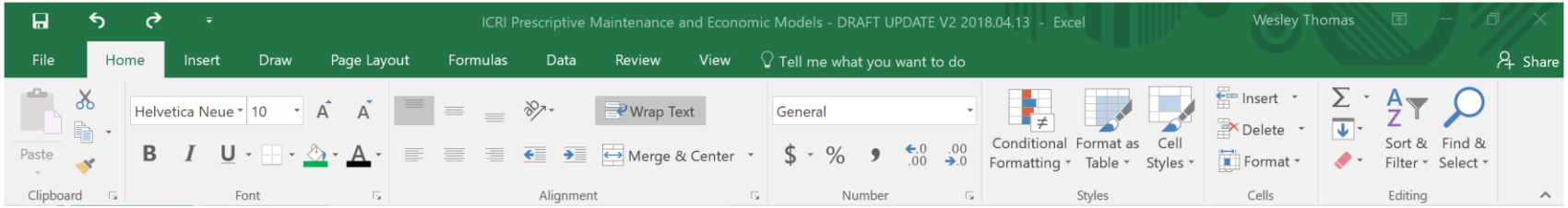
A/C #	Account Name	Density	Depreciation Rate
ACCOUNT 8, TIES			
8.10	TIES-WOOD	1	4.44
8.20	TIES-WOOD	2	3.43
8.90	TIES-WOOD	4 & 5	2.40
8.11	TIES-CONCRETE	1	3.00
8.21	TIES-CONCRETE	2	3.00
ACCOUNT 9, RAILS & OTM			
9.10	RAILS & OTM	1	2.78
9.20	RAILS & OTM	2	2.40
9.90	RAILS & OTM	4 & 5	1.78
ACCOUNT 11, BALLAST			

Surface Transportation Board

https://www.stb.gov/stb/industry/econ_cadlas.html

Class 1 Track Life: = 35.97 Years (100% / 2.78%)
Class 2 Track Life: = 41.66 Years (100% / 2.40%)
Class 4/5 Track Life: = 56.17 Years (100% / 1.78%)

Case Study: Life Extension



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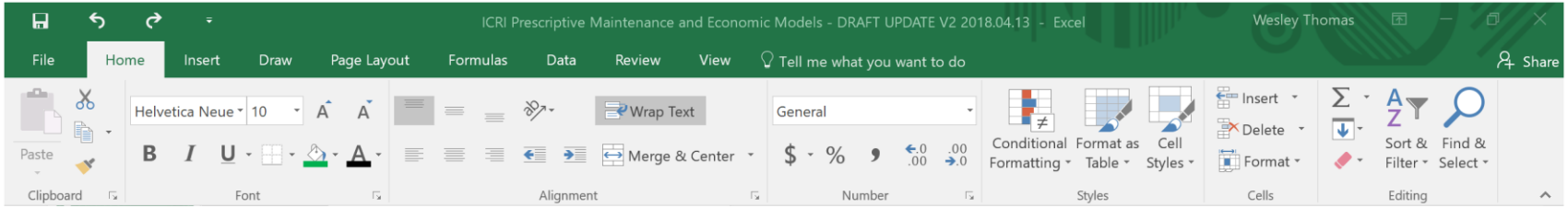

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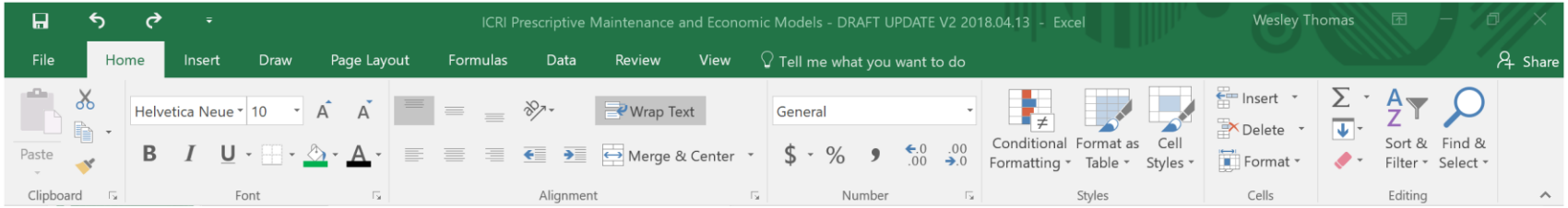
What are the Savings from Life Extension?

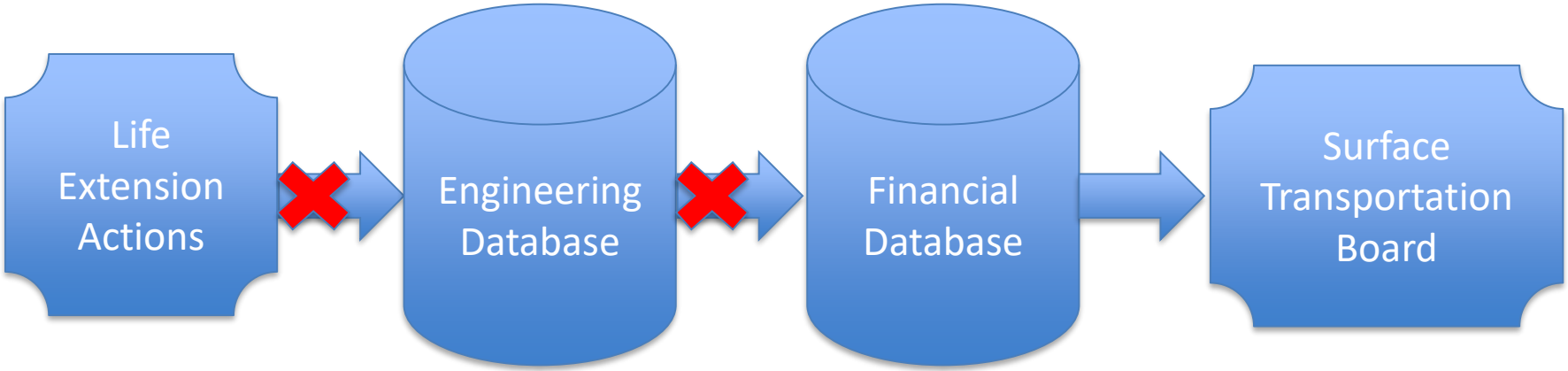
Case Study: Life Extension



What is the Return on Invested Capital?

					D	E	F	G	H
					Savings from Life Extension	OPEX Savings	FCF Savings		
					14%	$ 34,653,179.19	$ -		
					14%	$ -	$ 48,193,641.62		
					14%	$ 2,254,335.26	$ 2,254,335.26		
					14%	$ 2,312,138.73	$ 2,312,138.73		
					0%	$ -	$ -		
					0%	$ -	$ -		
8	Inspections	$	22,800,000	$ 22,800,000	0%	$ -	$ -		
9	TOTAL	$	356,500,000	$ 445,800,000	11%	$ 39,219,653	$ 52,760,116		
10									
11	Current Rail Life		34.6		Cost to Implement	$ 100,000,000	$ 100,000,000		
12	Desired Rail Life		39.6		ROIC	39%	53%		
13									
14	Compliance	$	54,400,000						
15	Preventive	$	57,900,000						
16	Capital/Depreciation	$	286,650,000						

Case Study: Life Extension



Is Financial Life Lower than Actual Life?

Next Steps

1. **Reach Out to Us**

2. **Use the Model**

3. **Test, Improve, and Add More Models**

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