GLOBAL PERFORMANCE MANAGEMENT ACADEMY

Using Lean Six Sigma to improve Efficiency in Production and Services Operations

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What is Lean Six Sigma?

Lean Six Sigma is a Problem-Solving methodology which focus on reducing waste (lean) and reducing variation (six sigma) using Five phases to make process effective and efficient.

1. Define – Understand the problem
2. Measure – Collect reliable data
3. Analyze – Identify the root cause
4. Improve – Develop ideas for improvement
5. Control – Keep improvements permanent

Lean Six Sigma?

LEAN + SIX SIGMA = LEAN SIX SIGMA

LEAN

Reduces waste by streamlining a process making it efficient

SIX SIGMA

Controls variability by effectively solving problems

LEAN SIX SIGMA

Lean accelerates SIX SIGMA: Solving problems and improving processes is faster and more efficient

What can be done using LSS approach?

Sources of Waste

	Definition	Examples
Transportation	**Transportation** (also knows as Touches) is the unnecessary movement of **materials** around an organization	▪ Carrying large quantities in and out of storage facilities ▪ Redundant movement of materials
Inventory	**Inventory** includes any materials or supplies in excess of the appropriate time.	▪ Purchasing excess inventory ▪ Long Cycle Times for certain parts, or suppliers
Motion	**Motion** is any movement of people that does not add value to the product or service.	▪ Inefficient workplace organization ▪ Inefficient placement of frequently used supplies, tools, etc.
Waiting	**Waiting** is a prevalent Waste and involves waiting for man, machine, materials, information etc.	▪ Excessive Cycle Time between process steps ▪ High amount of wait time vs. work time
Overprocessing	**Overprocessing** is an effort that doesn't add value to the product or service from customer's perspective	▪ Re-work loops or work-around ▪ Redundant process steps
Overproduction	**Overproduction** is making more, earlier, or faster than the next process needs it	▪ Error that occur over and over ▪ Customer dissatisfaction in a process
Defects	**Defects** are information, products, and services that are inaccurate and/or incomplete.	▪ Error that occur over and over ▪ Customer dissatisfaction in a process

Data Based Methodology

- **INFERENTIAL STATISTICS**
- **STATISTICAL ANALYSIS**
- **CHARTING & GRAPHING**
- **BRAINSTORMING**
- **INTUITION**

Sigma Levels

Yield	PPMO	COPQ	Sigma	
99.9997%	3.4	<10%	6	World Class Benchmarks
				10% GAP
99.976%	233	10-15%	5	
99.4%	6,210	15-20%	4	Industry Average
				10% GAP
93%	66,807	20-30%	3	
65%	308,537	30- 40%	2	Non Competitive
50%	500,000	>40%	1	

Source: Journal for Quality and Participation, Strategy and Planning Analysis

What does 20 - 40% of Sales represent to your Organization?

Cost of Poor Quality

Cost of Quality	
Cost of Conformance **(Money spent during the project to avoid failure)**	Cost of Nonconformance **(Money spent during and after the project because of failures)**
1. Prevention Costs (Build a quality product): ❑ Training ❑ Document Processes ❑ Equipment ❑ Time to do it right	1. Internal Failure Costs (Failures found by the project): ❑ Rework ❑ Scrap
2. Appraisal Costs: Assessing the Quality): ❑ Testing ❑ Destructive testing loss ❑ Inspections	2. External Failure Costs (Failures found by the customer): ❑ Liabilities ❑ Warranty Work ❑ Lost Business

Inspection

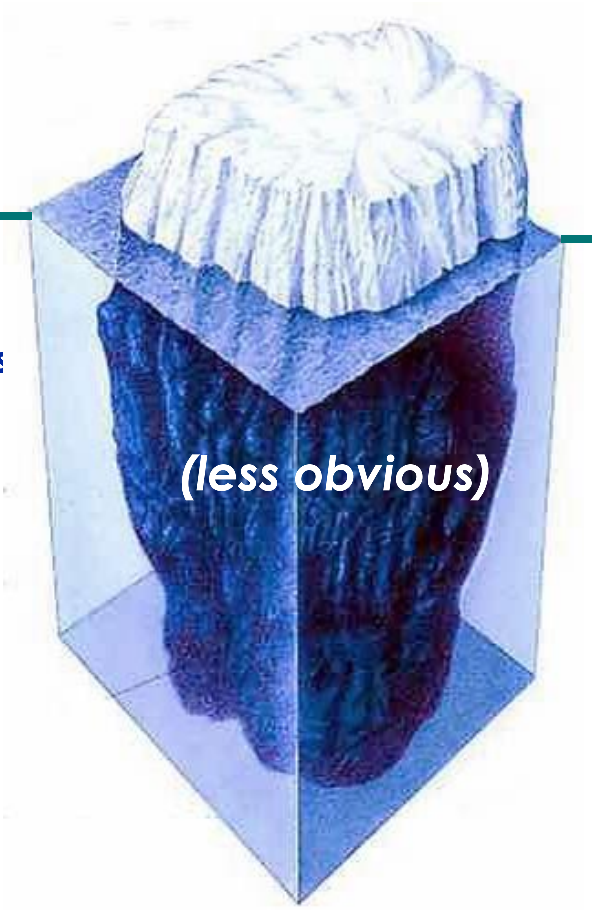
Warranty

Recode

Rework

Rejects

Visible Costs



Engineering change orders

Lost sales

Time value of money

Late delivery

Expediting costs

More Set-ups

Excess inventory

Working Capital allocations

Long cycle times

Excessive Material Orders/Planning

Hidden Costs

Lost Customer Loyalty

Problem Statement

Poor Example:

Because our customers are dissatisfied with our service, they are late paying their bills.

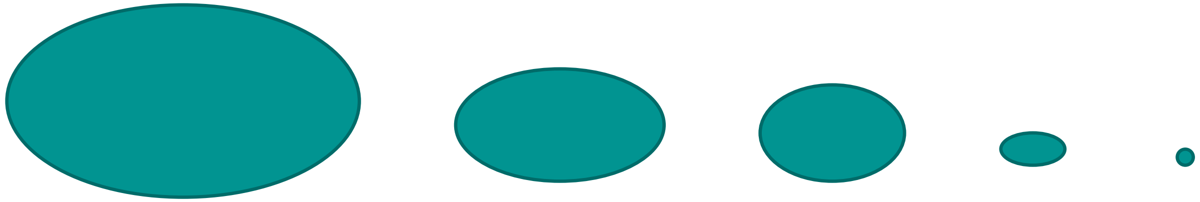
Improved Example:

In the last 2 years (when) 20% of our customers in ABC process (where) were over 60 days late (what) paying our invoices. This negatively affects our operating cash flow (how it impacts or consequences) by SR 2 Million.

What is 6 Sigma ?

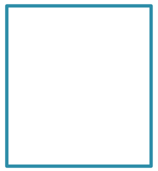
A measurement scale which compares the output of a process to the customer's requirements

Process Sigma	2	3	4	5	6
Defects Per Million opportunities (DPMO)	308537	66807	6210	233	3.4



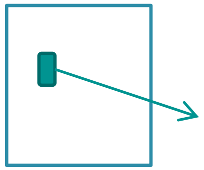
Compute Process Sigma

Unit: The item produced or processed



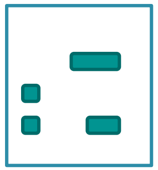
Form

Defect: any event that does not meet the specification of a CTQ as defined by the customer.



Critical field with missing information

Defect Opportunity: Any event which can be measured that provides a chance of not meeting a customer requirement (Specification)



critical fields on the form

Calculate process sigma : formula

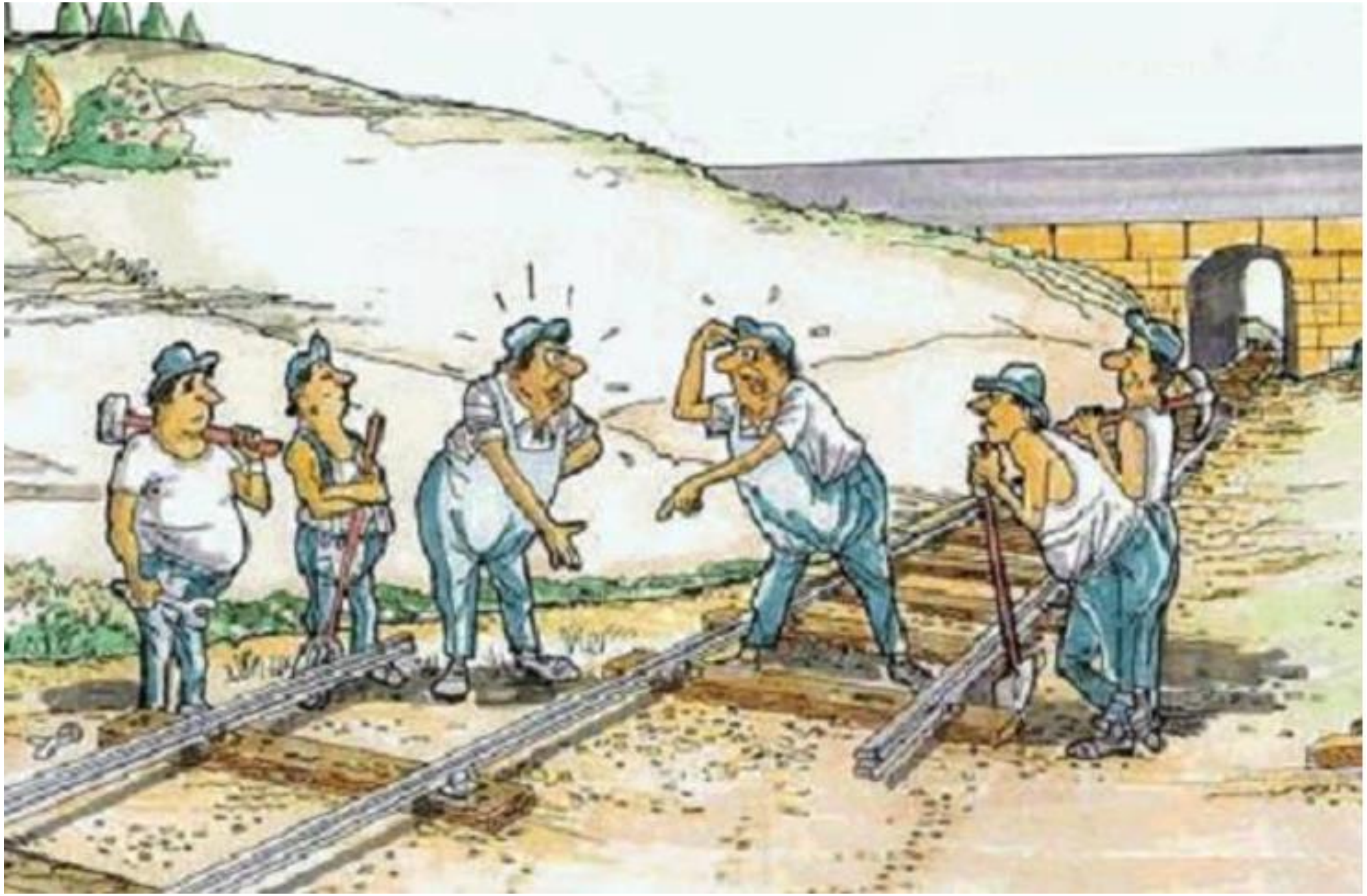
Calculate the number of Defects per million Opportunities

$$\text{DPMO} = \frac{\text{(No of Defects)}}{\text{No of Units X No of Opportunities}} \text{ X } 1\,000\,000$$

In the sigma table, look at the Sigma value relating to the DPMO determined

Conversion Table

Long term Yield	Process Sigma	Defects per 1,000,000	Long Term Yield	Process Sigma	Defects per 1,000,000
99.99966%	6.0	3.4	93.320 %	3	66,800
99.9995%	5.9	5	90.920%	2.9	80,800
99.9992%	5.8	8	90.320%	2.8	96,800
99.9990%	5.7	10	88.50%	2.7	115,000
99.9980%	5.6	20	86.50%	2.6	135,000
99.9970%	5.5	30	84.20%	2.5	158,000
99.9960%	5.4	40	81.60%	2.4	184,000
99.9930%	5.3	70	78.80%	2.3	212,000
99.9900%	5.2	100	75.8%	2.2	242,000
99.9850%	5.1	150	72.6%	2.1	274,000
99.9770%	5.0	230	69.2%	2	308,000
99.670%	4.9	330	65.6%	1.9	344,000
99.520%	4.8	480	61.80%	1.8	382,000
99.9320%	4.7	680	58.00%	1.7	420,000
99.9040%	4.6	960	54.00%	1.6	460,000
99.8650%	4.5	1350	50%	1.5	500,000
99.8140%	4.4	1860	46%	1.4	540,000
99.7450%	4.3	2550	43%	1.3	570,000
99.6540%	4.2	3460	39%	1.2	610,000
99.5340%	4.1	4660	35%	1.1	650,000
99.3790%	4.0	6210	31%	1	690,000
99.1810%	3.9	8190	28%	0.9	720,000
98.930%	3.8	10770	25%	0.8	750,000
98.610%	3.7	13900	22%	0.7	780,000
98.220%	3.6	17800	19%	0.6	810,000
97.730%	3.5	22700	16%	0.5	840,000
97.130%	3.4	28700	14%	0.4	860,000
96.410%	3.3	35900	12%	0.3	880,000
95.540%	3.2	44600	10%	0.2	900,000
94.520%	3.1	54800	8%	0.1	920,000



Project Charter Casthouse Slab Casting Process Improvement

Business Case:

Business demand continue to increase and the need to optimize the production is vital to the growth of the company and its people. Since the start of its operation Slab Casting never yet reach the full design capacity of 8 drops per day. Key deliverables are; identification of critical factors affecting the slab casting and place a sustainable controls around it. Other benefit will be if not to eliminate but lessen casting aborts and rejects.

VDC1 & VDC2 are not being maximized based on its design capacity. Current production performance is around 300K MT per year with an average of drops of 3.5 per day per VDC. We can cast 135 tons per drop and we have two VDC designed to do 650k tons per year.

Problem Statement:

VDC1 & VDC2 are not working into its maximum capacity of 8 drops per day. There are many factors affecting slab casting activity preventing it to work on its optimum performance.

Goal Statement:

("*SMART*": Specific, Measurable, Attainable, Relevant, Time bound")

1. Increase no. of drops by 42% Or production volume per year by 60%
2. Reduce number of cast aborts by 30%

SIGMA Level:

Basis of calculation: 1 cast is considered 60 opportunities (5 slabs x 12 possible reasons for cast aborts). From 2016 total drops of 540 we only produced 2218 good slabs that could have been 2700 slabs.

Baseline Process Capability (Feb '16 to Feb'17) = - 0.3 σ Z(LT) 1.8 σ Z(ST)
DPMO 394,950 Defect Rate 61%

Team Members:

Name	Role	%
Name	Champion	5%
Name	Sponsor	10%
Name	Project Lead	30%
Name	Team Member	10%
Name	Team Member	10%

Scope (In and Out):

In and Out scope

Process (Starts and Finishes):

Furnace preparation to bringing slab to Rolling Mill

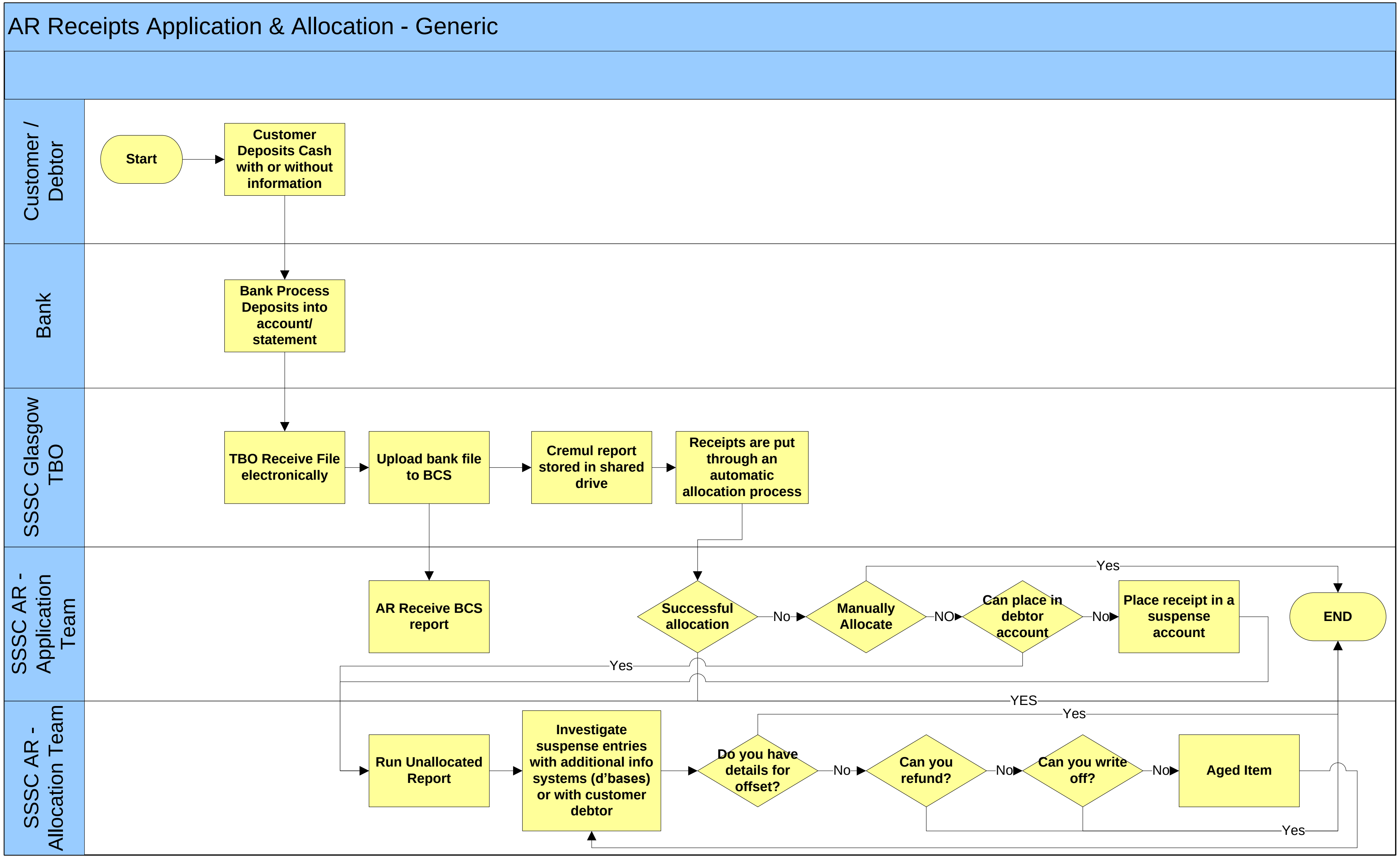
Estimated Financial Benefit:

Cost reduction? 25,000
Productivity Enhancement?
Increased capacity? 20,000

Phase	Completion Dates	Status
Define	17 Feb	CPT
Measure	30 Mar	CPT
Analyze	15 May	(Red)
Improve	01 Jul	(Green)
Control	17 Jul	(Green)
Realization	16 Aug	(Green)

STATUS Legend

Red	> 2 weeks behind
Yellow	1 day – 2 weeks behind
Green	On Track
CPT	Complete


AR Receipts Application & Allocation - Generic
Customer / Debtor
Bank
SSSC Glasgow TBO
SSSC AR - Application Team
SSSC AR - Allocation Team
Start
Customer Deposits Cash with or without information
Bank Process Deposits into account/ statement
TBO Receive File electronically
Upload bank file to BCS
Cremul report stored in shared drive
Receipts are put through an automatic allocation process
AR Receive BCS report
Successful allocation
No
Manually Allocate
NO
Can place in debtor account
No
Place receipt in a suspense account
Yes
END
Yes
YES
Yes
Run Unallocated Report
Investigate suspense entries with additional info systems (d'bases) or with customer debtor
Do you have details for offset?
No
Can you refund?
No
Can you write off?
No
Aged Item
Yes

Relationship between SIPOC and indicators

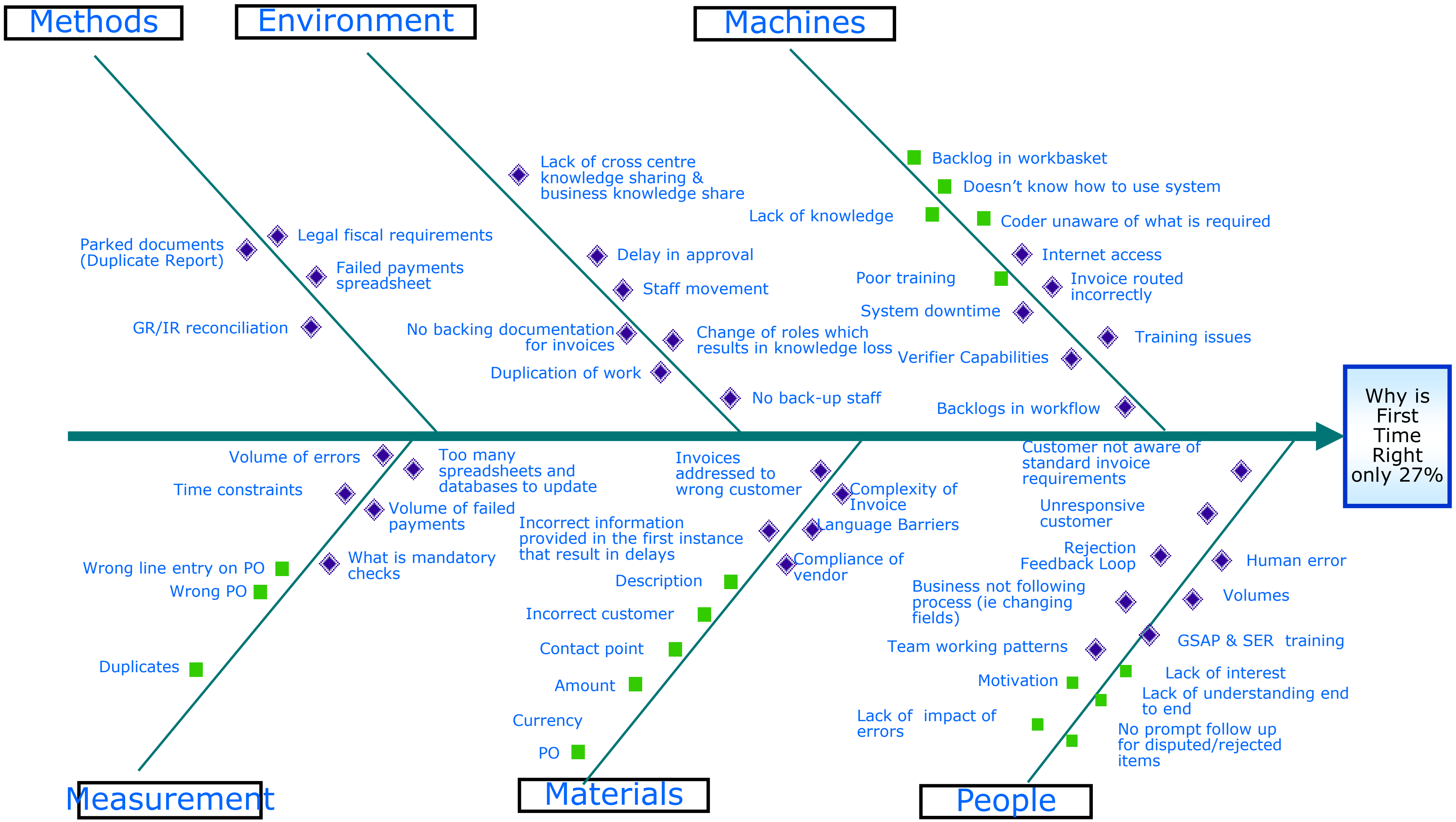
Start Boundary	
Suppliers	Input

Process

End Boundary	
Output	Customers

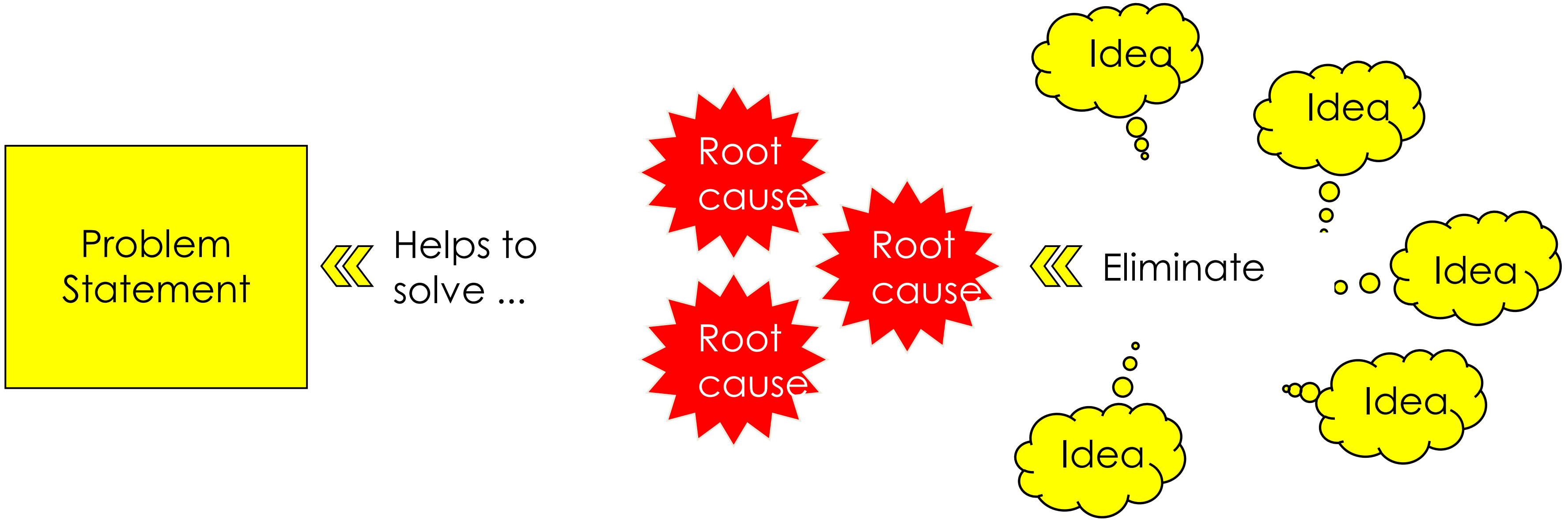
Input indicators	Process indicators	Output indicators
Measures that evaluate the degree to which the inputs to a process, provided by suppliers, are consistent with what the process needs to efficiently and effectively convert into customer-satisfying outputs.	Measures that evaluate the effectiveness, efficiency and quality of the transformation processes – the steps and activities used to convert inputs into customer-satisfying outputs.	Measures that evaluate dimensions of the output – may focus on the performance of the business as well as that associated with the delivery of services and products to customers.

Root Cause Analysis



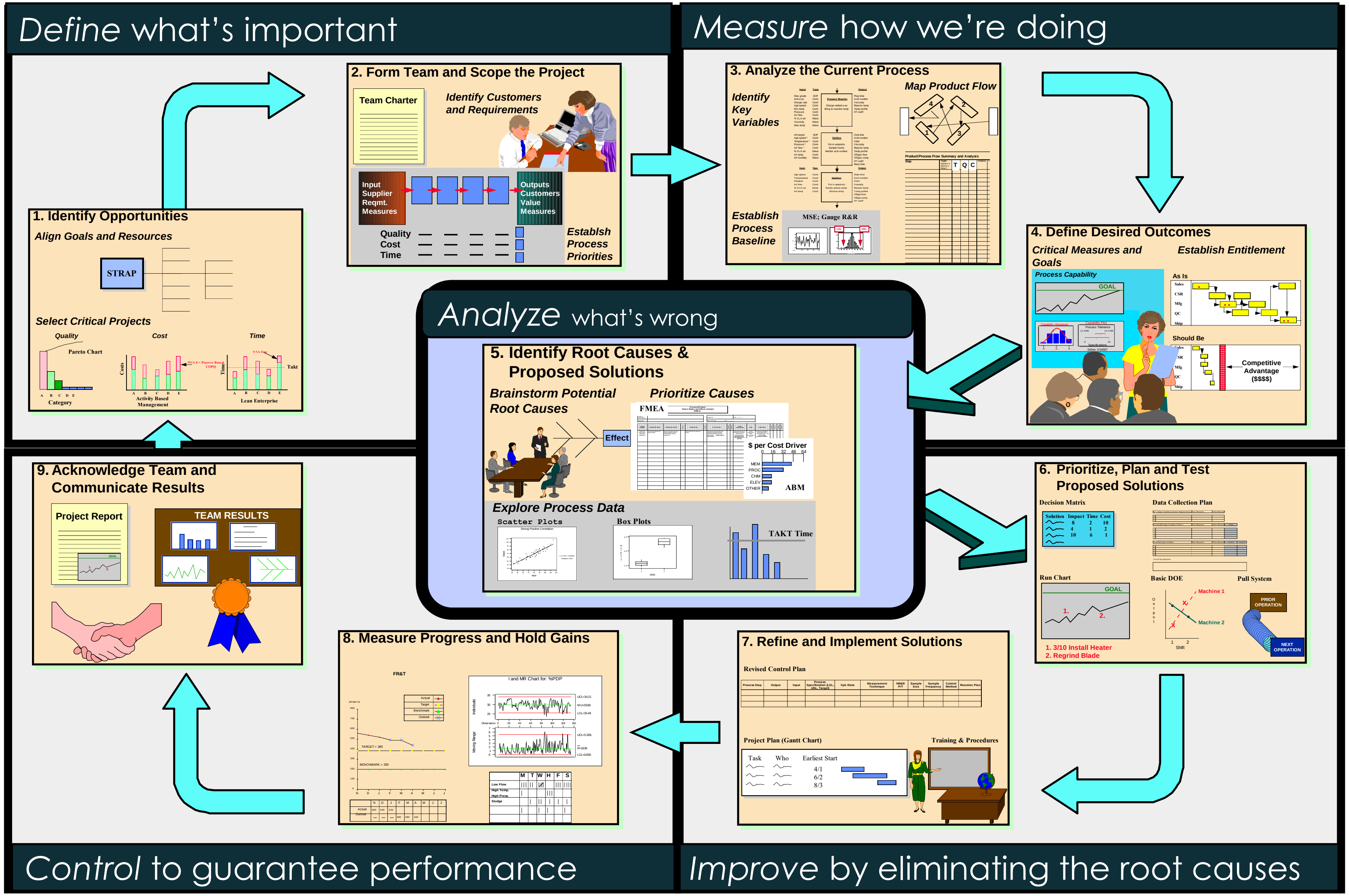
Improve

- Up to this point, the team has focused on gaining greater levels of understanding of the deviations affecting current operations by defining problem statements
- After we have verified root cause, we must begin to generate ideas that ultimately will be the solutions to drive process improvement
- The reduction or elimination of the root causes are the basis for the solutions the team will generate



Control

How would you control your improved processes?


Define what's important
Measure how we're doing
Analyze what's wrong
Improve by eliminating the root causes
Control to guarantee performance
1. Identify Opportunities
Align Goals and Resources
STRAP
Select Critical Projects
Quality
Cost
Time
Pareto Chart
Category
Activity Based Management
Lean Enterprise
Takt
2. Form Team and Scope the Project
Team Charter
Identify Customers and Requirements
Input Supplier Reqmt. Measures
Outputs Customers Value Measures
Quality
Cost
Time
Establish Process Priorities
3. Analyze the Current Process
Identify Key Variables
Map Product Flow
Establish Process Baseline
MSE: Gauge R&R
T
Q
C
4. Define Desired Outcomes
Critical Measures and Goals
Establish Entitlement
Process Capability
GOAL
As Is
Should Be
Competitive Advantage ($$$$)
5. Identify Root Causes & Proposed Solutions
Brainstorm Potential Root Causes
Prioritize Causes
FMEA
Effect
$ per Cost Driver
ABM
Explore Process Data
Scatter Plots
Box Plots
TAKT Time
6. Prioritize, Plan and Test Proposed Solutions
Decision Matrix
Data Collection Plan
Run Chart
Basic DOE
Pull System
Machine 1
Machine 2
PRIOR OPERATION
NEXT OPERATION
1. 3/10 Install Heater
2. Regrind Blade
7. Refine and Implement Solutions
Revised Control Plan
Project Plan (Gantt Chart)
Training & Procedures
Task
Who
Earliest Start
4/1
6/2
8/3
8. Measure Progress and Hold Gains
I and MR Chart for: %PDP
9. Acknowledge Team and Communicate Results
Project Report
TEAM RESULTS

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Thank you

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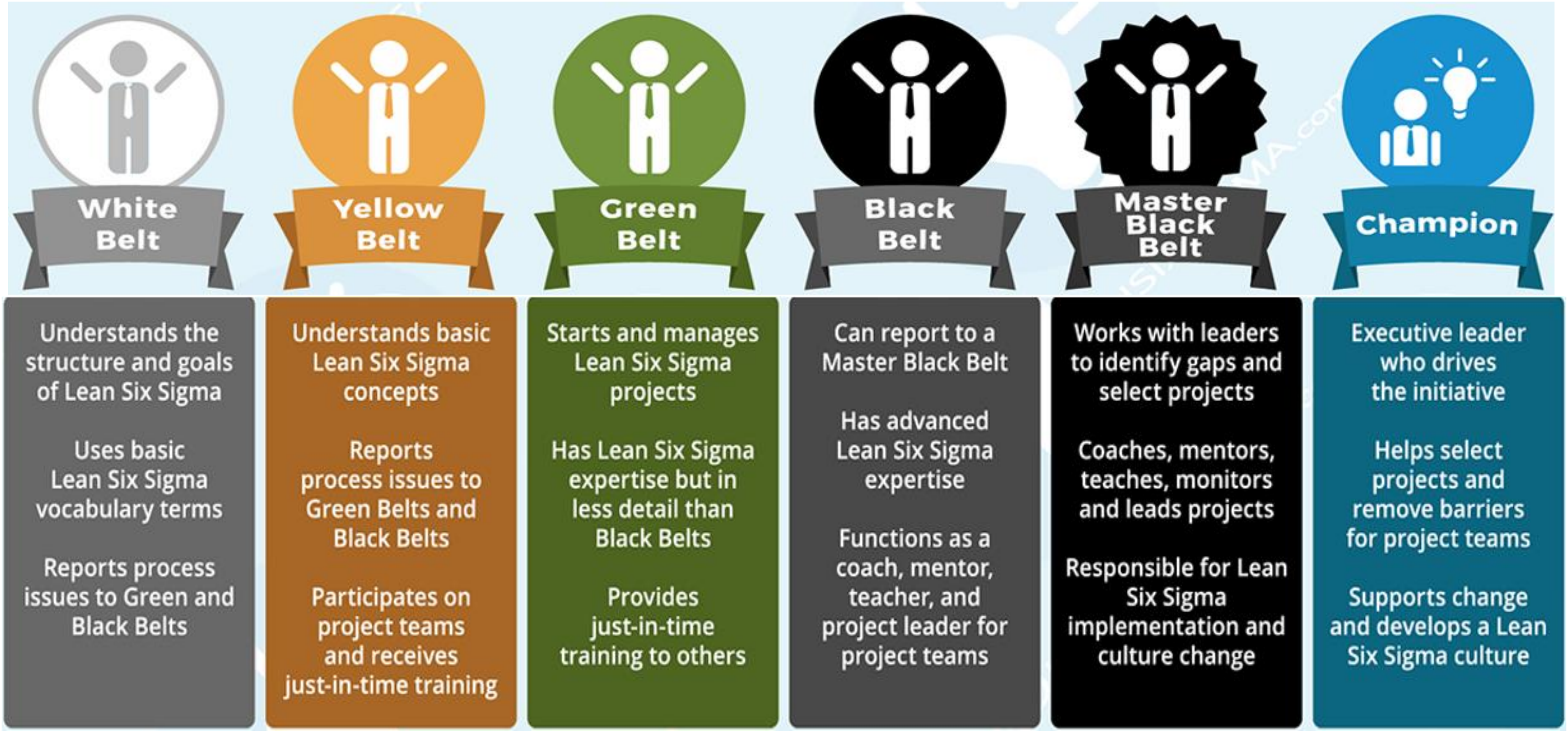
APPENDIX


White Belt
Understands the structure and goals of Lean Six Sigma
Uses basic Lean Six Sigma vocabulary terms
Reports process issues to Green and Black Belts
Yellow Belt
Understands basic Lean Six Sigma concepts
Reports process issues to Green Belts and Black Belts
Participates on project teams and receives just-in-time training
Green Belt
Starts and manages Lean Six Sigma projects
Has Lean Six Sigma expertise but in less detail than Black Belts
Provides just-in-time training to others
Black Belt
Can report to a Master Black Belt
Has advanced Lean Six Sigma expertise
Functions as a coach, mentor, teacher, and project leader for project teams
Master Black Belt
Works with leaders to identify gaps and select projects
Coaches, mentors, teaches, monitors and leads projects
Responsible for Lean Six Sigma implementation and culture change
Champion
Executive leader who drives the initiative
Helps select projects and remove barriers for project teams
Supports change and develops a Lean Six Sigma culture