Group 7 - Reshoring

Chao Xu
Tolga Ozdil
Kiran Bhimani
Yuexin Zhang
Ziyuan Wei
Cong Wang

What is Reshoring?

- Many major companies in the world move their manufacturing facilities and services to countries that has cheap working and labor costs. However, reshoring became a viable option as the manufacturing costs and wages started to increase as well as time/communication problems became more apparent in the past decade.

- Reshoring is the practice of bringing manufacturing and services back to the U.S. from overseas.

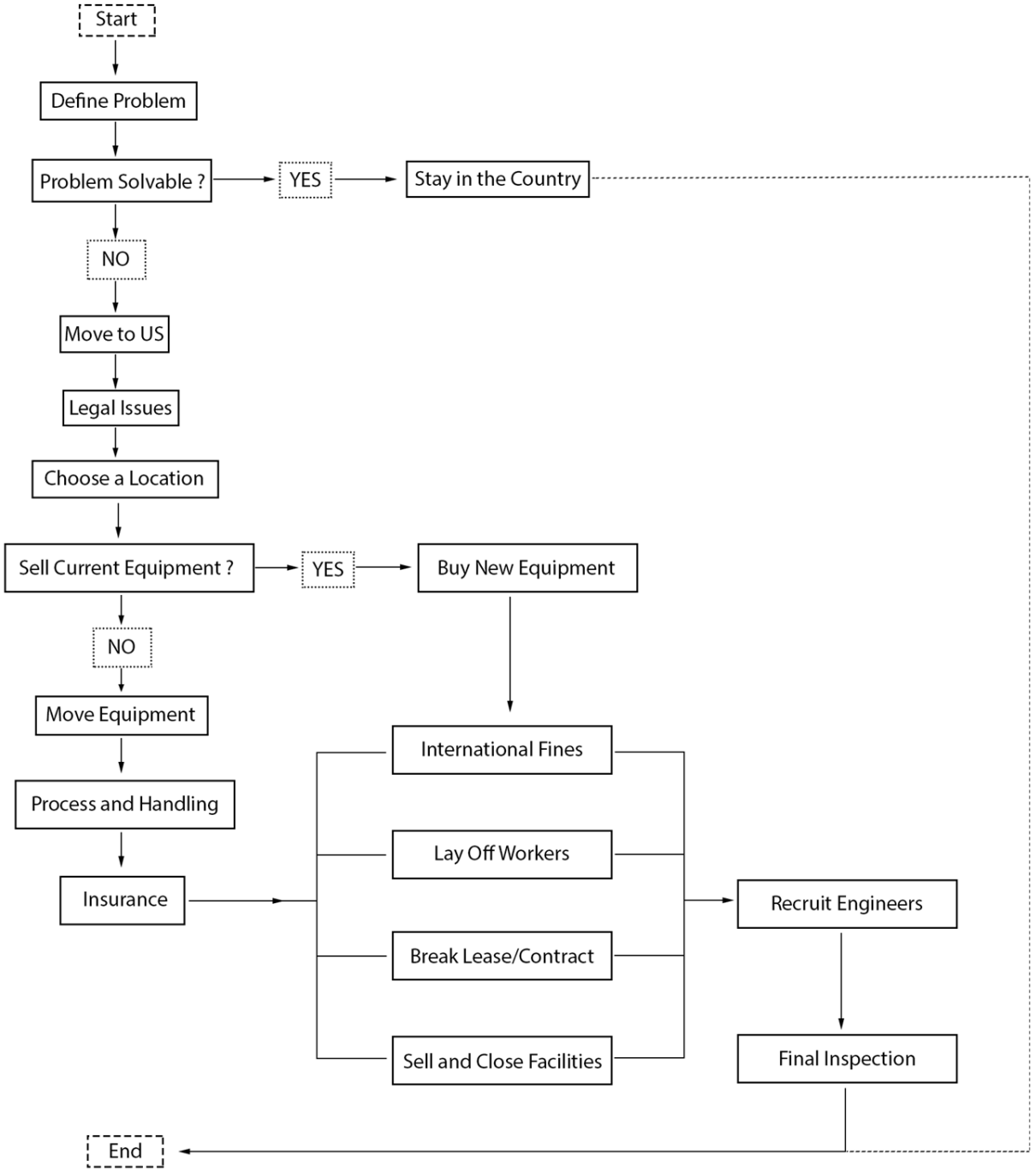
Benefits of Reshoring

Strengthen the U.S. economy
- Balance trade and budget deficits
- Reduce Unemployment
- Well-paying manufacturing jobs
- Fosters a skilled workforce

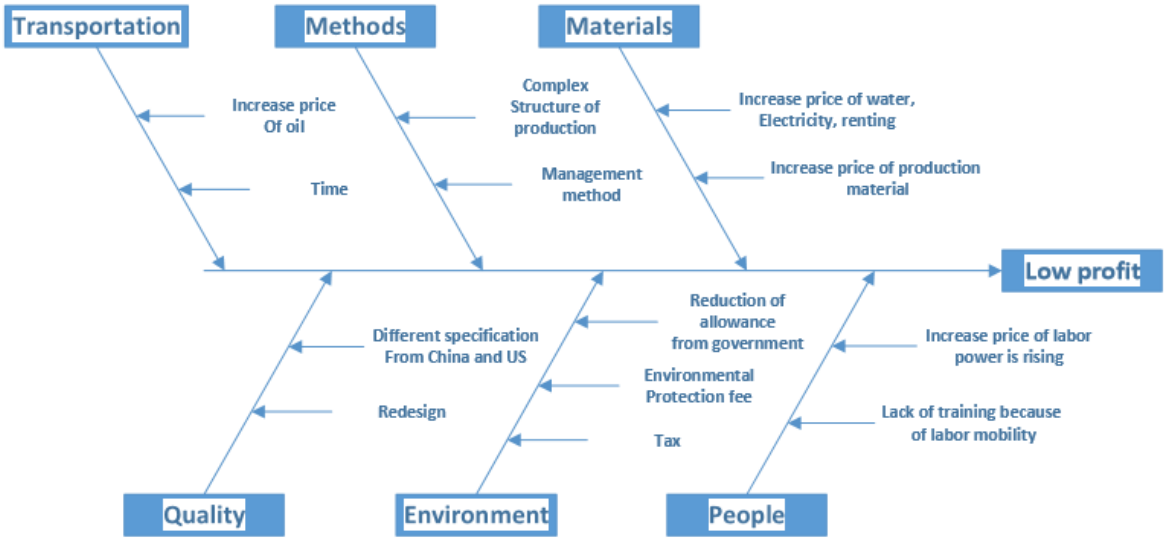
Manufacturing Companies
- Reducing the total cost of products
- Improve balance sheets
- More Effective Product innovations

Problem Statement

- Off shoring for GE used to be the most feasible action for the company could take in order to profit from mass-production. However, off shoring in general is not as profitable as it was before. GE started to re-shore to their original countries but this process is highly risky and must be done according to a carefully studied plan of action.


Start
Define Problem
Problem Solvable ?
YES
Stay in the Country
NO
Move to US
Legal Issues
Choose a Location
Sell Current Equipment ?
YES
Buy New Equipment
NO
Move Equipment
Process and Handling
Insurance
International Fines
Lay Off Workers
Break Lease/Contract
Sell and Close Facilities
Recruit Engineers
Final Inspection
End

Fishbone


Transportation
Methods
Materials
Increase price
Of oil
Time
Complex
Structure of
production
Management
method
Increase price of water,
Electricity, renting
Increase price of production
material
Low profit
Different specification
From China and US
Redesign
Reduction of
allowance
from government
Environmental
Protection fee
Tax
Increase price of labor
power is rising
Lack of training because
of labor mobility
Quality
Environment
People

Fault Tree Analysis

- Fault Tree Analysis (FTA) is a top down failure consequence assessment technique that is useful in identifying safety concerns so that product modifications can be made.
- Originally developed in 1962 at Bell Laboratories and the technique remains relevant today
- Mainly used in the fields of safety engineering and reliability engineering to understand how systems can fail, to identify the best ways to reduce risk.

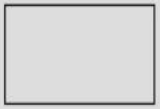
Benefits of FTA

- Identification of single failure points
- Identification of safety concerns
- Evaluation of software and man-machine interfaces
- Evaluation of design change impacts
- Simplification of maintenance and trouble-shooting procedures
- Assessment of modifications or enhancements

Structure

- Key elements:
  - Gates represent the outcome
  - Events represent input to the gates

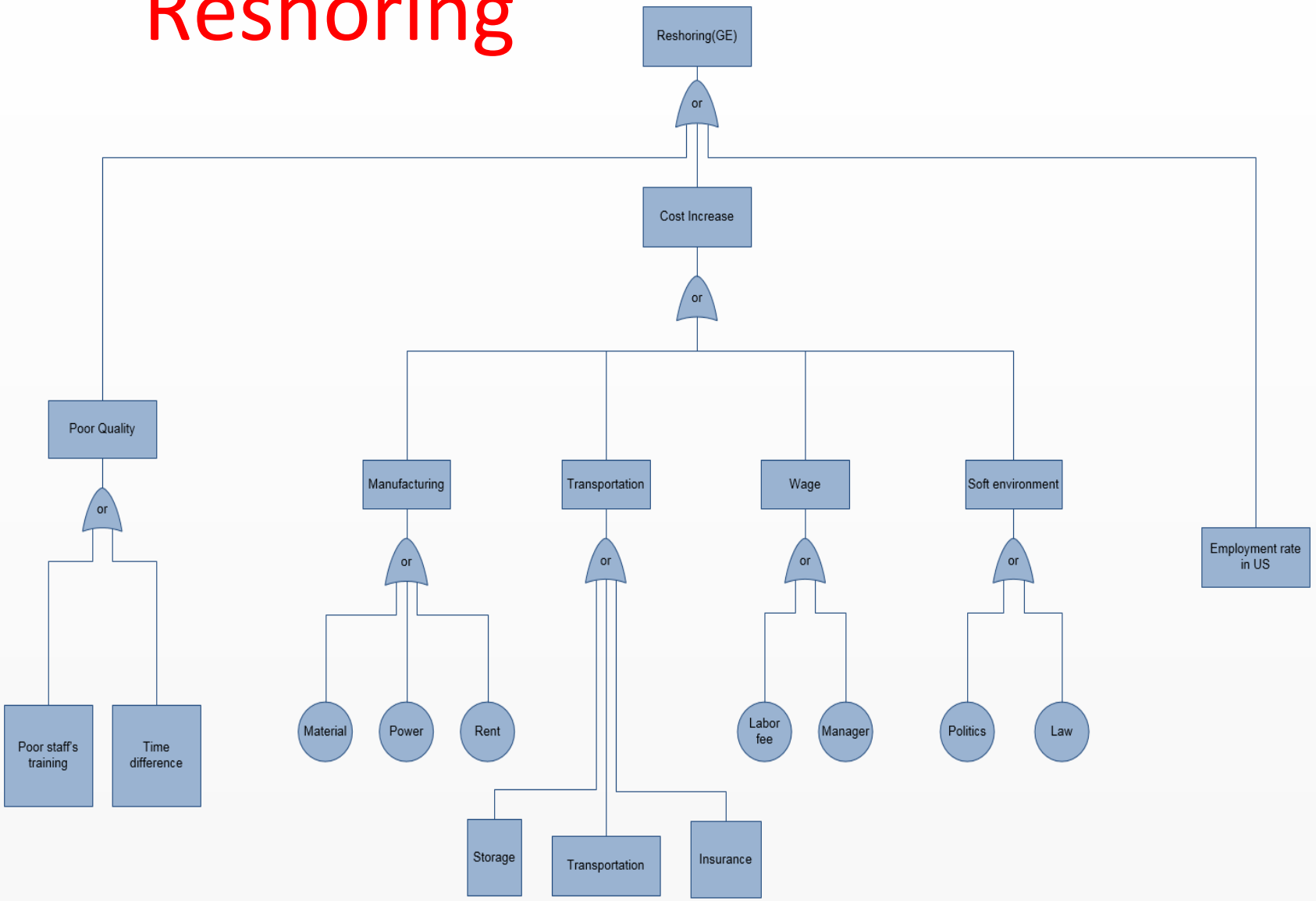
- Symbols in FTA

	Event : Primary Or Intermediate Failure or Event
	Cause : Events that Drive the Failure
	OR Gate : Failure occurs if ANY of the Input Event Occurs
	AND Gate : Failure occurs if ALL of the Input Event Occurs
	Transfer Point : To another Page or Analysis

Procedure

- Define an event of interest as the top event of the cause and effect tree.
- Define the next level of the tree
- Develop questions to examine the credibility of branches
- Gather data to answer questions
- Determine whether the branch is credible
- Determine whether the branch is sufficiently developed
- Stop branch development
- Stop when the scenario model is complete
- Identify causal factors

FTA of GE Company Reshoring



Reliability Analysis

Introduction

- Reliability is a devices ability to function within specifications for a period of time without failing. Statistics along with known standard distribution's can be used to examine the device reliability and to determine confidence intervals that can be used to predict a product performance.

Introduction

- **MTTF (Mean Time to Failure), Failure Rate & Censored Data**
- The Mean Time to Failure is a measure of how long we would expect a typical water heater to last and is calculated for these experiments on the chi-sq distribution. The more samples or experiments tested, the more accurate of product reliability can be determined.
- When we have an experiment where we are missing information, the experiment is cut short, censored experiments might not accurately specify product reliability.

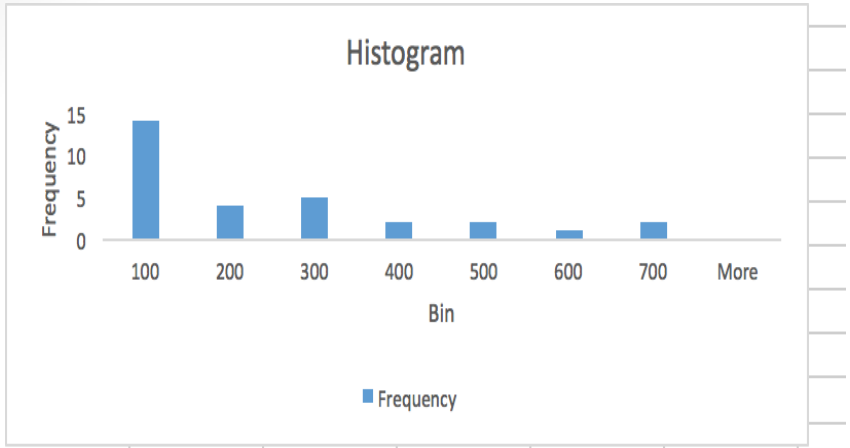
Exponential Distribution

- We will use the exponential distribution to represent out MTTF. In Minitab (a computational statistics tool) we can use the random number generator to create 30 time measurements with a mean of 203 hours.

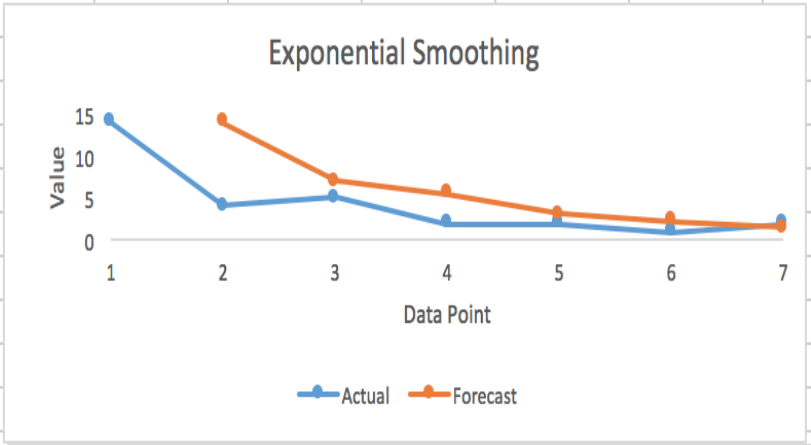
DATA

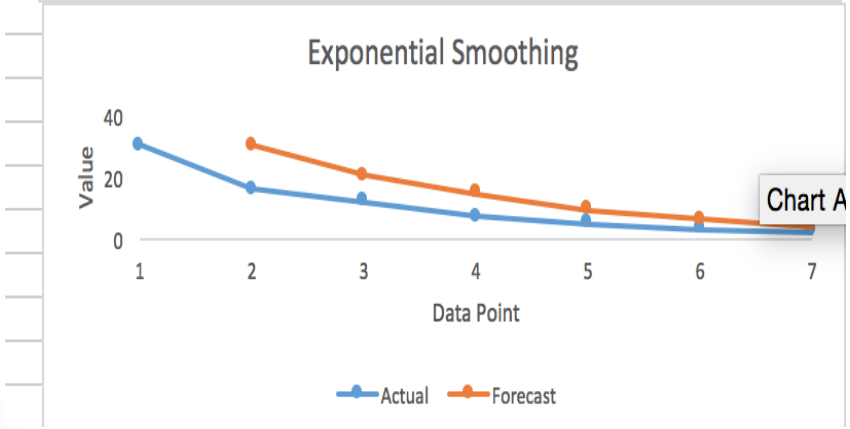
TBF				
6.8871351	32.80045779	79.87216232	153.0988772	223.6041748
8.0348898	62.78706971	83.94206669	190.4541096	259.9342293
10.72280963	67.84346075	88.89792071	191.0244206	294.6496025
26.87423955	68.02684957	94.75708818	206.3141272	365.6700157
29.15773254	68.81734112	106.4846417	210.9093955	388.6301317
223.6041748	259.9342293	294.6496025	365.6700157	388.6301317

Data



FREQUENCY, NUMBER OF FALIURE FREE PERIODS HAVING INDICATED TIME BETWEEN FALIURE





CUMULATIVE FREQUENCY, NUMBER OF INTERVALS EQUAL TO OR GREATER INDICATED TIME BETWEEN FALIURE

Reference Data Calculation

TOTAL TIME	6091.663926		
DEGREE OF FREEDOM	30 data in this case		
95% Confidence interval for the meantime to failure			
We can use Chi-Squared distribution table to caculate the confidence interval in the experiment			
n=30			
α(confidence level)=0.05			
T(sum of Failure)	6091.663926		
16.79077227	chi-square(60,0.025)		
40.3915849			
725.5966348	301.6303491	(725.6,301.6)	
95% Confidence interval for the failure rate(FR)			
Failure Rate=1/meanlife	0.001378176	0.00331532	
90% Confidence Bounds for MTTR and FR @MTTF			
R-lower(T)=P{x>=T}=EXP{-0.0014*203}	0.510171059		
R-upper(T)=P{x>=T}=EXP{-0.0033*203}	0.755957769		

Conclusion for reference data

- Therefore from the data analysis we can see with 95% confidence level for mission time of 6091 hours from the test data we can say that the diagnosis of a water heater results in complete success is between 51% to 75%.
- The goal is probably met, but the rate is not good enough… we would like to improve over time.

Truncated data @10th Failure

With Truncated Data @ 10th Faliure		
n=10	α=0.05	
T	1758.298808	
Chi-square(20,0.025)	9.590777392	
Chi-square(20,0.975)	34.1696069	
102.9159518	366.664502	(102.9,366.7
95% Confidence interval for the failure Rate(FR)		
Failure Rate=1/meanlife	0.009716667	0.00272729
90% Confidence Bounds for MTTR ans FR @ MTTF		
R-lower(T)=P{x>=T}=EXP{-0.0097*203}	0.139110967	
R-upper(T)=P{x>=T}=EXP{-0.0027*203}	0.574853742	

TRUNCATED DATA @ 0.2 MTTF

With Truncated Data @ 0.2 MTTF		
MTTR=203		
0.2*MTTR=40.6		
Degrees of freedom are based on our known data(10) plus 2		
95% Confidence Interval for the Mean Time to Failure(MTTF)		
n=10	α=0.05	T=40.6
Chi-square(22,0.025)	10.98232073	
Chi-square(22,0.025)	36.78071208	
2.207678846	7.393701383	(2.2,7.39)
95% Confidence interval for the failure Rate(FR)		
Failure Rate=1/meanlife	0.452964435	0.13525026
90% Confidence Bounds for MTTR ans FR @ MTTF		
R-lower(T)=P{x>=T}=EXP{-0.45*40.6}	1.03079E-08	
R-upper(T)=P{x>=T}=EXP{-0.135*40.6}	0.004123057	

Reliability Analysis Conclusion

- Based on the calculations above, and considering that the reference data is most accurate , we see that in both cases on censored (truncated) data we get a larger confidence interval and larger failure rate when we are forced to use incomplete data.

Reshoring Conclusion

- Reshoring has its time and place

- According to the semester's worth of data analysis including: FTA analysis, Reliability Analysis, Cause and Effect, Supply Chain Analysis, Six sigma and more, we can strongly conclude that Reshoring will be beneficial to our company.