An Industrial Rescue

Group 6

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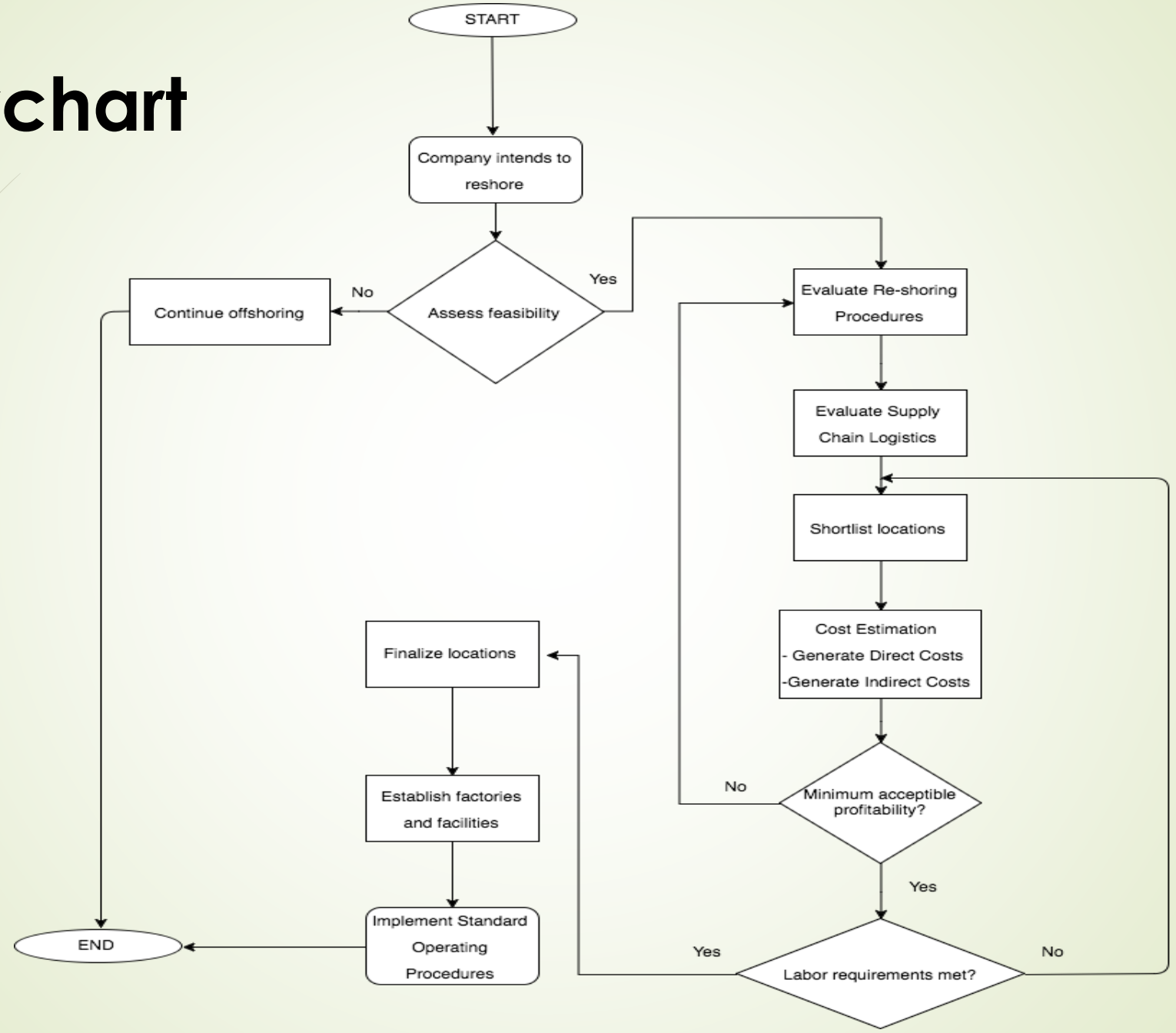
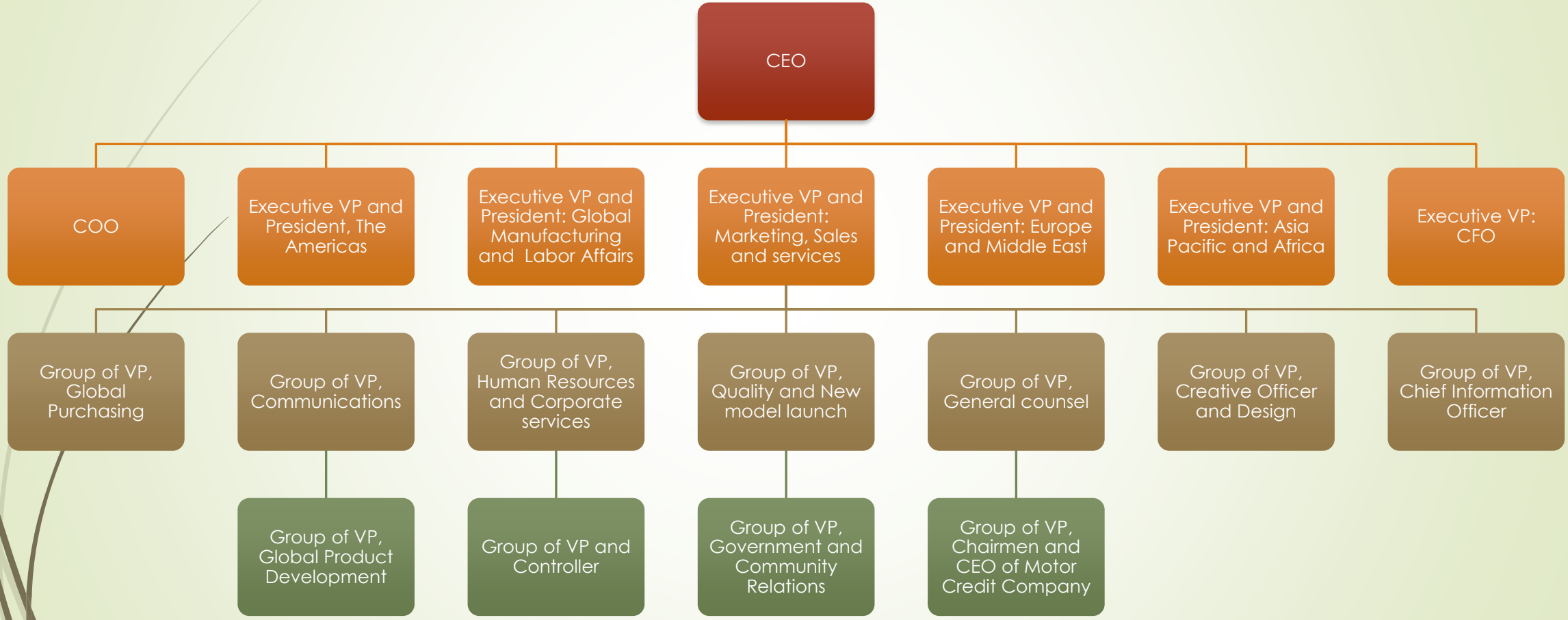
BACKGROUND

"There are many factors that makes the re-shoring effort an attractive option for the US manufacturers. A leading cause is the appreciation of the labor costs in China and South East Asian countries which have long been the manufacturers for the western market. Other motives for re-shoring includes: lead times, logistics, appreciation of Chinese currency etc.; this combined with the current political atmosphere has caused manufacturers to assess the feasibility and benefits of re-shoring back to the USA."

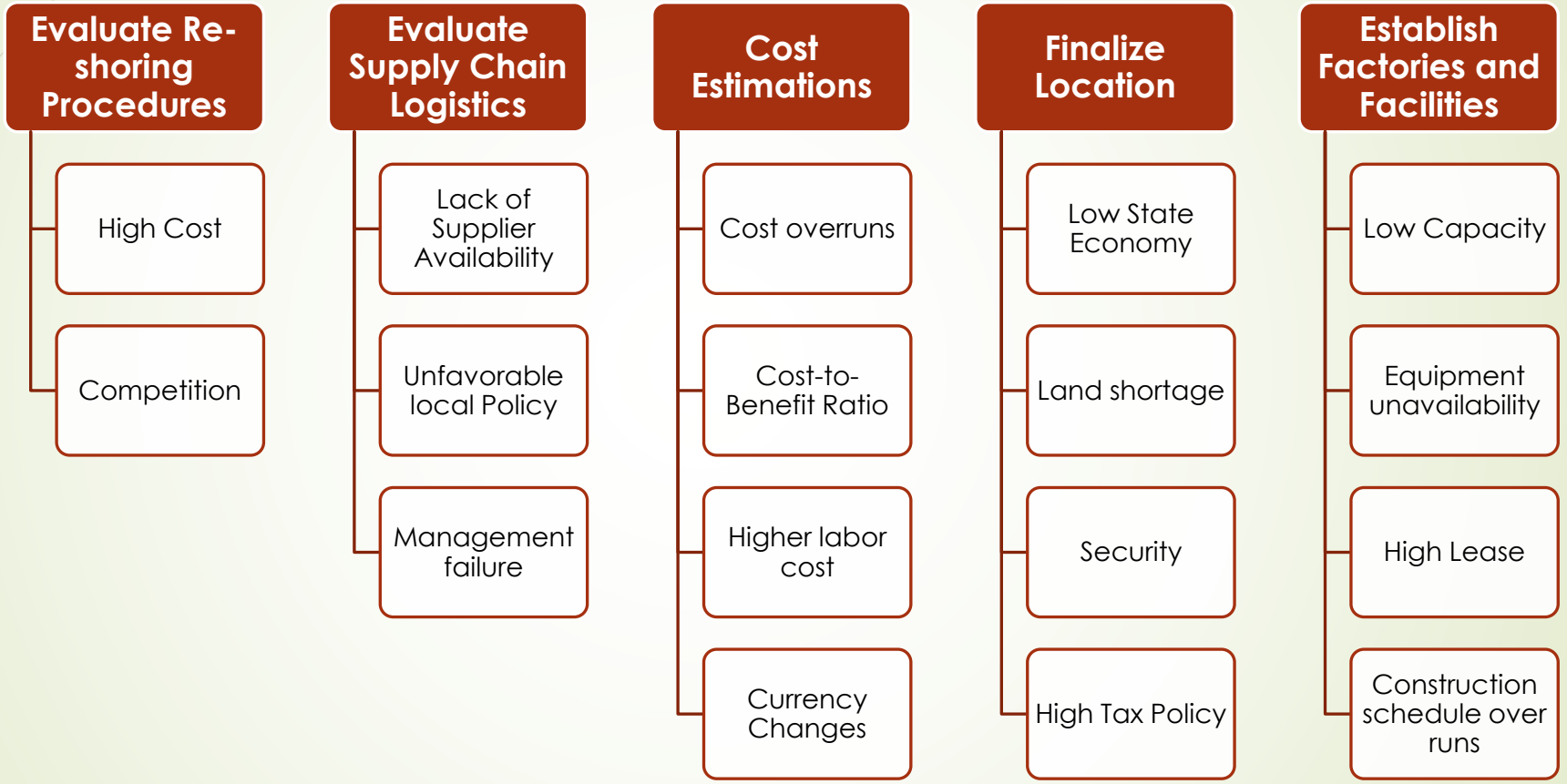
Flowchart


START
Company intends to reshore
Assess feasibility
No
Continue offshoring
Yes
Evaluate Re-shoring Procedures
Evaluate Supply Chain Logistics
Shortlist locations
Cost Estimation
- Generate Direct Costs
-Generate Indirect Costs
Minimum acceptible profitability?
No
Yes
Labor requirements met?
Yes
No
Finalize locations
Establish factories and facilities
Implement Standard Operating Procedures
END

Organization Chart



Brain Storming and Affinity Diagram



Items of Concern

- Total cost
- Cost to benefit ratio
- Labour cost
- Quality control
- Risk mitigation strategies
- Supply chain management -> Raw material -> Supply availibility
- Location
- Labor availibility
- Government Policies, regulations
- Tax policy
- Project sustainibility
- Regulation of infrastracture
- Transitional Phase
- Cost overruns

Diagnosis of Issues from Interview Exercise

The questions arrive at the following diagnosis of issues:

- Is the reshoring project sustainable?
- What is the Cost to Benefit ratio?
- What risk mitigation strategies should be implemented during the course of the project?
- How will the End-to-End supply chain be managed?
- What steps to be taken to mitigate the issues faced during transition phase?

Root Cause Analysis

- Reshoring project might not be sustainable, due to several factors including changing government policies and regulations, resource scarcity, quality issues, supplier issues and lack of skilled personnel.
- Costs might outweigh the benefits, due to schedule over-runs, change control, currency fluctuation, lawsuits, resolving redundancy issues, new wage policies and operations change.
- Risks will include, government policies, inventory reserve deficit during transition, political strife in the shut down locations, unexpected budget cuts, administrative conflicts, lack of training and quality control.
- Issues with End-to-End Supply chain might arise due to lack of suppliers and resources, logistics issues and procurement issues.
- Transitional phase might cause inventory deficits, training issues, schedule overruns, disgruntled employees who will be laid off and severance settlements.

Solutions

The root cause analysis shows us the major issues that might impede the reshoring process, the following are some solutions that might be implemented to mitigate the issues mentioned before:

- Firstly, during the planning stage all these issues need to be categorized with respect to the impact level on the project, and make use of risk mitigation strategies and tools to assess how to cope when an issue arises.
- Scheduling should only be done after the above process to stay within the timescales set for the project, any deviations should be anticipated and preventive actions should be planned while making the risk mitigation strategies.
- Supply Chain systems to be assessed to weigh options between the costs related to the logistics and procurement of parts and materials, i.e. to decide on which parts and materials need to be procured by the same suppliers and which can be locally sourced without affecting the quality standards.
- Contingency plans should be in place before the project begins, in order to support in external failures.
- Gather information of government policies, strive for incentives.
- Simulate supply chain logistics, refine the processes.
- Refine transportation & purchase processes, staff planning.
- Sign up contracts, overrun penalties included.

Measures to assess the Improvements

- Study the degree of completion of COPQ, standing in the marketplace, and quality culture.
- Assess the operations of quality objects.
- Do policies and plans ensure that quality will be competitive?
- Does the plan cover all processes(big Q)?
- Compare the before with the after.

Measures to make Improvements Sustainable

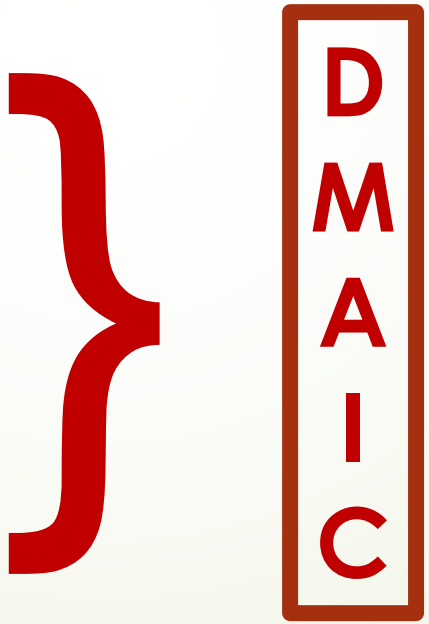
- Benchmarking
- Standard operation procedures building
- Data collection
- Execution assess
- Process control planning
- Change management

Introduction-Six Sigma(DMAIC)

The Six Sigma approach is a collection of managerial and statistical concepts and techniques that focus on reducing variation in processes and preventing deficiencies in product.

Five phases:

- Define
- Measure
- Analyze
- Improve
- Control



DEFINE PHASE

This section defines the problem statement, identifies and evaluates projects for project selection using various quality tools devised for the define phase.

Step 1 for Define Phase

- **Problem**

  "Cost to benefit ratios need to be maintained at the target levels, while also assessing the implications of the reshoring process on current and future - operations, staff and company objectives."

- **Identify Potential Projects**

  A. Factory Relocation
  B. Production of Inventory Bank (Transition Period)
  C. Quality Assurance
  D. Training

COPQ

Process	Internal failure	External failure	Appraisal	Prevention
Evaluate Re-shoring Procedures	• Price • Inventory • Total cost	• Competition • Regulations & Policies		• Government incentives
Evaluate Supply Chain Logistics	• Personnel Risk • Ownership • Management	• Local policy • Supplier Availability • End-to End Supply Chain	• Quality Control • Inspection & test	• Logistics Simulations
Cost Estimations	• Cost-to-Benefit Ratio • Minimum Wage • Cost overruns	• Higher labor cost • Currency Changes	• Employee Benefits	• Equipment logistics • Staff Planning
Finalize Location	• Resource Availability • Skilled Labor	• State Economy • Land shortage • Security • Tax Policy		
Establish Factories and Facilities	• Capacity: Warehouse, Production • Equipment availability	• Lease Policy • Construction Contractors • Construction schedule over runs		• Contractor - Late Penalties

SIPOC

Suppliers

- Raw Materials
- Logistics
- Semi-finished Items
- Equipment Maintenance
- Sub-contractors
- Third Party Inspection Entities
- Construction Companies

Input

- Suppliers
- Resources
- Equipment
- Labor
- Investors and Stakeholders
- Budget and Schedule

Process

- Process Mapping
- Process Documentation
- Data Collection
- Data Analysis
- Process Improvement

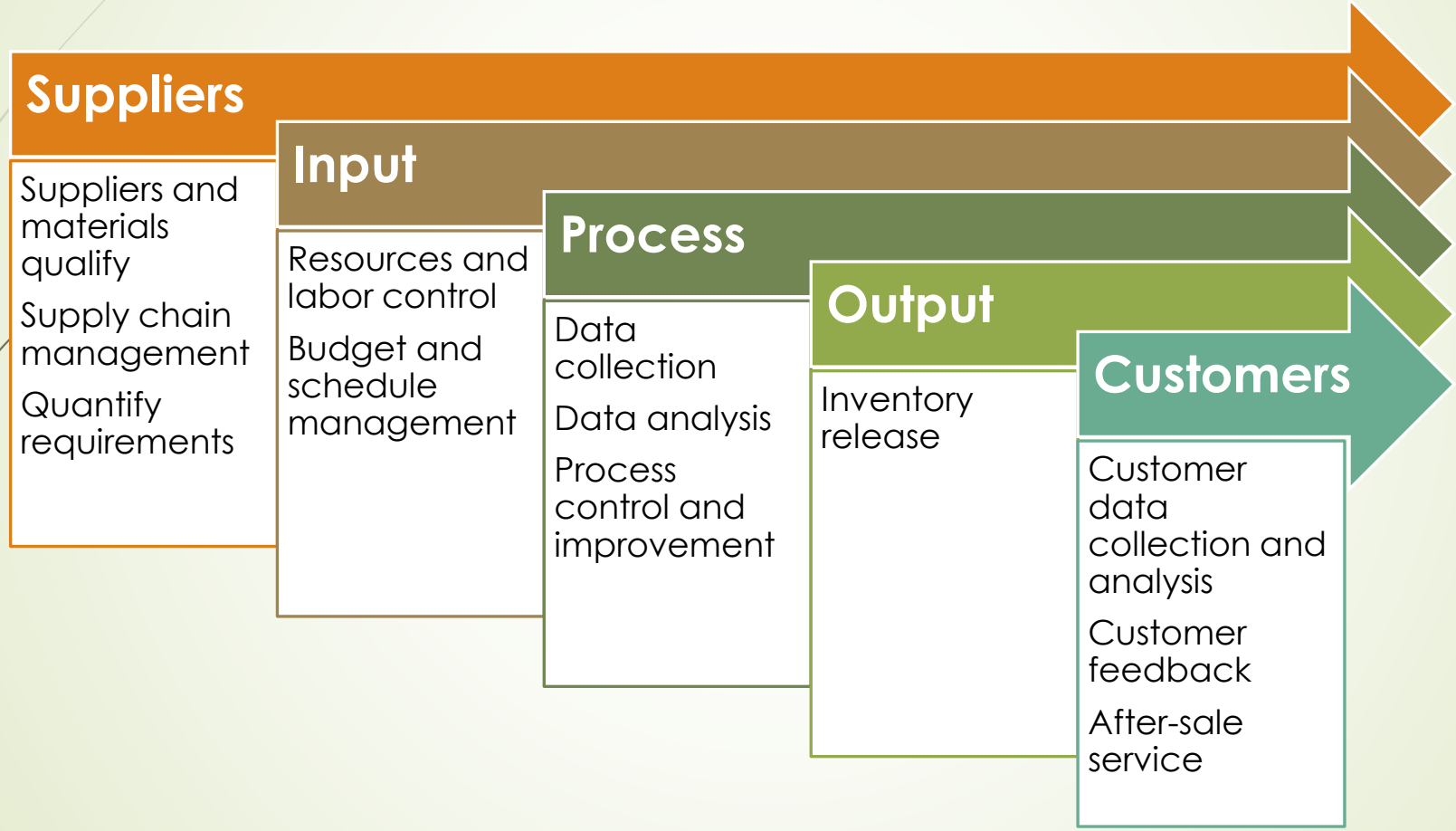
Output

- Higher Revenue and Profits
- Employment creation
- New re-shored facilities

Customers

- **Internal**
  - Company
  - Top Management
  - New employees
- **External**
  - New Suppliers
  - Government
  - Community benefitting from relocated facilities

CTQ


Suppliers
Suppliers and materials qualify
Supply chain management
Quantify requirements
Input
Resources and labor control
Budget and schedule management
Process
Data collection
Data analysis
Process control and improvement
Output
Inventory release
Customers
Customer data collection and analysis
Customer feedback
After-sale service

Quality

Evaluate Projects

Project	Savings ($mil)	Probability	Cost ($mil)	Time(years)	PPI
A	800	0.7	250	1	2.24
B	90	0.5	26	0.5	3.46
C	120	0.85	10	0.5	20.4
D	60	0.4	8	0.25	12

PROJECT SELECTION:

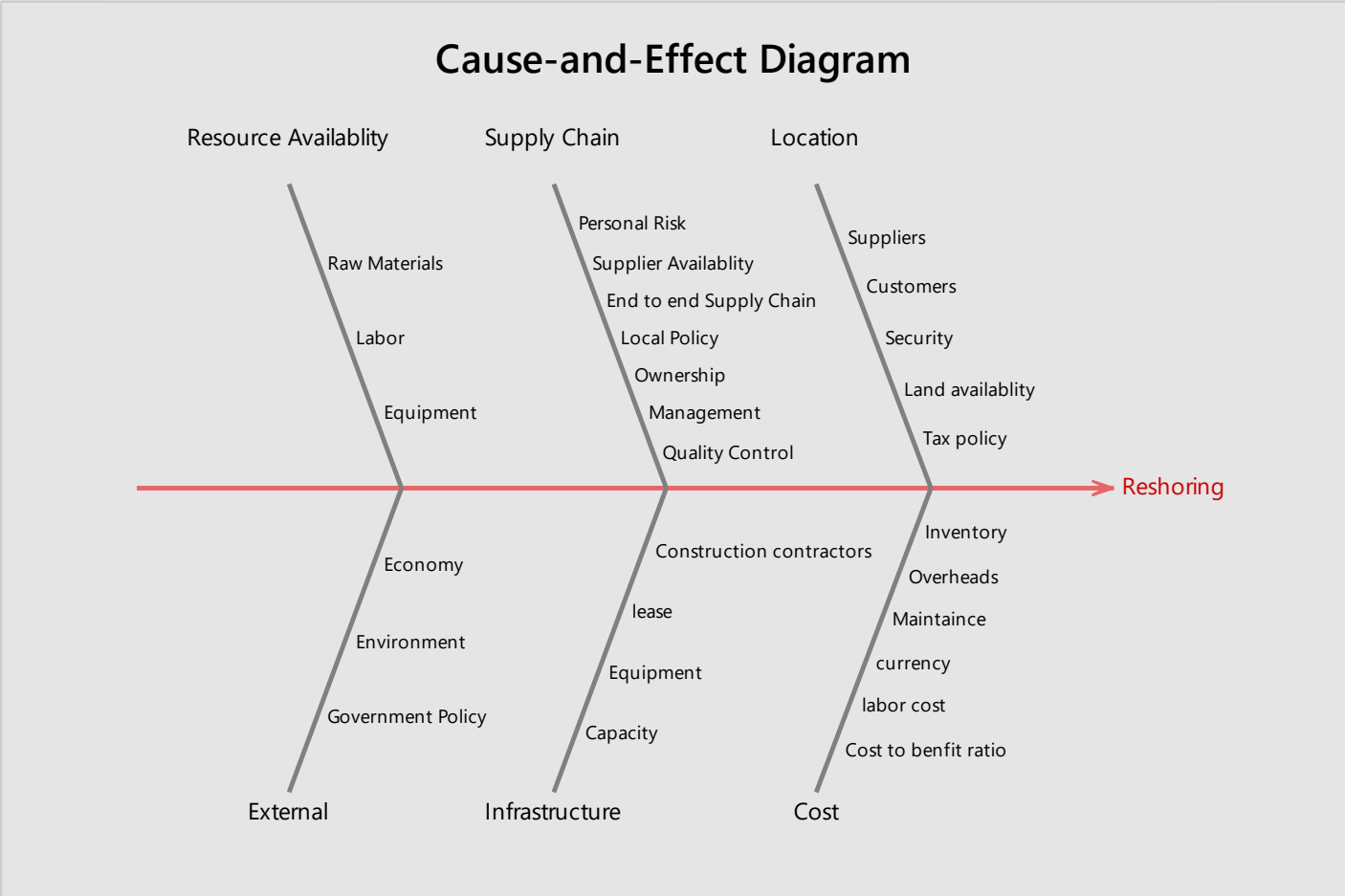
- By looking at the above PPI for each project, **PROJECT C – Quality Assurance** takes highest project priority.
- Considering the problem statement and objectives of the company, **PROJECT A will take higher priority,** followed by Project C, Project D and finally Project B respectively.

MEASURE PHASE

This phase will verify the process needs, implement data collection and document process, implement a valid measuring system, establish a baseline performance and Gage R&R that is critical for the process in order to achieve goals set in the define phase.

VERIFICATION OF PROCESS NEEDS

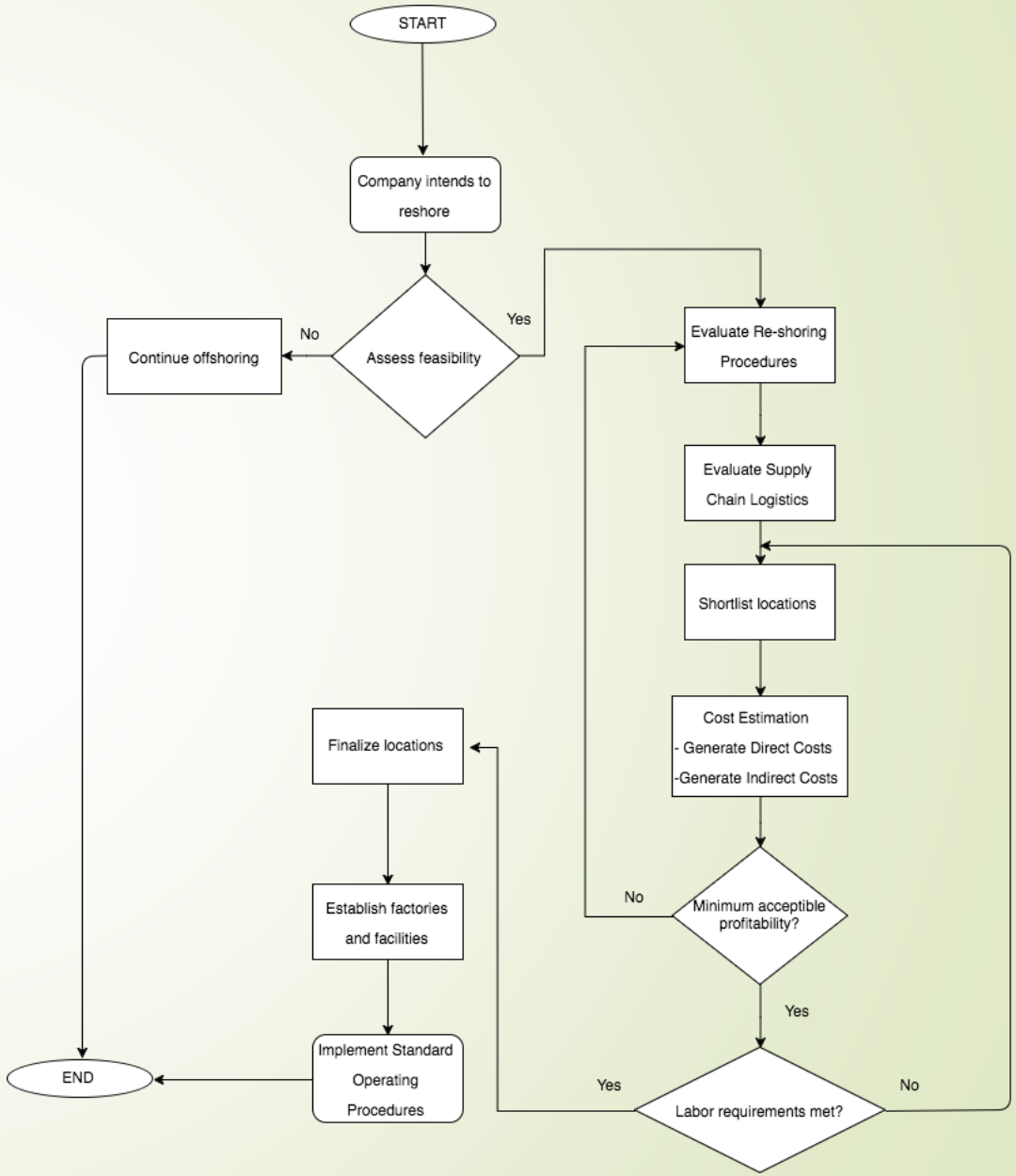
- We can do this by using the Cause and Effect Diagram



PROCESS MAPPING

DOCUMENTING THE PROCESS:

- Recording possible **defects** in the process flow.
  - Possible defects: cost and schedule overruns, non availability of skilled labor etc.
- Identifying and recording any **symptoms** of possible defects.
- Propose **theories** for the reasons of these defects and symptoms.
- Find proven **causes** to support the theories.
  - E.g. – inaccurate scheduling, resource unavailability, underrated budget expectations, low level of higher education rates in selected locations for reshoring etc.
- Record **remedies** implemented to eliminate causes of the defects.



PLAN DATA COLLECTION

Following data will be gathered for analysis on the process requirements and improvement procedures:

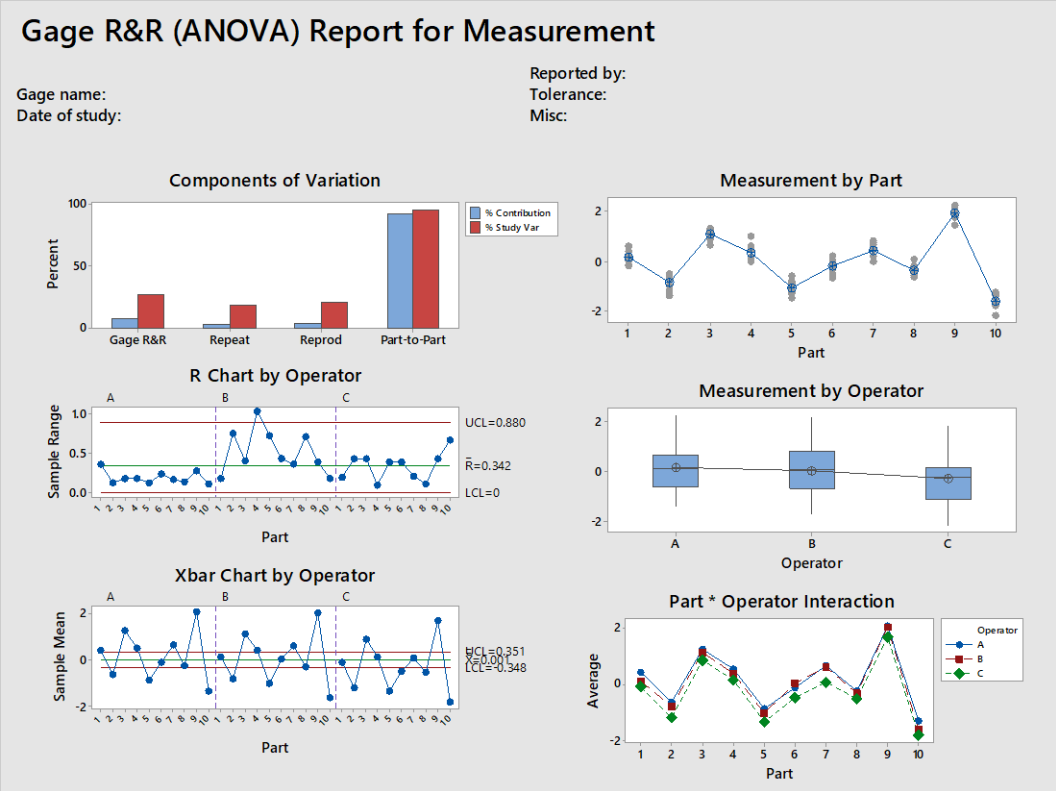
- Costs involved in relocation process
- Comparison of manufacturing hourly compensation in different countries
- Manufacturing Sector Employees per Year
- Annual Shipping Costs Comparison
- CNY vs USD exchange rate – trends
- Gas and Electricity Price Trends in US
- Estimates of jobs created by reshoring

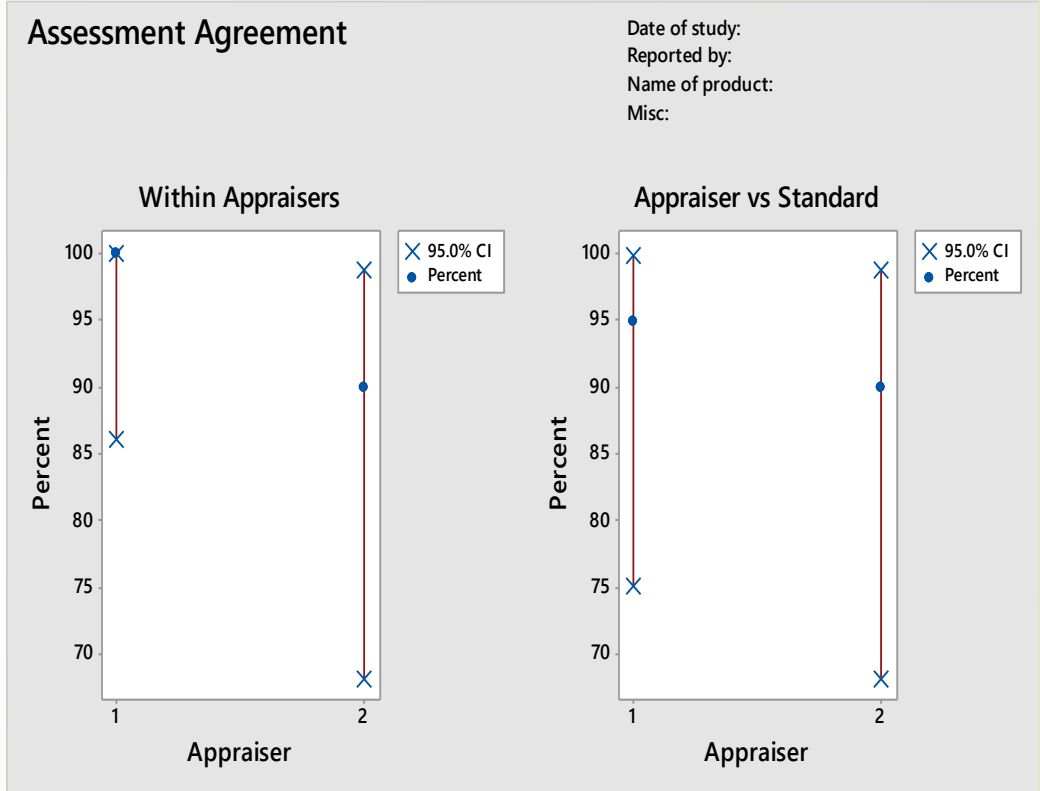
BASELINE PERFORMANCE

- **LONG TERM**
  - Sustaining the relocated facilities and operations.
  - Generate higher revenue and benefits consistently.
  - Maintaining quality standards

- **SHORT TERM**
  - Effectively control the transitional phase.
  - Meet project scheduled timelines and budget requirements.
  - Implement standardized procedures for newly re-shored facilities.
  - Evaluating and establishing/restoring supply chain systems.
  - Mitigate adverse situations arising due to factory shut downs in offshored locations.

Measurement System Analysis: Gage R&R



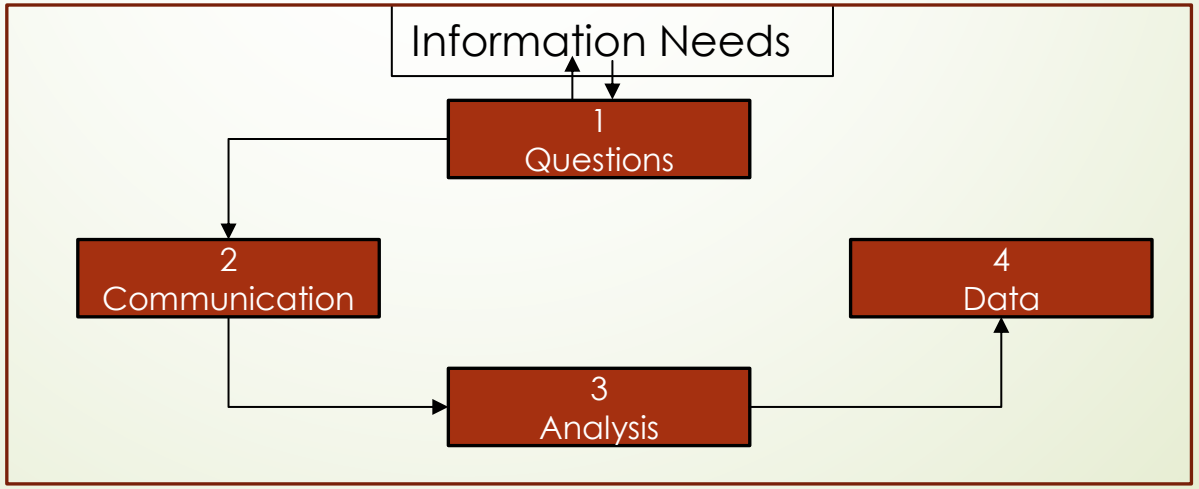


Gage R&R tool determines the variability in the measuring system to find inconsistencies in measurement results. For our Project: Industrial Rescue process, since we did not have data we have used the same data provided by professor. We look at the parts as our different "Projects" concerning the reshoring process, the operators as "Project Managers" and the measurements as "Return on Investments".
Total Gage R&R is 7.76%, and our Par-to-Part contribution is 92.24%. Hence:

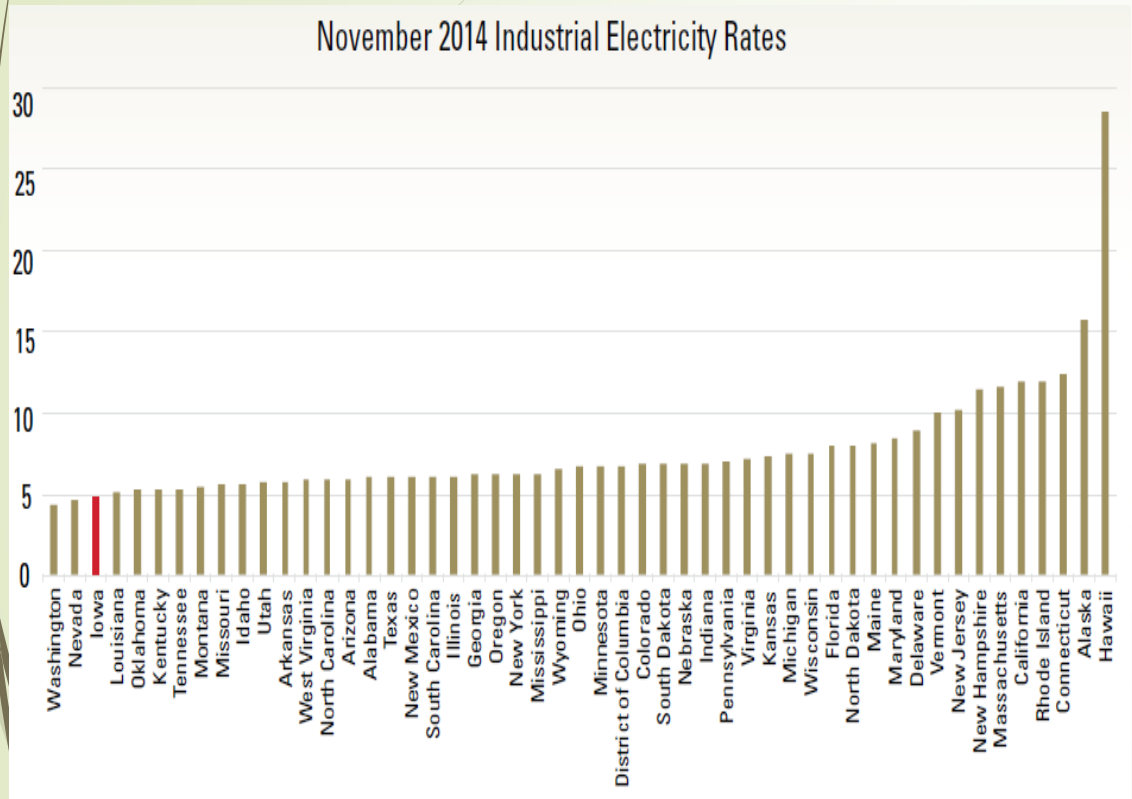
Project Managers agree on the number of unacceptable projects so the measurement technique is acceptable and effective.

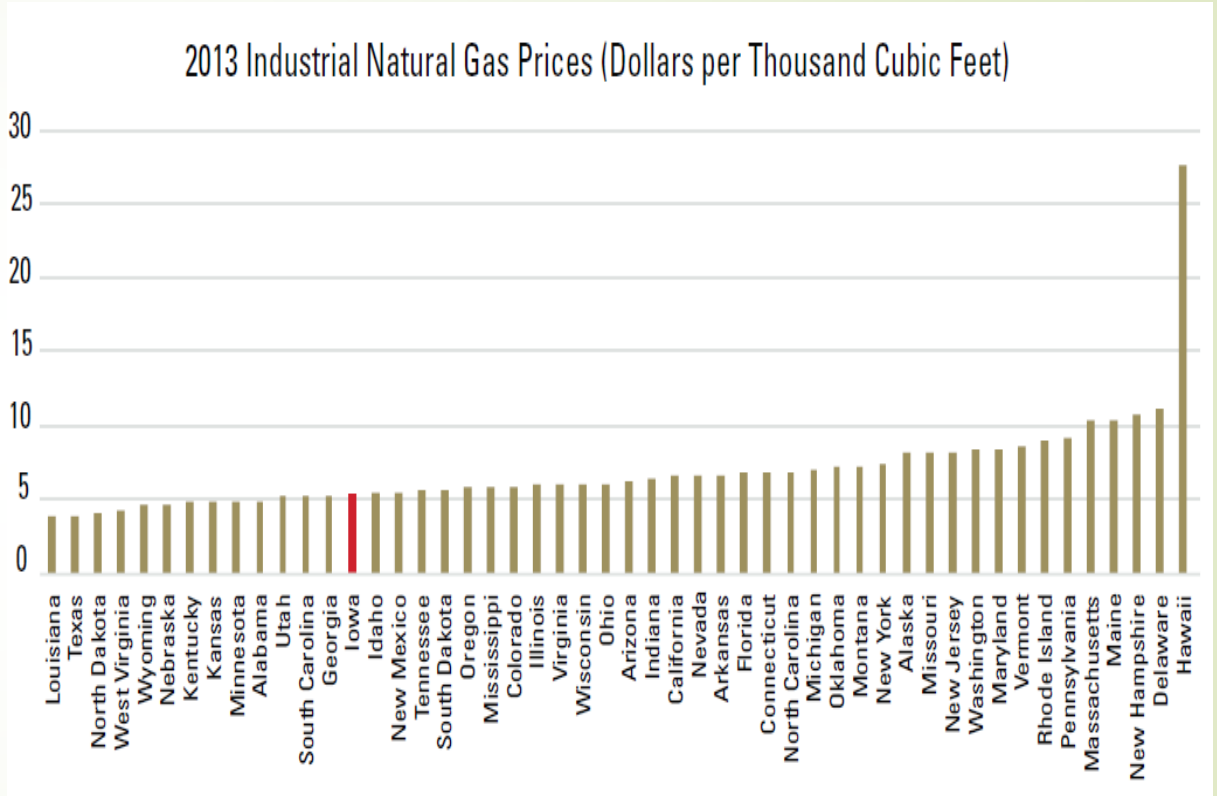
ANALYZE PHASE

This phase will comprise of the collection and analysis of the data required for the process.



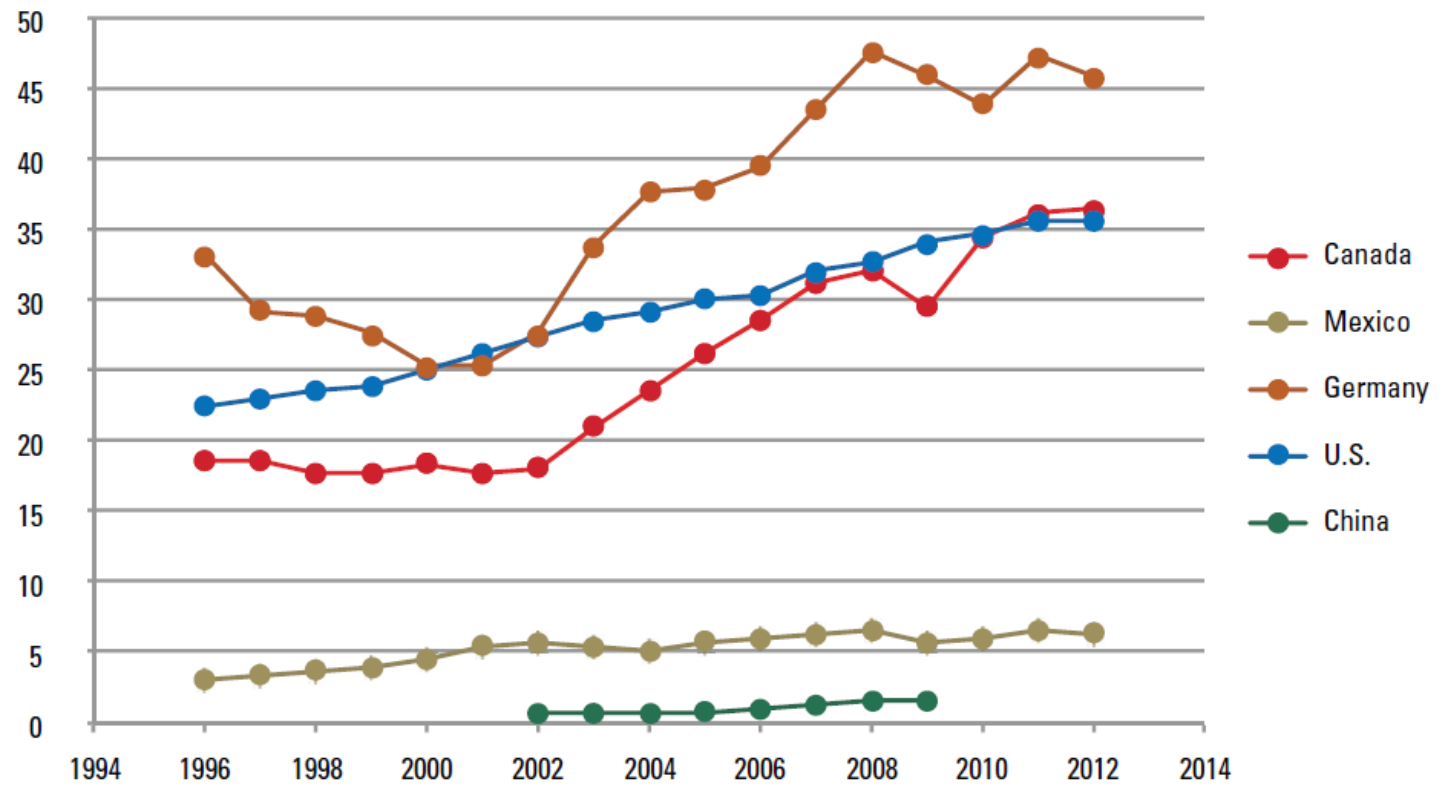
Comparison of Energy Costs in US





The figures show the states where electricity and gas rates are relatively low.

Comparison of Labor Rates in different countries

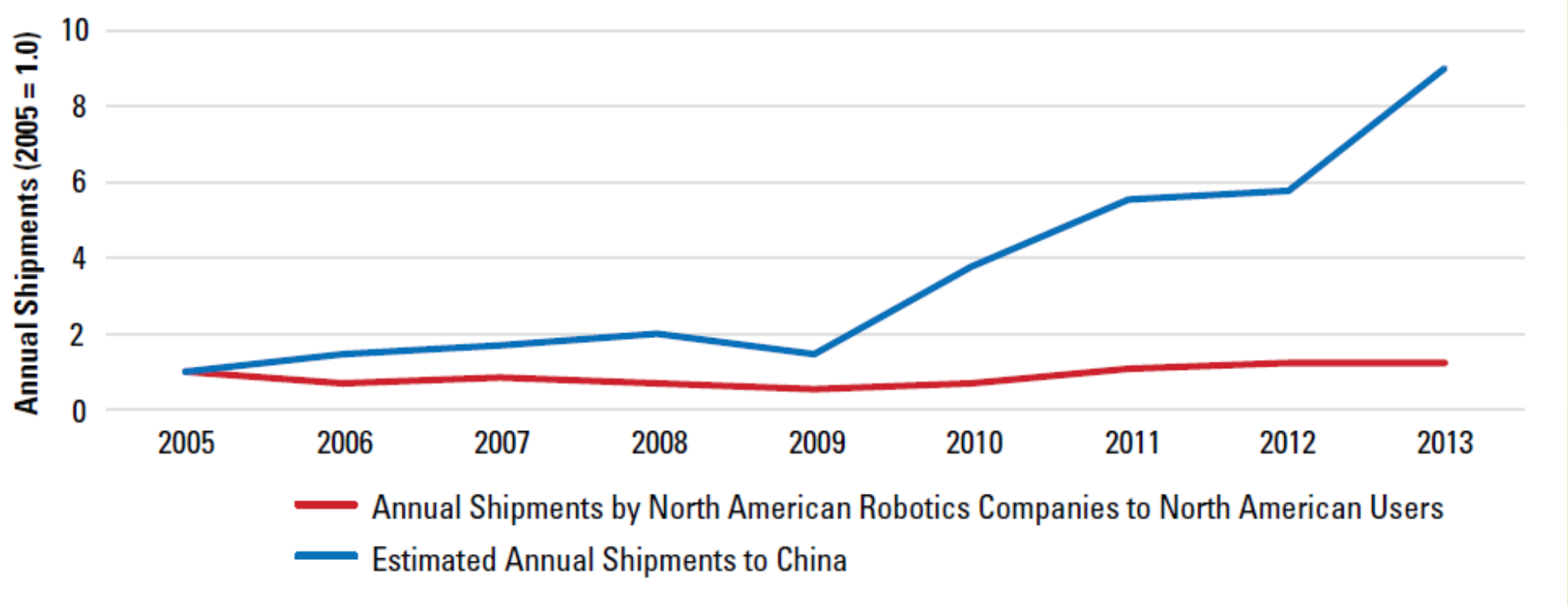


The graph shows the trends of the labor rates in various countries.

Manufacturing Sector Employees per Year

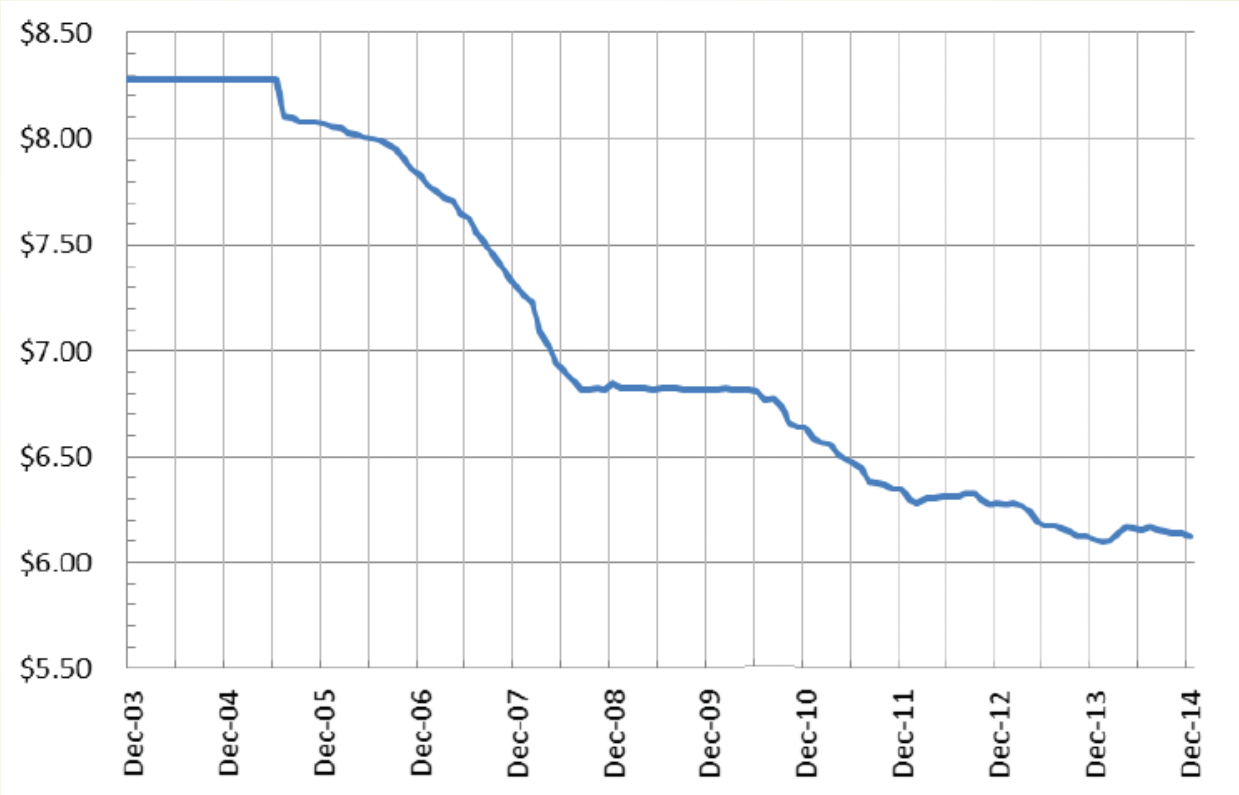
Employees number dramatically fell in 2000-2010. It began to rebound in 2010 when many companies started reshoring.

Annual Shipping Cost Comparison
(North America vs China)



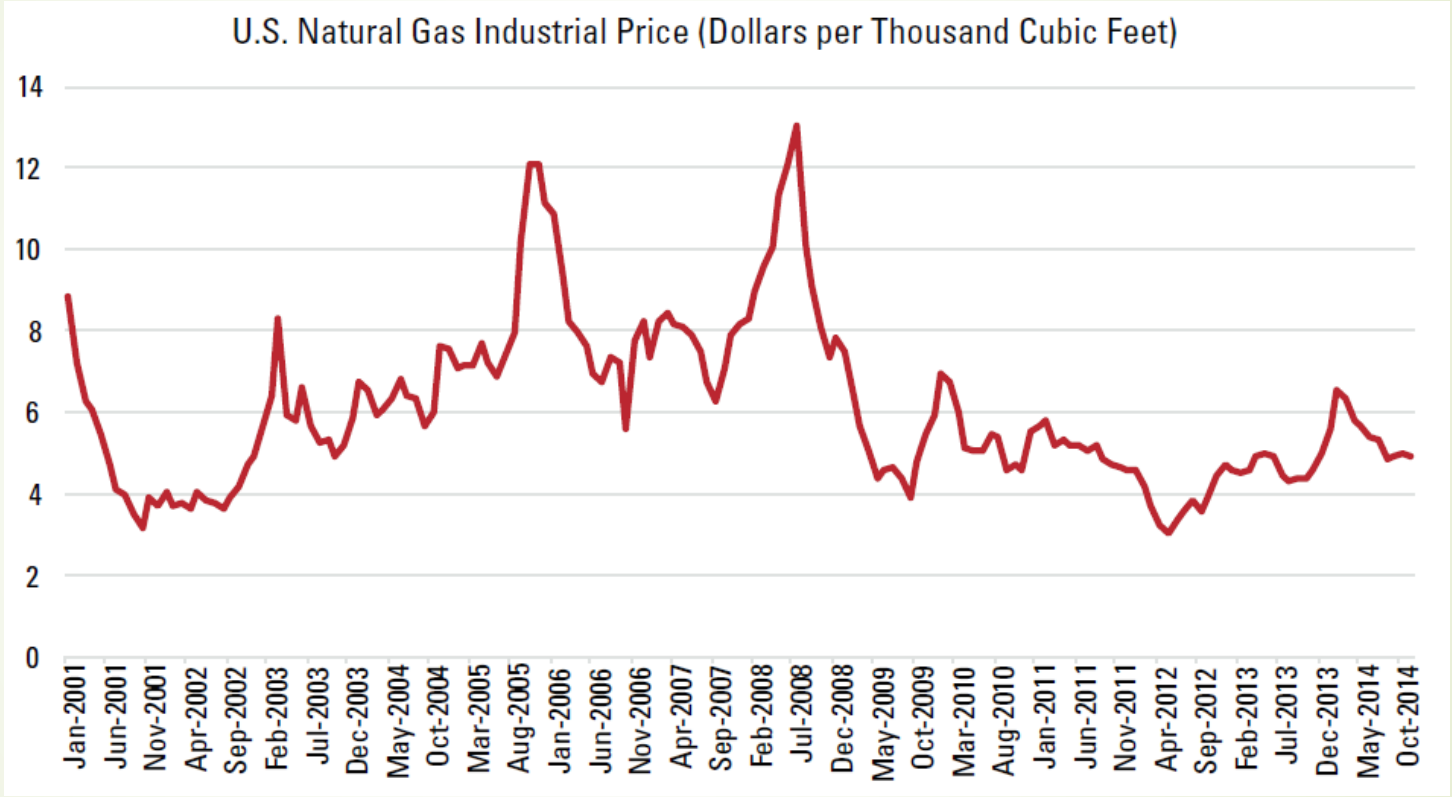
We can see the steep increase in the shipment rates to China vs the steady figures for shipment rates to North America.

CNY vs USD exchange rate – trends



CNY vs USD exchange rate keep falling since 2003. The trend increased labor cost of all off-shoring companies.

Gas Price in US



Gas price has stayed low since 2008.

Estimates of jobs created by reshoring

Job Range	By When	Source
Up to 70,000 per year	2016	Reshoring Initiative
2 to 3 million total	2020	Boston Consulting Group
Up to 1 million total	2023	Walmart Buy America Initiative

The sources suggest a huge increase in employment in future due to the reshoring efforts in the United States of America.

IMPROVE PHASE

In this phase we propose process improvement strategies and solutions.

Areas of Improvement and Solutions

- List feasible solutions

Problems	Solutions
Cost to Benefit Ratio	• Extensive Planning for Schedule, Resource Planning and Budget Plans, before relocation begins • Have set minimum ROI for approval of each project
Supply Chain	• Risk Mitigation Plans • Mistake Proofing • Strict Change Control Policies
Quality	• Quality Audits • Implement QMS Systems: ISO, Baldridge, EHSMS,
Transition Period Inventory Deficit	• Build an Inventory Bank – with minimum stock requirements for the entire transition period • Demand Forecasts

Other areas of Improvement

- Deal with resistance to change
- Implement these solutions in operations

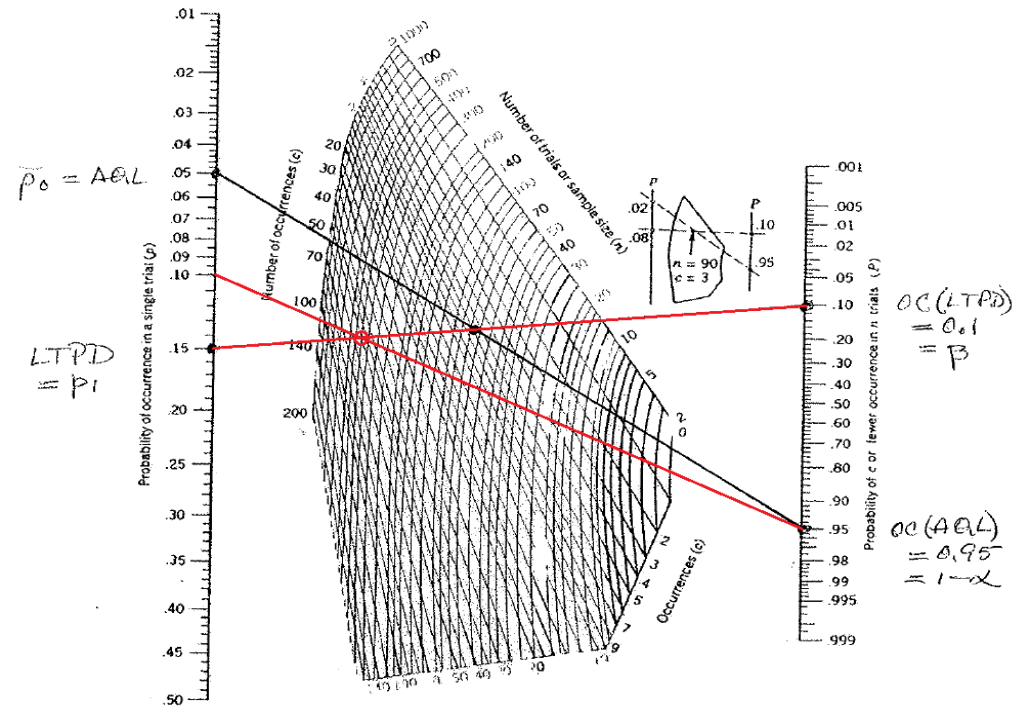
CONTROL PHASE

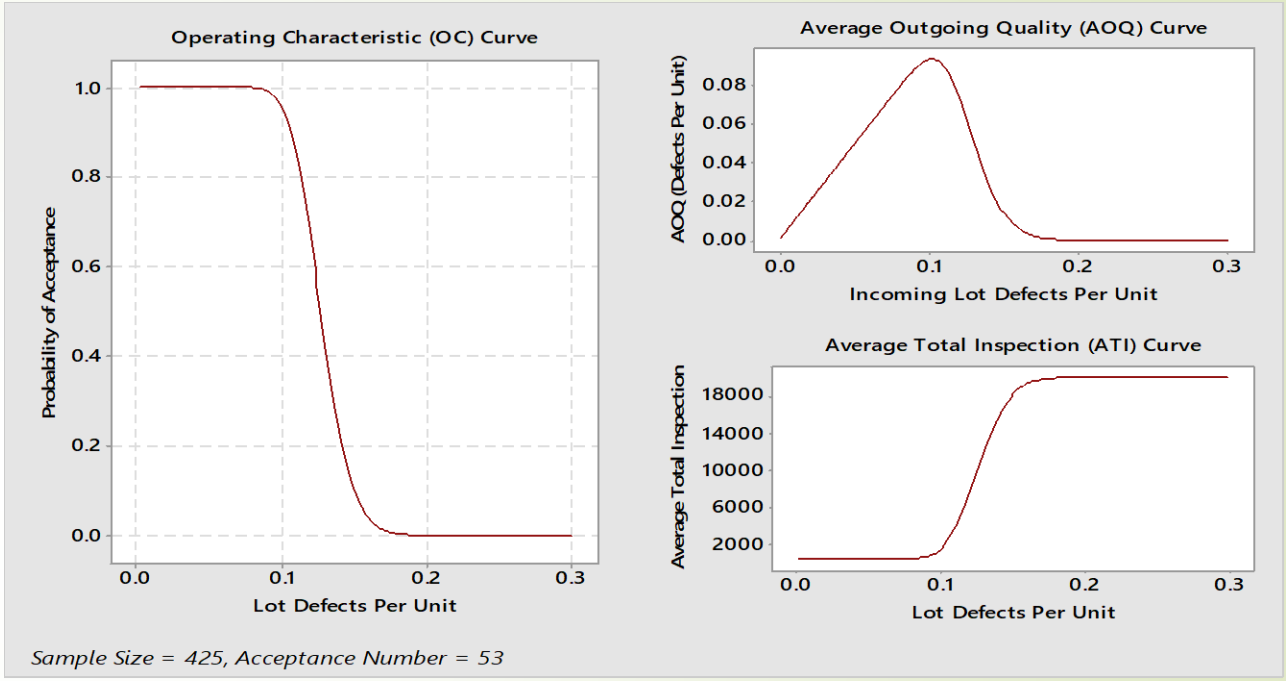
In this phase we implement control measures to ensure the process is sustained, monitored and all measuring systems are validated.

Control Techniques

- Ensure permanent implementation of solutions.
- Use of Control tools for implementation of Control Processes such as:
  - Process Control Plan
  - Mistake Proofing/ Poke-Yoke techniques
  - Standard Operating Procedures
  - Change Management
  - Statistical Process Control
- Document all historical data, and record the lessons learnt for implementation into future processes.
- Compare results: Actual vs Target vs Baseline.
- Regular inspection and audits.

Acceptance Sampling



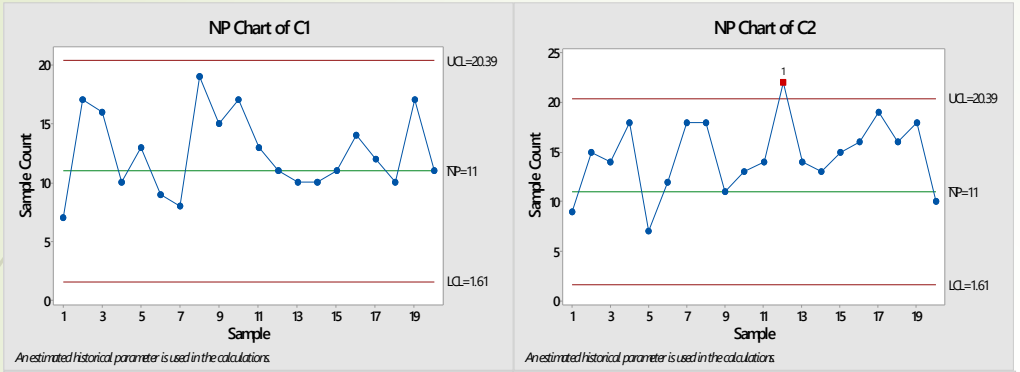


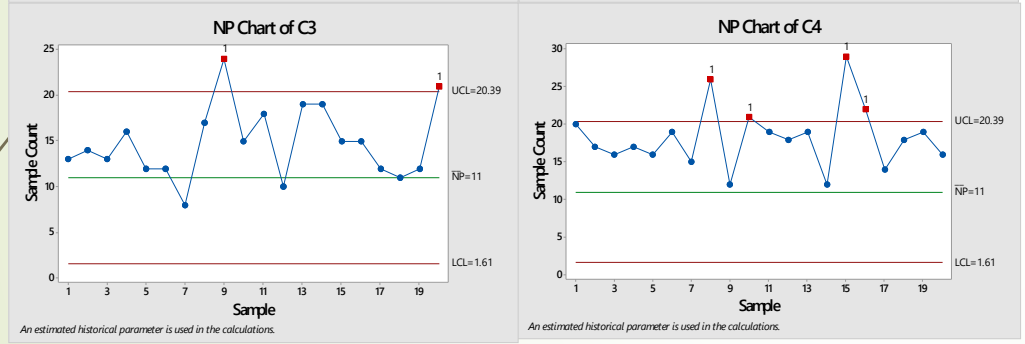
Alternative	Total cost	Result ($)
No inspection	NpA	100000
Sampling	nI+(N-n)pAPa+(N-n)(1-Pa)I	96233.97
100% inspection	**NI**	**40000**

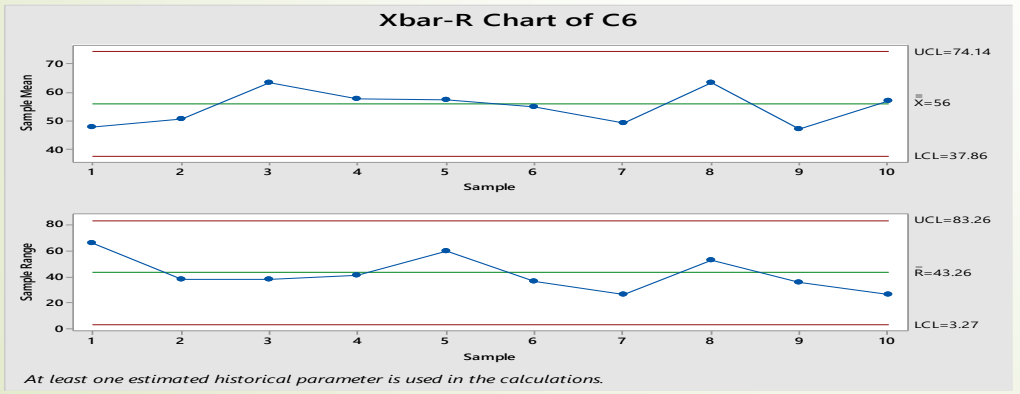
Pb=I/A=2/50=0.04, Pd=0.1>Pb

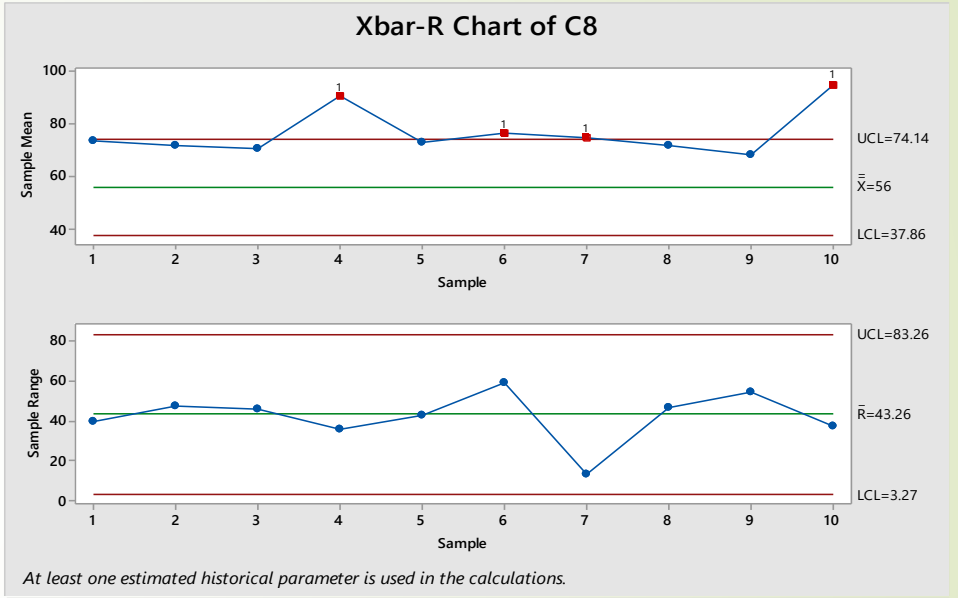
From Pd>Pb and table above, 100% inspection is best. The cost of no inspection is $60000 more than 100% inspection and sample inspection also costs in the same range as no inspection. Hence 100%inspection is the best in this case.

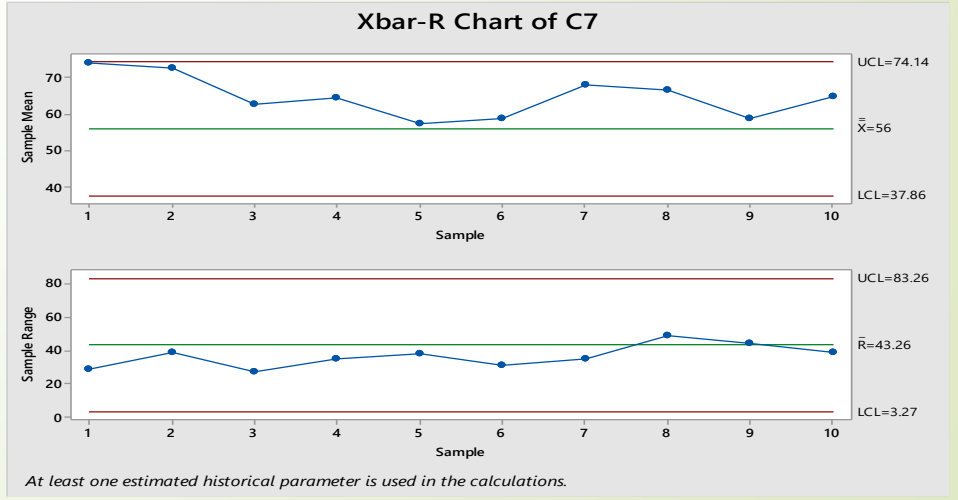
Statistical Process Control











QFD: House of Quality

"How long will it do?"

Reliability Analysis

The dynamic quality of a product over time

- The ability of a product to work for a required time and to prevent failures

ASQ Definition

- Probability that a product, system or service will perform its intended function adequately for a specified period of time, operating in a defined operating environment without failure.

FMEA ANALYSIS

Process Step	Failure Mode	Severity 1-10 10 = most severe	Occurrence 1-10 10 = highest prob. of occurrence	Detection 1-10 10 = lowest prob. of detection	RPN	Improvement Action
Evaluate Re-shoring Procedures	Wrong evaluation	8	4	7	224	Extensive Planning for Schedule, Resource Planning and Budget Plans, pilot run before relocation begins
Evaluate Supply Chain Logistics	Supplier Unavailability	7	5	5	175	• Risk Mitigation Plans • Mistake Proofing • Strict Change Control Policies
	Logistics Failure	7	8	4	224	
Cost Estimations	Cost overruns	10	6	8	480	Constantly track and measure the progress
	Currency Changes	4	7	4	112	Forecasting
Establish Factories and Facilities	Construction schedule over runs	8	9	7	504	Use good scheduling tools & charts
	Equipment Unavailability	6	7	6	252	Better sourcing procedures and supplier relation

“A place for everything, everything in its place”

- Benjamin Franklin

Organization, rules and following the rules is key to a successful lean project.

What is ”Lean” manufacturing?

- Introduced by Toyota group and also sometimes referred to as “**Toyota Production System (TPS)**”
- Removal of “**Fat**”, “**Slack**” or “**Waste**” from a system or process
- It focuses on efficiency of a process

Lean Tools

- **Value Stream Mapping** (VSM)
- **5S**
- **Kanban** (pull systems)
- **Poka-yoke** (mistake-proofing)
- **Heijunka** (level-production)
- **Kaizen**

These tools help systematically eliminate "**the 3 evil M's**"

- **Muda:** waste/non value
- **Mura:** inconsistent use of people
- **Muri:** excessive demands on people

Advantages of Lean Six Sigma

- Lean reduces '*waste*' and Six sigma reduces '*variance*' in a process or system.

- Reduced time/waste because of lean combined with Six Sigma's focus on process quality, increases the efficiency of the process or system significantly, end result of which is reduced operational costs.

NOTE: If lean systems are not integrated properly, it creates a ripple effect through the existing six sigma process and more problems than improvements!!

Value Stream Mapping (VSM)

- VSM provides an overview of the process and where non value added activities reside.
- Inputs to the VSM are assessed to analyze which ones have the greatest impact on the outputs.
- It is the **1st step in Lean** process
- It has two phases: **Current State** and **Future State**
- It helps streamline the process to create change by removing unnecessary steps, delays and waste.

How to implement VSM?

Steps:

1. **Identify Current State (Define Phase)**
   - We first define which process needs to be improved
2. **Observe and confirm process (Measure Phase)**
   - Collect data such as: cycle times, lead times, non-value added activities etc.
3. **Map the flow**
   - Construct the Current State Map
4. **Identify opportunity for improvement (Analysis phase)**
   - Brainstorm on how to eliminate unnecessary steps, non-value added activities to reduce cycle times
5. **Construct Future State (Improve Phase)**
6. **Create Implementation Plan (Control Phase)**

Define: Where in the process can we implement VSM?

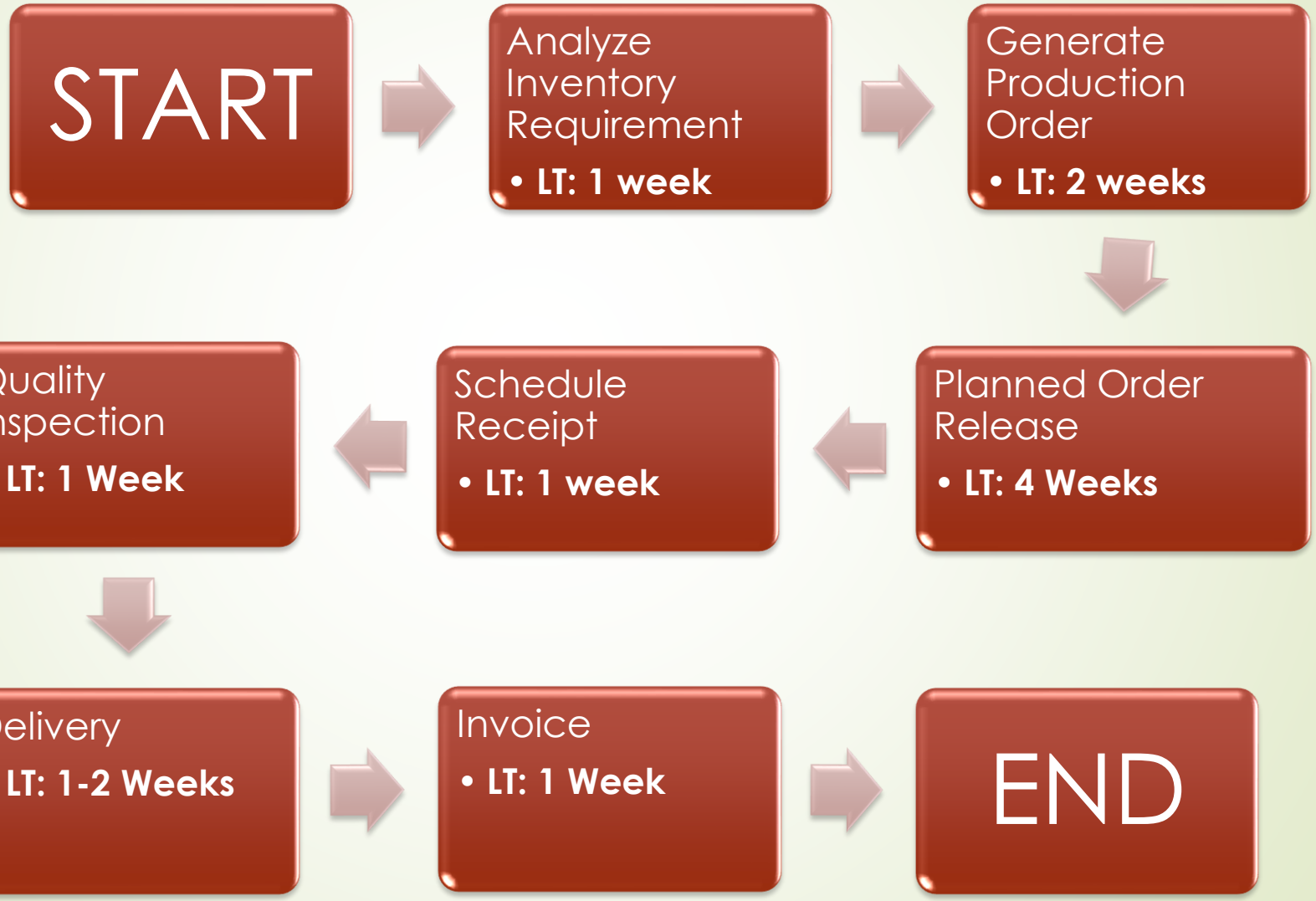
- The first step in VSM is to identify and select a process to be improved

- We selected, the **inventory bank production** during the transition phase, i.e. the period just before the manufacturing unit is re-shored and operations can begin in the US.

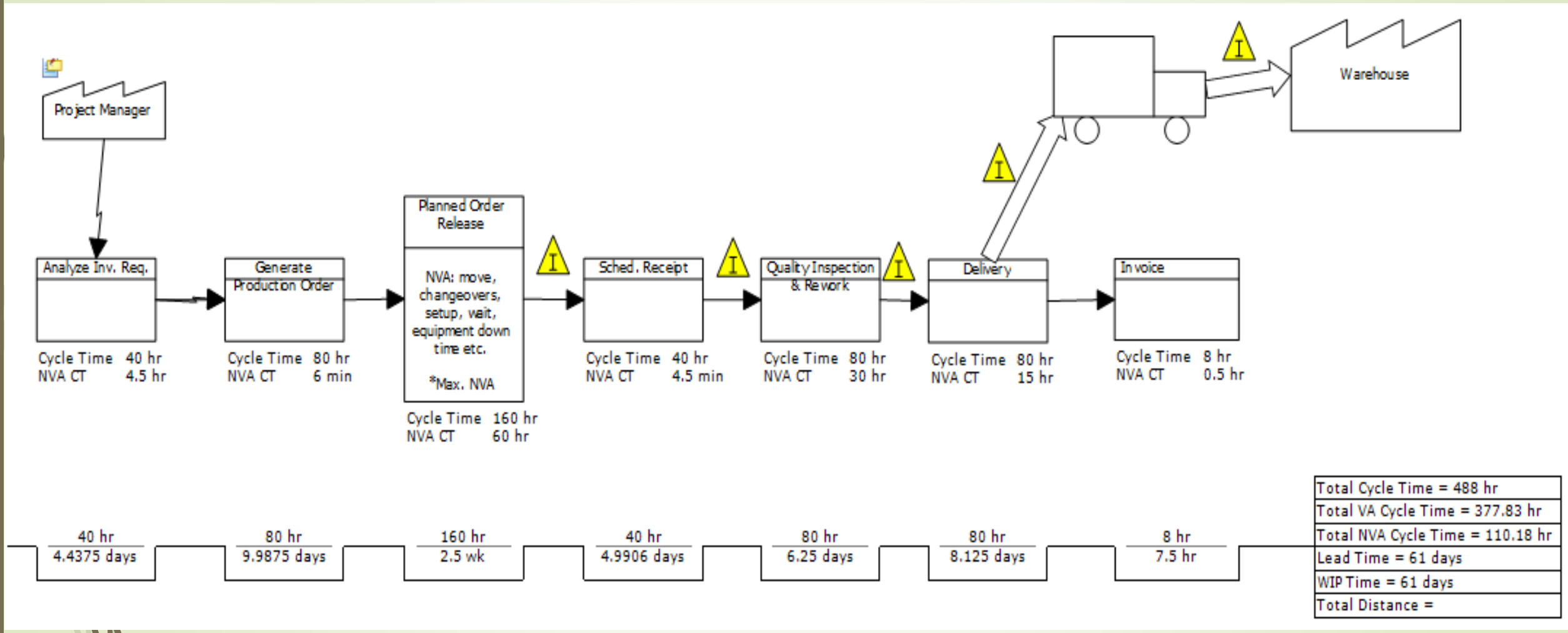
- We chose this process because of the importance the "**time value**" of this process:

  1. **Quick**er the **transition** ~ **Less Inactive time** for the manufacturing unit
  2. During transition inactivity, "*Inventory Bank*" is necessary so the sales are not affected

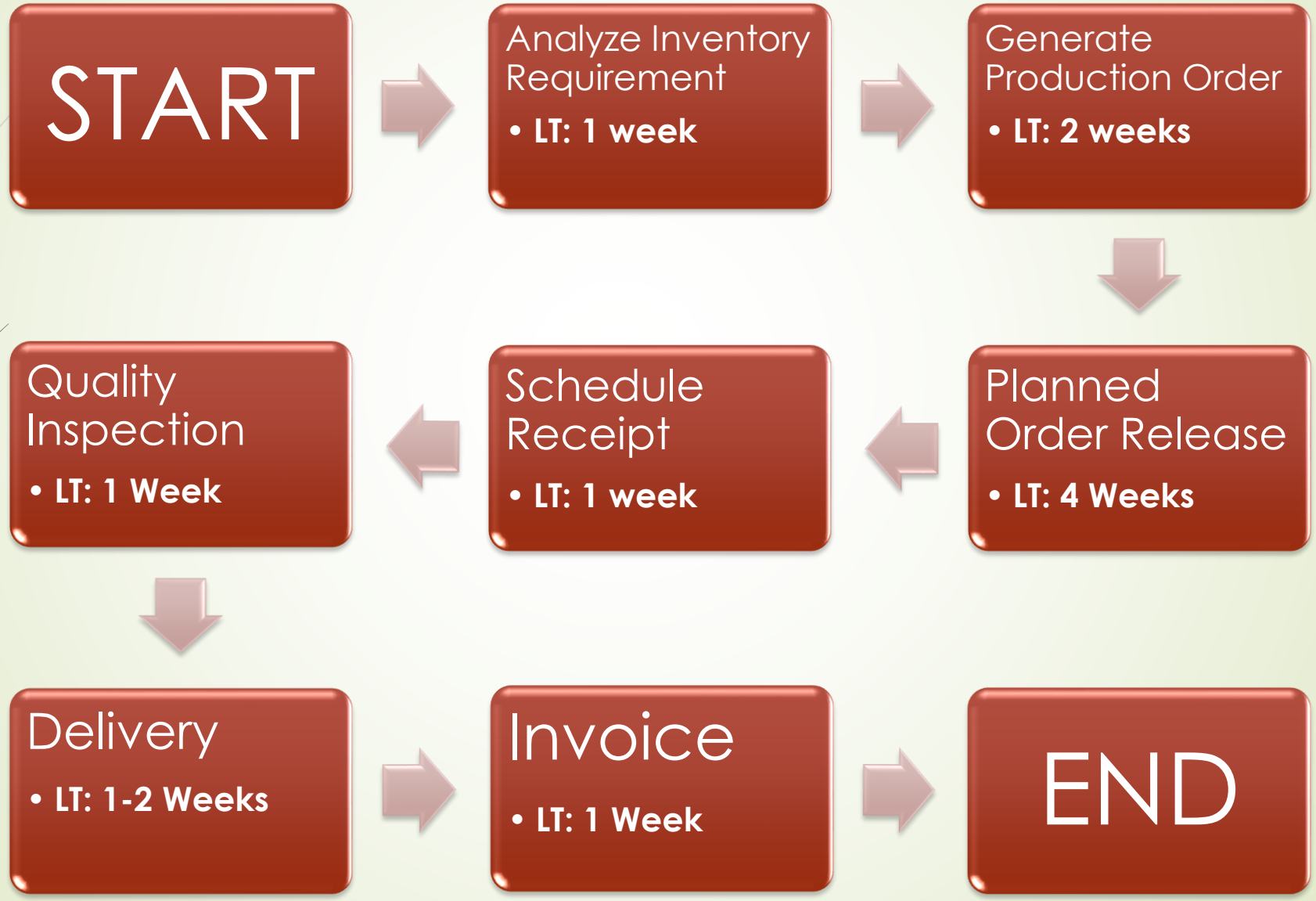
Measure Current State



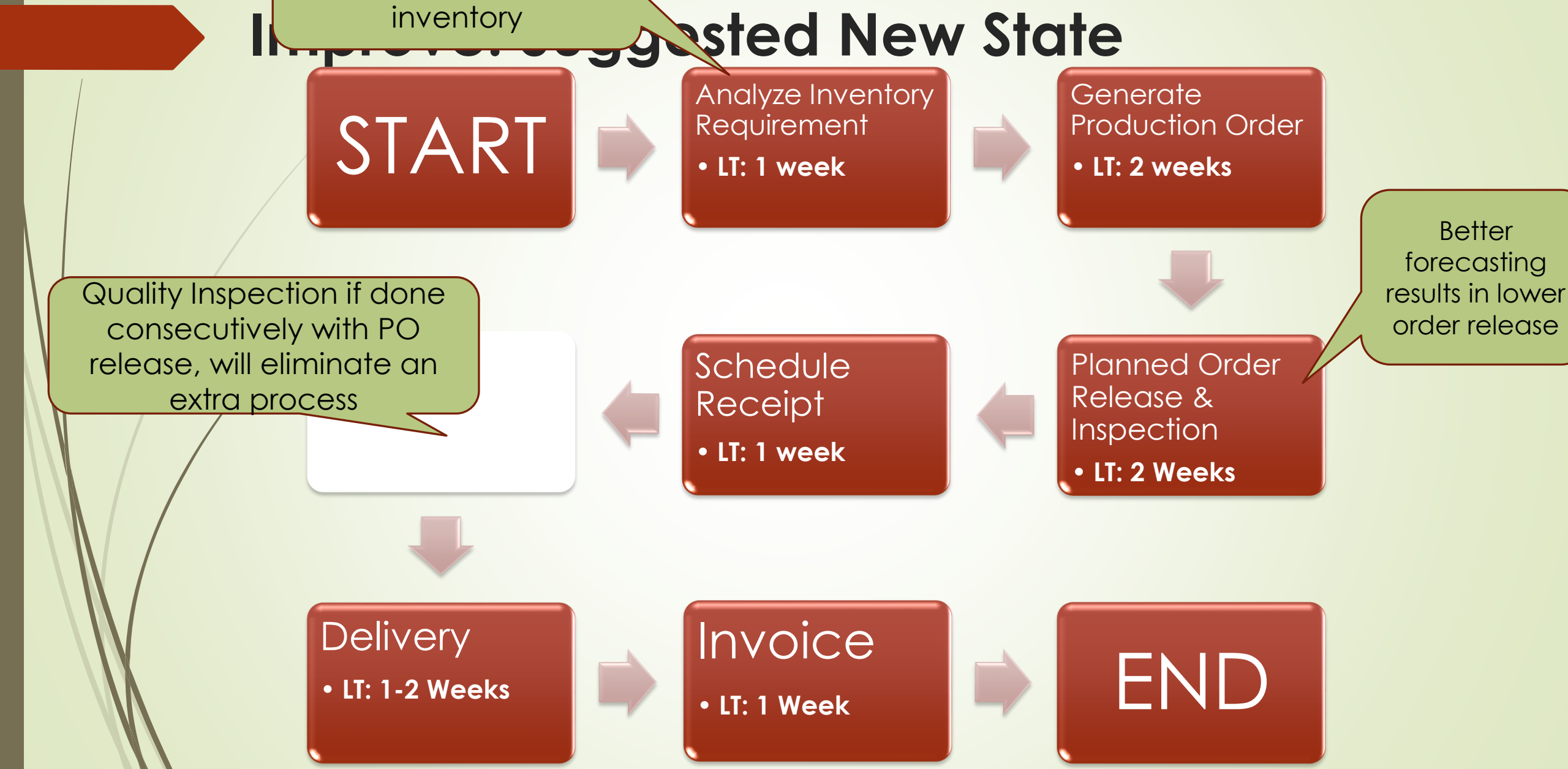
Analyze Current State



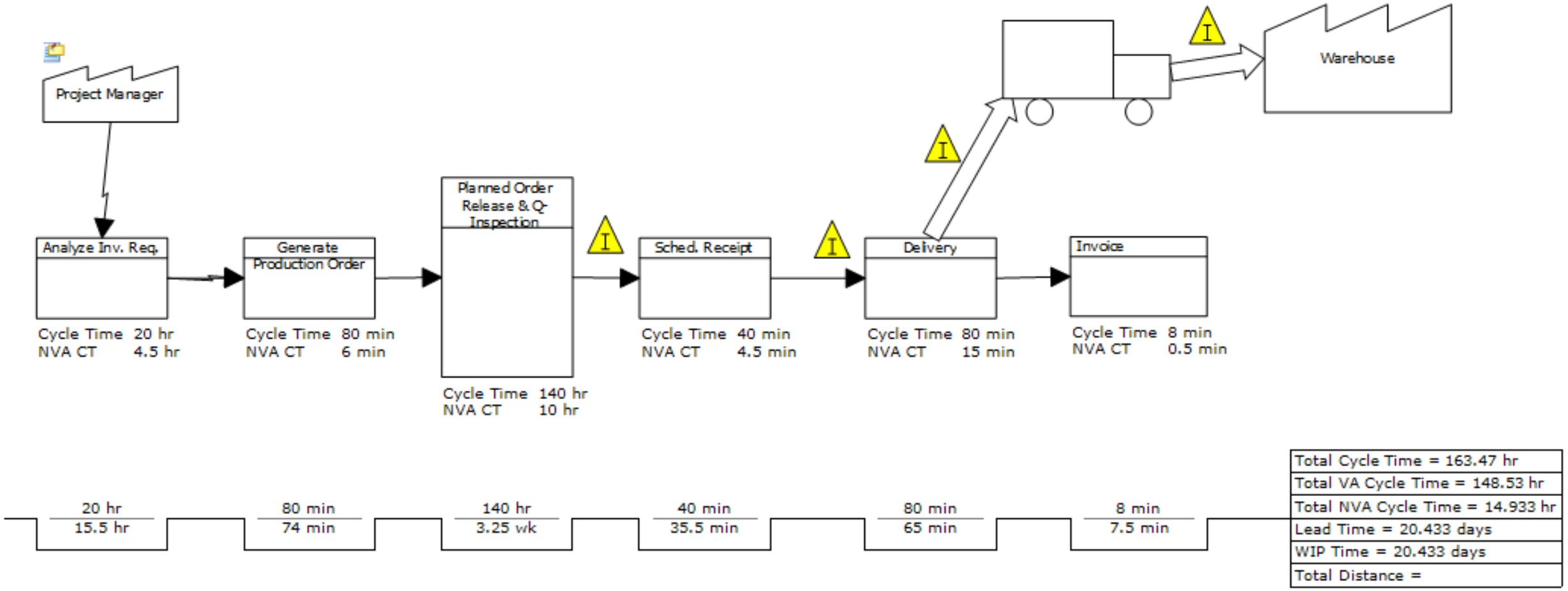
Current State



Improved: Suggested New State



Future State



Conclusions

- Major factors that affect the reshoring process, are cost to benefit ratio, supply chain, location, labor policies and external factors like government regulations amongst others.
- Reduced time/waste because of lean combined with Six Sigma's focus on process quality, increases the efficiency of the process or system significantly, end result of which is reduced operational costs.
- Our Gage R&R analysis method determined that the the measuring systems used in our processes of project selection is acceptable by our project managers.
- Our acceptance sampling exercise shows for our processes we should do 100% inspection due to significance of each process, unlike products these processes are key for the stage-wise progression of the reshoring process.
- Lastly our Reliability Analysis of the processes show that establishing the new facility must be given the highest priority.

Questions?

References

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