LEAN SOLUTIONS ACADEMY



Lean Six Sigma Training

Green Belt

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The ILSSI Exam

- Done online at ILSSI.org after training is finished
- Login and Password will be provided https://ilssi.org/login/
- Proctored by Webcam (ProctorU.com)
- Sign-in and Schedule exam on ProctorU.com
- Open Book
- 100 Multiple Choice Questions
- Pass mark is 70%
- Result issued immediately
- Retake is available

ilssi.org



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Body of Knowledge

1. The Fundamentals of Lean Six Sigma
2. Meanings of Lean and Six Sigma
3. General History of Lean Six Sigma
4. Lean Six Sigma Projects
5. DMAIC
6. PDCA
7. Kaizen and Kaizen Events
8. Root Cause Analysis
9. Voice of the Customer, and Business
10. Lean Six Sigma Belt Roles
11. Defining a Process
12. Critical to Quality Characteristics (CTQs)
13. Cost of Poor Quality (COPQ)
14. Pareto Analysis
15. Basic Lean Six Sigma Metrics
16. Selecting Lean Six Sigma Projects
17. Problem Statements
18. Building a Business Case & Project Charter
19. Project Metrics
20. SIPOC
21. The 8 Elements of Waste
22. 5S
23. Lean Thinking
24. Kanban
25. Poka-Yoke (Mistake Proofing)
26. Process Definition
27. Cause & Effect / Fishbone Diagrams
28. Process Mapping, SIPOC, Value Stream Map
29. Failure Modes & Effects Analysis (FMEA)
30. Six Sigma Statistics
31. Basic Statistics
32. Use of Excel , Minitab and Sigma XL
33. Descriptive Statistics
34. Normal Distributions & Normality
35. Graphical Analysis
36. Histograms
37. Box Plots
38. Measurement System Analysis
39. Precision & Accuracy
40. Bias, Linearity & Stability
41. Gage Repeatability & Reproducibility
42. Variable & Attribute MSA
43. Process Capability
44. Capability Analysis
45. Concept of Stability
46. Attribute & Discrete Data
47. Hypothesis Testing
48. Hypothesis Testing Uses
49. Practical vs. Statistical Significance
50. Alpha & Beta Risk
51. p-values
52. Types of Hypothesis Test
53. Hypothesis Testing with Normal Data
54. 1 & 2 sample t-tests
55. Hypothesis Testing with Non-Normal Data
56. Mann-Whitney
57. Simple Linear Regression
58. Correlation
59. Regression Equations
60. Non- Linear Regression
61. Multiple Linear Regression
62. Confidence & Prediction Intervals
63. Designed Experiments
64. OFAT
65. Full Factorial Experiments
66. Full Factorial Designs
67. Statistical Process Control (SPC)
68. Data Collection for SPC
69. I-MR Chart
70. X-bar-R Chart
71. U Chart
72. P Chart
73. NP Chart
74. X-S chart

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Class Schedule

Day 1

- What is Lean Six Sigma ?
- 8 Wastes
- 5S
- Voice of the Customer (VOC) and CTQs Process
- Mapping, Value Stream Mapping

Day 2

- Pull, Kanban and Flow
- Visual Management
- Poka Yoke
- Standardized Work
- SMED
- Kaizen / Kaikaku
- **Define Phase**
- Problem and Project Selection and Definition
- Business Case Project Charter
- **YELLOW BELT EXAM (as Homework)**

Day 3

- **Measure Phase**
- **Introduction to SigmaXL**
- Fishbone Diagram, Pareto Charts
- FMEA
- Six Sigma Statistics
- Measurement System Analysis

Day 4

- Process Capability
- **Analyse Phase**
- Correlation and Regression Analysis
- Introduction to Design of Experiments (DOE)

Day 5

- Hypothesis Testing
- **Improve Phase**
- **Control Phase**
- Control Plans
- Statistical Process Control (SPC)
- Control Charts
- **Revision and Rework of Mock Exam Questions**
- **GREEN BELT EXAM (In own time)**

WHAT IS

LEAN SIX SIGMA?

Lean Six Sigma Timeline



Guinness Brewery



Walter Shewhart

Introduces SPC Statistical Process Control



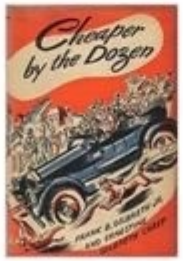
W. Edwards Deming

Joseph Juran

1900 1930 1950



Ford Assembly Line



Gilbreth,
•Management Theory
•Industrial Engineering



Toyota Production System

Taiichi Ohno
Shigeo Shingo
Kaoru Ishikawa

Lean Six Sigma Timeline



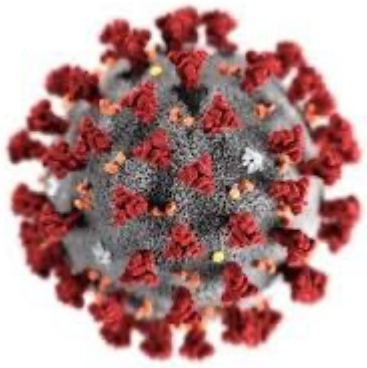
Lean Six Sigma Timeline

Shift in Focus

2008 Financial Crisis

Covid-19





Cost Cutting
Automation
Down-sizing
'*Do More with Less*'

Survival
Innovation
Adapting
Re-structuring
Re-designing

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Influential Leaders in Lean Six Sigma Principles

The evolution of Lean Six Sigma was heavily influenced by American and Japanese engineers, statisticians and quality control experts 1950-1980.



Walter Shewhart
(SPC and Control Charts)



W. Edwards Deming
(Quality Management
PDCA Plan, Do, Check, Act)



Joseph Juran
(Quality Planning, Quality Improvement
Quality Control)



Taiichi Ohno
7-Wastes, Gemba-Walk



Shigeo Shingo
SMED, Poka Yoke

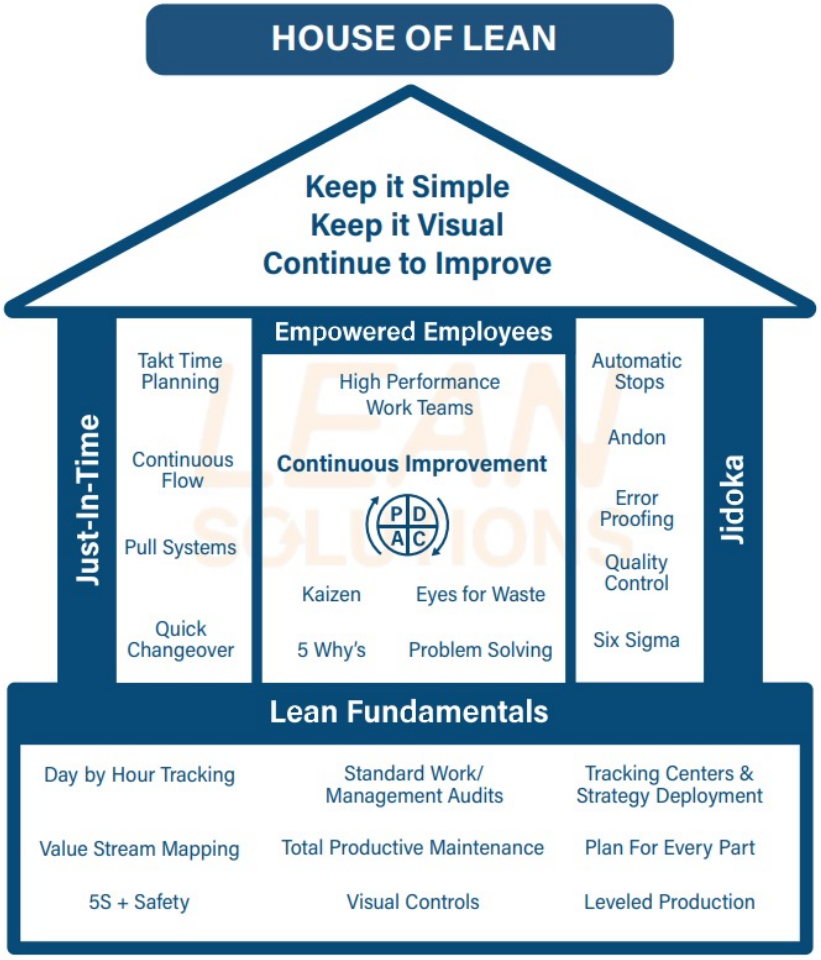


Lillian Gilbreth
Process Flow
Ergonomics



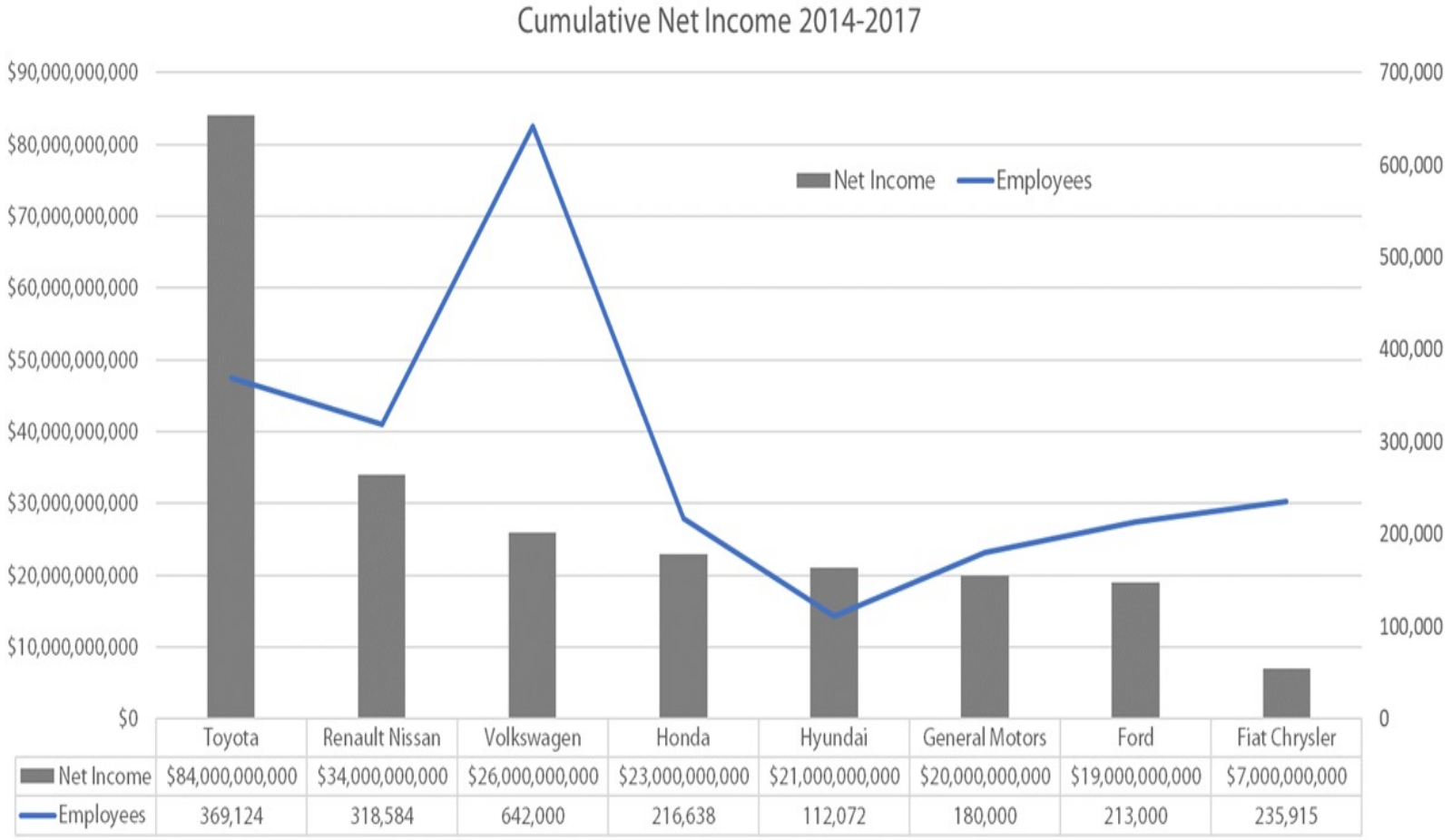
Kaoru Ishikawa
7-Quality Tools

Toyota Production System (TPS)



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Superiority of the Toyota Production System (TPS)



	Toyota	Renault Nissan	Volkswagen	Honda	Hyundai	General Motors	Ford	Fiat Chrysler
Net Income	$84,000,000,000	$34,000,000,000	$26,000,000,000	$23,000,000,000	$21,000,000,000	$20,000,000,000	$19,000,000,000	$7,000,000,000
Employees	369,124	318,584	642,000	216,638	112,072	180,000	213,000	235,915

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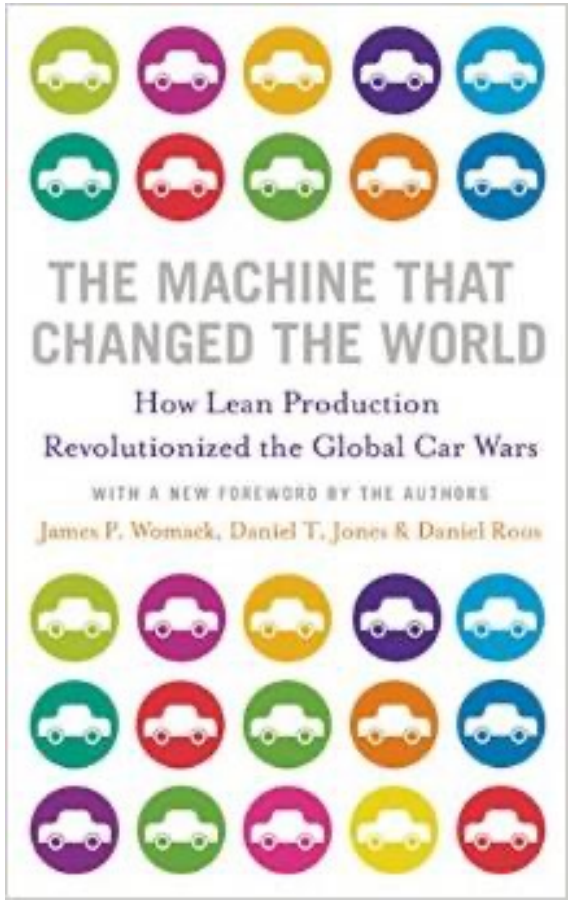
Data Source: Yahoo Finance

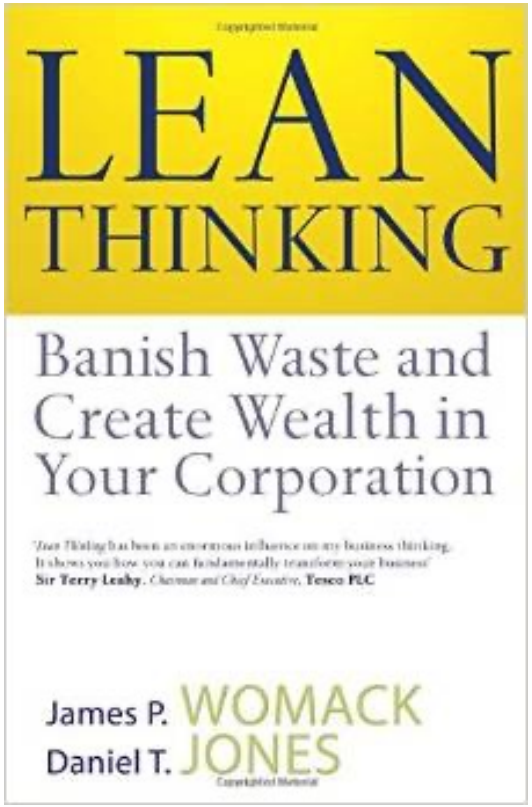
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"The Machine that Changed the World" 1990





"Lean Thinking" (1993)

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Origins of Six Sigma : Motorola and General Electric (GE)



Bob Galvin : CEO of Motorola 1980's

MOTOROLA
intelligence everywhere



1985 Bill Smith coins the term "Six sigma"



1987 Motorola trademarks the term "Six Sigma"



Jack Welch : CEO of GE 1981-2001

Jack Welch (CEO) made Six Sigma the management and corporate culture of General Electric 1981 – 2001.

- Every manager was trained as at least To Green Belt level.
- During his tenure at GE, the company's value rose 4,000%.

Why is it called Six Sigma ?

σ, *sigma*

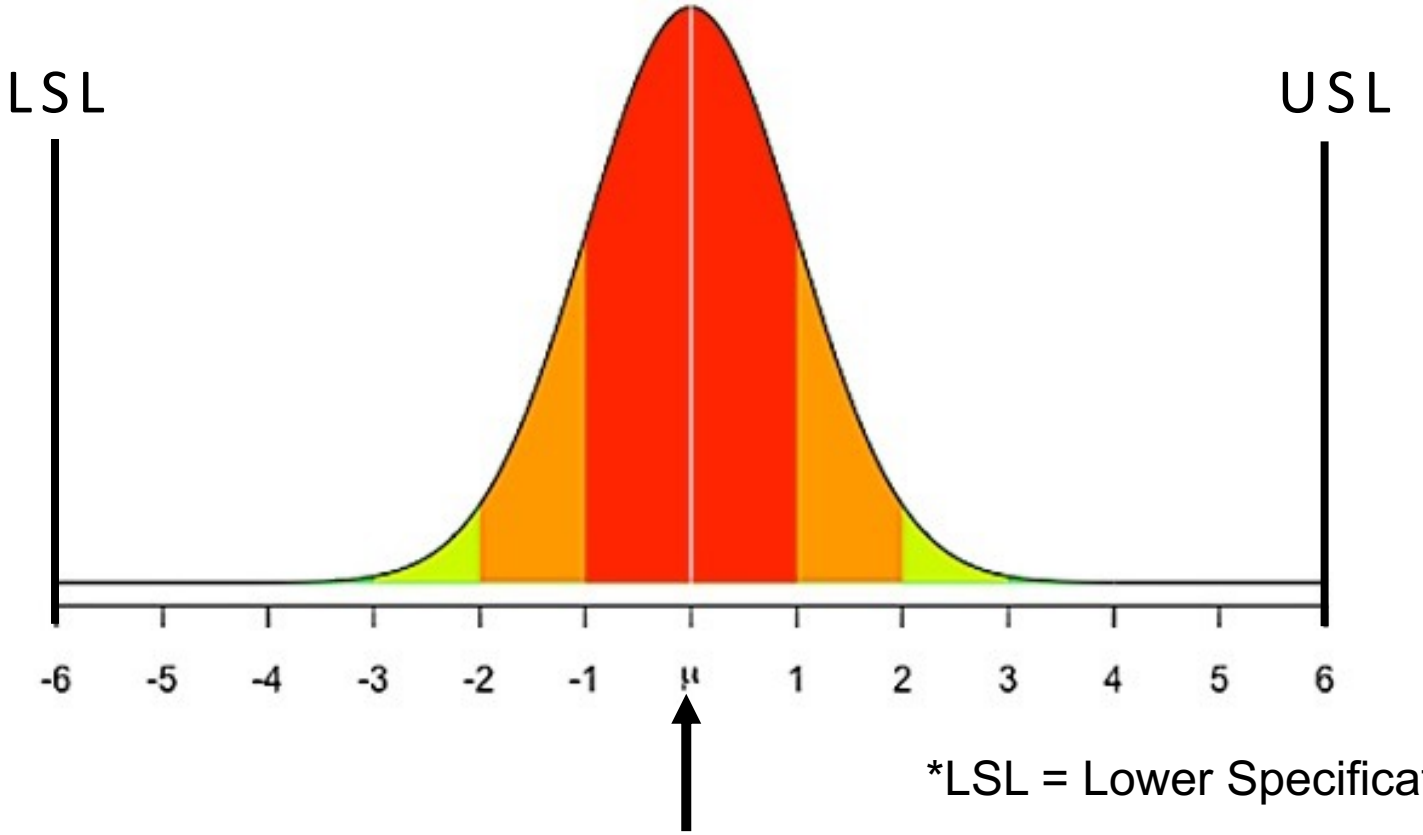
'Sigma' is a Greek Symbol to signify the mathematical concept called **Standard Deviation** . This is an important measure of **Variation** in a process.

$$\sigma = \sqrt{\frac{\sum_{i=1}^{N} (X_i - \mu)^2}{N}}$$

You don't need to remember or even
To understand this equation…
Its just 'behind the scenes' !!



Six Sigma refers to a process having 6 Standard Deviations (Sigmas) between the mean average of the process (center) and the closest customer specification limit.



*LSL = Lower Specification Limit

*USL = Upper Specification Limit

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Defects vs Process Sigma Level

Process Sigma Level	Defects per Million Opportunities (DPMO)
1	691,500
2	308,500
3	66,800
4	6,200
5	233
6	**3.4**

DPMO = Defects per Million Opportunities (for Defects)

DEFINITION :
A "Six Sigma Process" is one that produces no more than 3.4 defects per million opportunities for defects

3.4 DPMO

A "Six Sigma Process" is often described one that produces no more than
3.4 Defects Per Million Opportunities for defects

3.4 DPMO (Defects Per Million Opportunities)

0.00034 % Defects

99.99966 % Correct

What is a 0.1% Defect Rate look like ?

What is 99.9% Quality ?
0.1 % Defects

- 1 unsafe plane landing per day at JFK
- 100 wrong drug prescriptions per day in US
- 10,000 Houses without electric / day in US
- 100,000 wrong bank transfers per day
- 1 million e-mails sent incorrectly per day

This is why we need Six Sigma processes !

3-Star Manufacturing Inc.

What are the possible Defects ?

- **Shapes**
- **Colours**
- **Size**
- **Concentric**



What Defect Rate is acceptable ?

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Lean and Six Sigma COMPLIMENT each other

Lean can work alone



Six Sigma can work alone



Lean Six Sigma



They Perfectly Complement Each Other !!

Lean Principles

1. Understand the **value** in the product or service
2. Identify the **value stream** in each product or service
3. Make the product or service **flow**
4. **Pull** value from the downstream (just in time delivery)
5. Continuous Improvement towards **perfection**
6. Involve workers and **respect workers** opinions

NOTE: *Only the first 5 Lean Principles were taught. Many books and videos still refer to the '5 Lean Principles'*

**Source: Lean Thinking by James P. Womack and Daniel T. Jones*

Six Sigma Principles

1. Reduce Variation and you will reduce Defects / Errors
2. Root Cause Analysis of problems (RCA)
3. Use Data for Decision making (instead of guessing !)
4. Use of Statistical Analysis tools and charts
5. Process Optimization using Designed Experiments and Regression Analysis, Predictive Modelling. Hypothesis Tests
6. Improvement projects using the DMAIC Framework

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We use Lean Six Sigma for ....

PROCESS IMPROVEMENT

Increase Value

Traditional View of Our Processes

Inputs

Raw Materials
Raw Data
Manpower
Energy

Operations

Outputs

Finished Goods
Refined Materials
Information
Services
etc

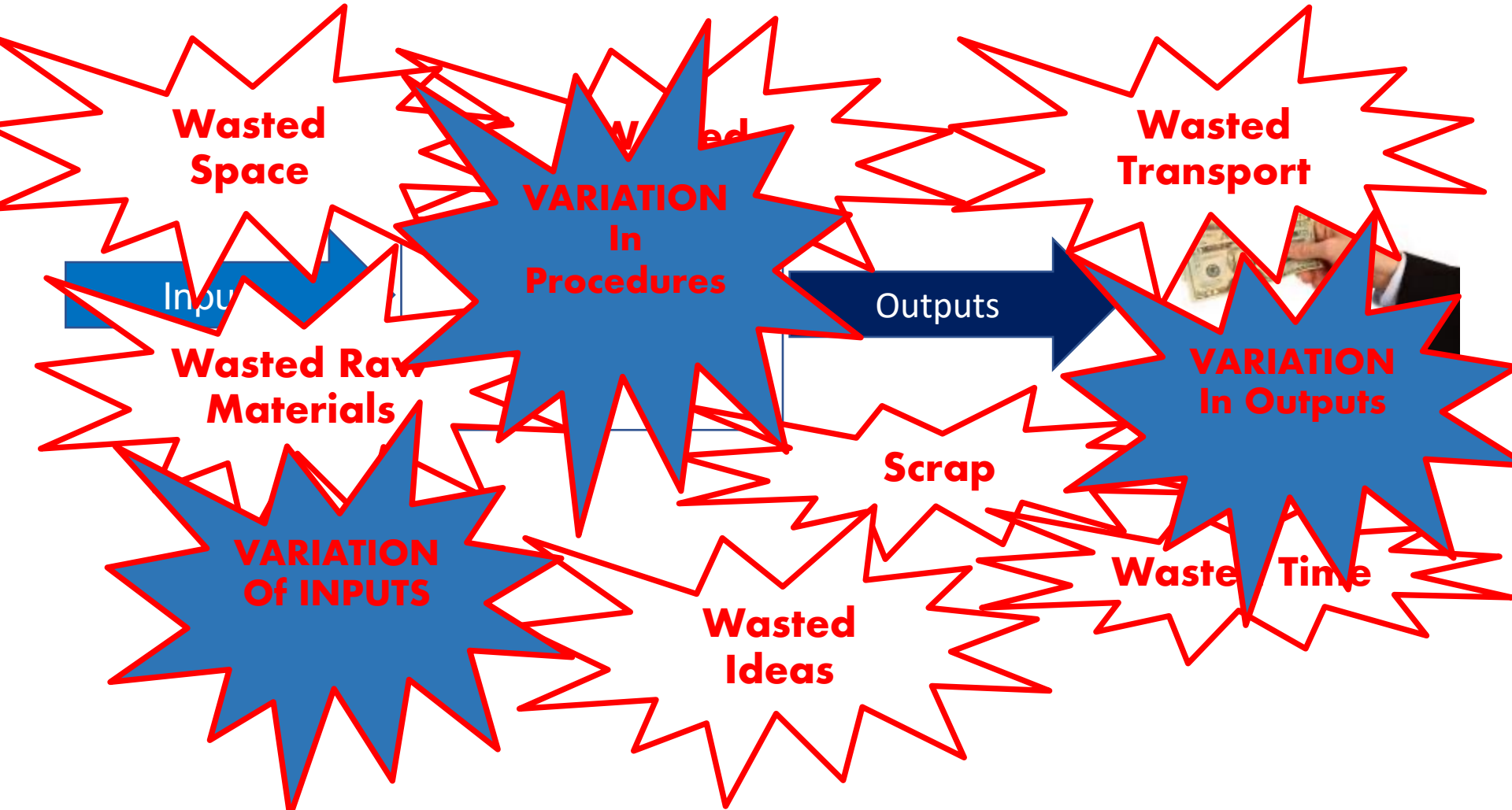


Customer

Lower Value → **Higher Value**

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What our processes actually look like



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3-Star Manufacturing Inc.

Perfect for Cake Decorations

- **3 Star Shapes**
- **3 different Colors**
- **3 different Size Stars**
- **Concentric Shapes**



- **Target Weight = 10 grams**
- **Upper Specification Limit = 12 grams**
- **Lower Specification Limit = 8 grams**

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ROLL → WEIGH → FLATTEN → CUT → ASSEMBLE → WEIGH







<u>Roll Ball</u>

Small : 8 to 12 grams Target = 10 grams

Medium : 13 to 17 grams Target = 15 grams

Large : 18 to 22 grams Target = 20 grams

Everything is a process

Inputs

What do we need to create Value for Customers ?

Hint **: The '4 M' rule**

M A T E R I A L S

M A N P O W E R

M A C H I N E S

M E T H O D

Inputs

What do we need to create Value ?

Examples of Inputs in your work (Which 'M' is it ?) :

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

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Operations



Transforming the Inputs into Outputs (Operations)

Examples of Operations at your company :

1. _____
2. _____
3. _____
4. _____

Outputs

What your Customer wants (Outputs)

The 'TOP 5' Outputs at your company :

1. _____

2. _____

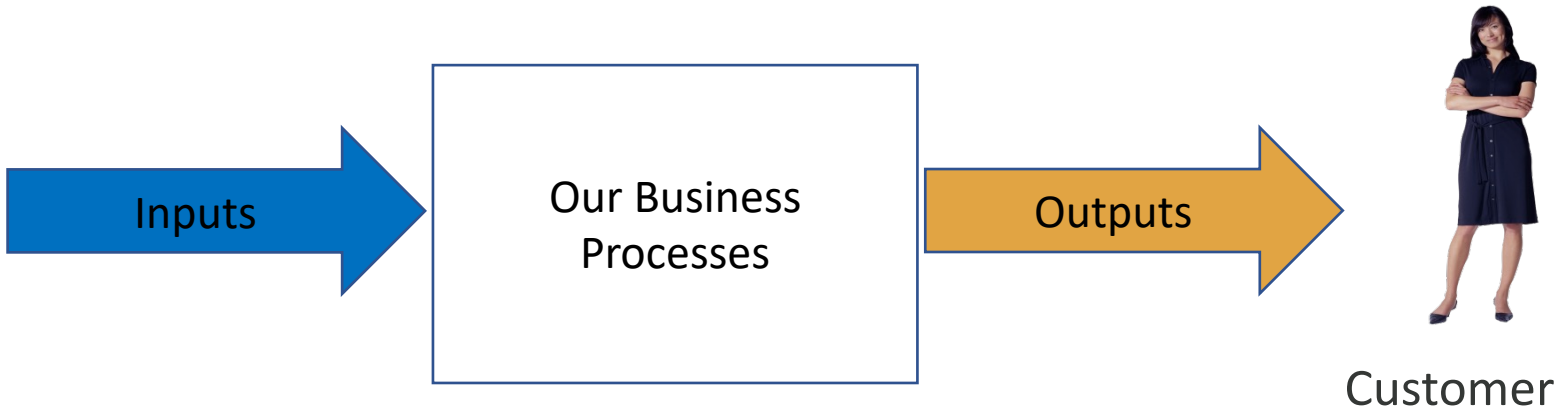
3. _____

4. _____

5. _____

Increase Value

Lower Value → Higher Value



- Safer
- Easier
- Better Quality (less defects and rework)
- Faster (on time)
- Lower Cost

What did Shigeo Shingo say about this ?



Shigeo Shingo : 1909 - 1990

- '*There are four purposes of improvement:* ***easier, better, faster, and cheaper.*** *These four goals appear in order of priority. Hence the first is to make the work easier for workers while improving the fruits of their labour.'*
- *'Intensifying the work should never be undertaken even if the same working hours are maintained.'*

Non-Stock Production : The Shingo System of Continuous Improvement', (1988)

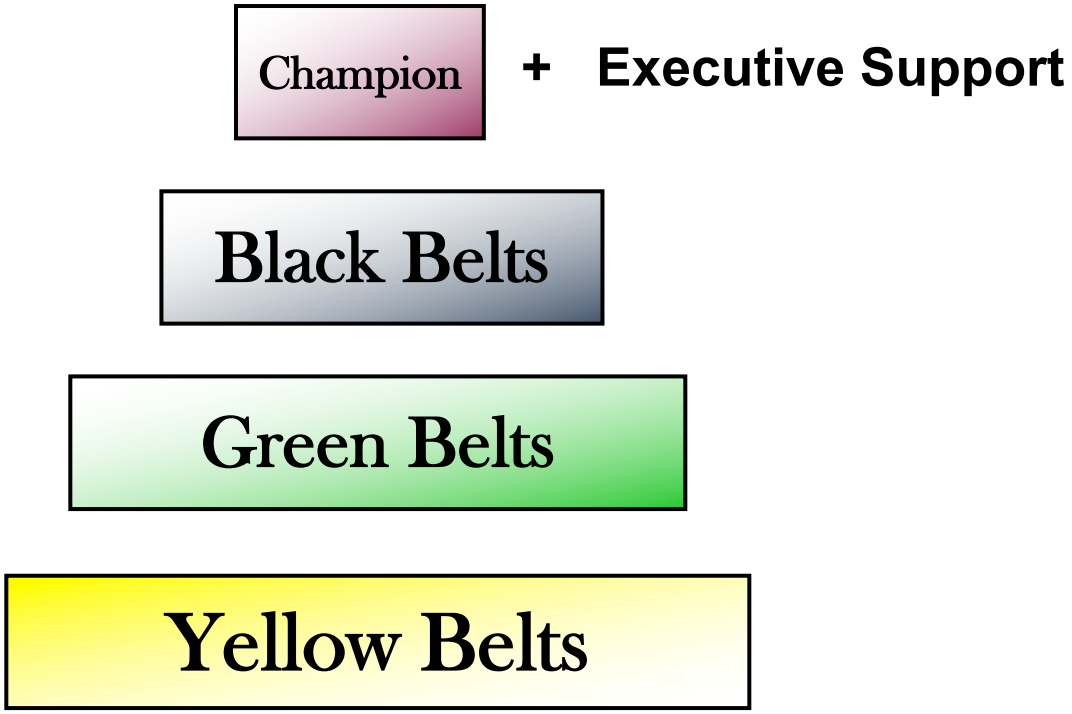
Shigeo Shingo was a primary architect in the development of the Toyota Production System.

SQDC

1. Easier and **Safer** for workers (S)
2. Produce Better **Quality** Outputs for customers (Q)
3. **Deliver** the Outputs on Time (D)
4. Lower the **Cost** of Production (C)

The **SQDC** model of Production

Lean Six Sigma Roles and Responsibilities



Champion/Process Owner

Champions help to identify and select the most important projects to work and break down political barriers / roadblocks for Lean Six Sigma to succeed

- Assist with Project selection and initiation
- Obtain needed project resources and eliminate roadblocks
- Participate in project review meetings
- Provide Governance / Ask the right questions
- Set up a training programs

Black Belt



Black Belts are Lean Six Sigma process experts, think strategically and lead larger projects within the business.

- Approx 1 Black Belt every 50 - 100 employees (1 %)
- Dedicated to process improvement 100% of time
- Project team leader for larger / high profile projects
- Facilitates DMAIC teams and helps Green belts
- Thinks strategically and towards Enterprise level goals
- Works cross-functionally

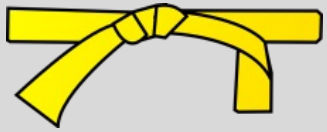
Green Belt



Green Belts are practitioners of Lean Six Sigma improvement and lead small/medium projects or support larger Black Belt Projects.

- Approx 1 Green Belt for every 10 - 30 employees (5 %)
- Involved approx 50% time on projects
- Typically works projects within their Functional Area
- Team members for larger projects
- Team leaders for small / medium projects

Yellow Belt



Yellow Belts are Workers and Functional Specialists and apply the Lean Six Sigma Methodology to their own work and serve on project teams on a part-time basis.

- As many as possible (target is 100% of workers)
- Functional workers, Subject Matter Specialists. Team members
- Provide support to Black Belts and Green Belts as needed
- Team members on DMAIC teams
  - Supporting projects with process knowledge and data collection

Summary

At this point you should be able to:

- Describe the goals of our process improvement
- Understand the origins of Lean and Six Sigma
- Describe the principles of Lean
- Describe the principles of Six Sigma
- Describe the defined roles of Lean Six Sigma belts

Quiz 1 :

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- What was the name of the first company to use the name 'SIX SIGMA' to describe its Quality Management System.
- **MOTOROLA**

- What is the First Principle of Lean production ? What is the most important thing that a Lean process must produce ?
- **VALUE** (for the customer of the process)

- Which Japanese company is considered as being the first to use true 'Lean Production' effectively and successfully ?
- **TOYOTA**

- A basic principle of Six Sigma is to always find the true original source of a defect or problem. This is called _____?
- **ROOT CAUSE ANALYSIS**

- A "Six Sigma Process" is often described one that produces no more than 3.4 DPMO What does DPMO stand for ?
- **DEFECTS PER MILLION OPPORTUNITES FOR DEFECTS**

What is the role of a Yellow Belt on a Lean Six Sigma project?

A YELLOW BELT IS A TEAM MEMBER WHO ASSISTS A GREEN OR BLACK BELT, USING THEIR KNOWLEDGE OF THE PROCESS THAT THEY CURRENTLY ARE WORKING WITHIN.

What is the role of a Green Belt in an organisation ?

A GREEN BELT IS A PROJECT TEAM LEADER FOR SMALL AND MEDIUM SIZED PROCESS IMPROVEMENT PROJECTS.

What is the role of a Black Belt in an organisation ?

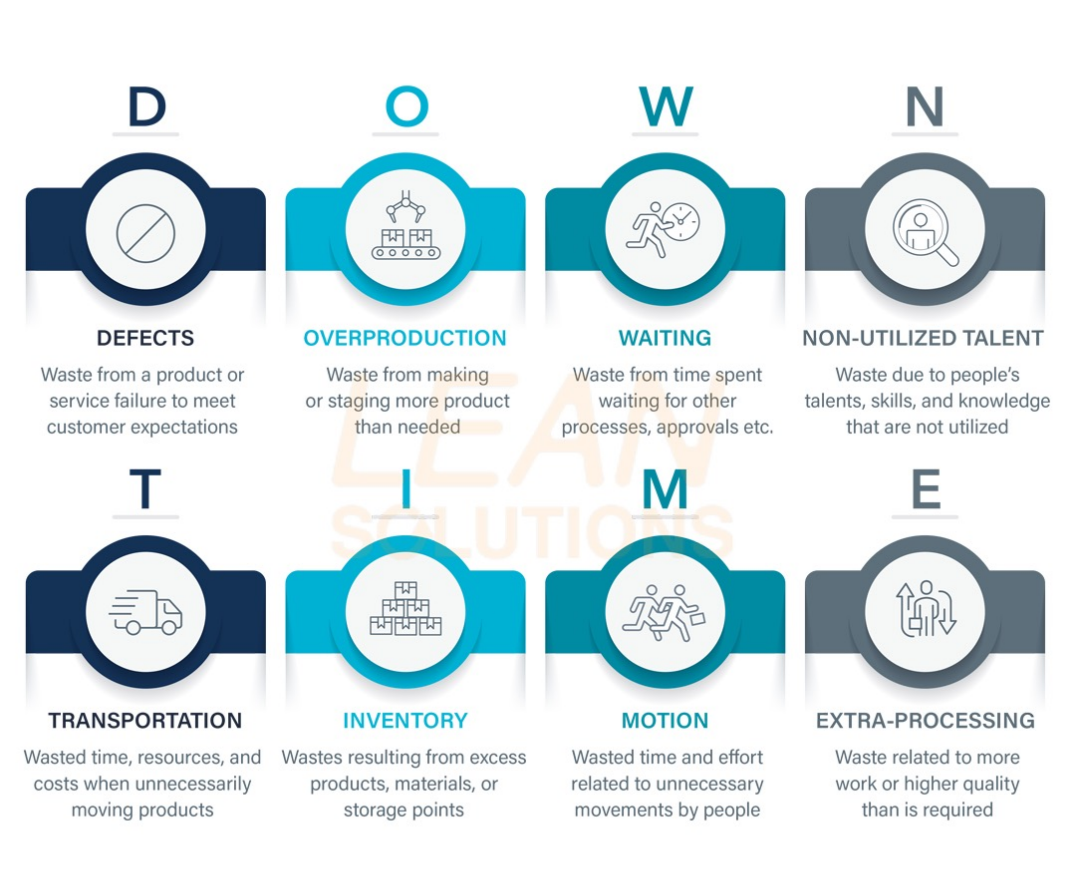
A BLACK BELT IS A PROJECT TEAM LEADER FOR LARGE PROBLEM SOLVING / IMPROVEMENT PROJECTS or OVERSEES THE WORK OF GREEN BELTS FOR MULTIPLE PROJECTS. A BLACK BELT IS A FULL TIME PROBLEM SOLVER FOR THE ORGANISATION.

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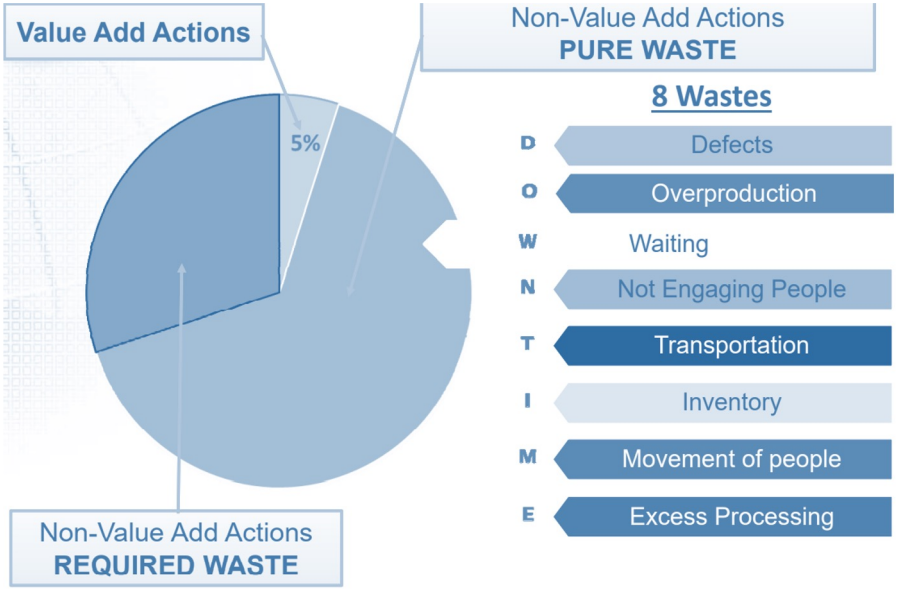
Recognizing Waste



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CATEGORIES
OF ACTION



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SOLUTIONS



WASTE
WALK

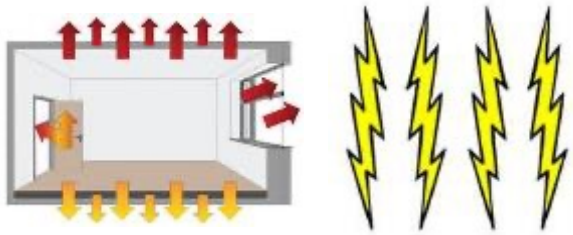
A planned visit to where work is being performed to observe what's happening and to note the waste.

- Explain to the people in the area of observation what you are doing.
- Study the area for 20-30 minutes.
- As you see work that appears to be waste, jot down the example you see.
- Take action immediately if possible or develop a plan to remove waste

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Other 'Non-Traditional 'Categories of Waste



Utility / Energy (Heat / Electrical) losses



Mis-Communications



Over - Communications



Skilled Staff Losses

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Where is the **Waste** ?

ROLL → WEIGH → FLATTEN → CUT → ASSEMBLE → WEIGH









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Quiz 2:

- Which of the traditional 8-Wastes of 'DOWNTIME is concerned with reducing the complexity of processes and taking out unnecessary steps or activities ?
- **Non-Essential Processing / Over Processing**

- What is the name of the Waste of producing more that the customer demand can absorb ?
- **Over-Production**

- What is Waste called when an activity or step in process needs to be repeated because it was not done 'Right-First-Time' ?
- **Rework / Defects**

- What Waste results in Queues or Backlogs of materials or work ?
- **Waiting (due to a Bottle-next in the process)**

- What is the Japanese word for 'Waste' ?
- **MUDA**



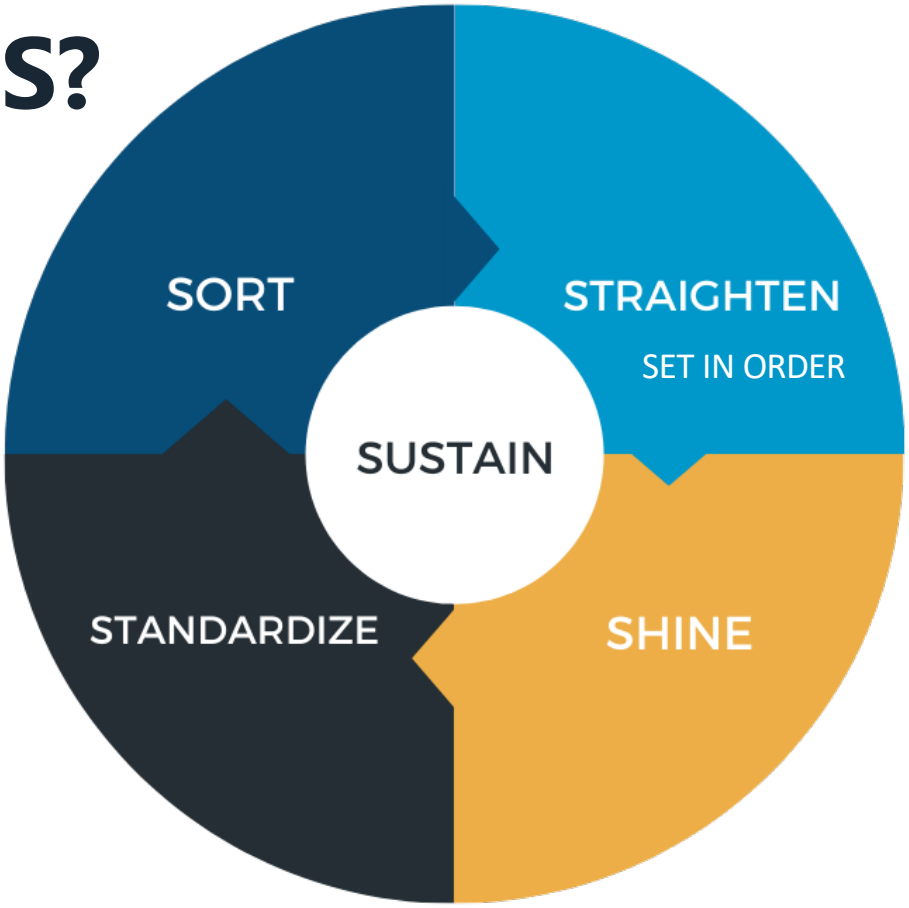
5S

Continuous Improvement
should not be just an event.

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WHAT IS 5S?



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WHY 5S?

Workplace Organization and Visual Management Fundamental to Your Facility

- SAFER!
- Problems Become Visible
- Promotes culture

Result: Improved Safety, Quality and Cost

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FIND A FLATHEAD SCREWDRIVER



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FIND A FLATHEAD SCREWDRIVER



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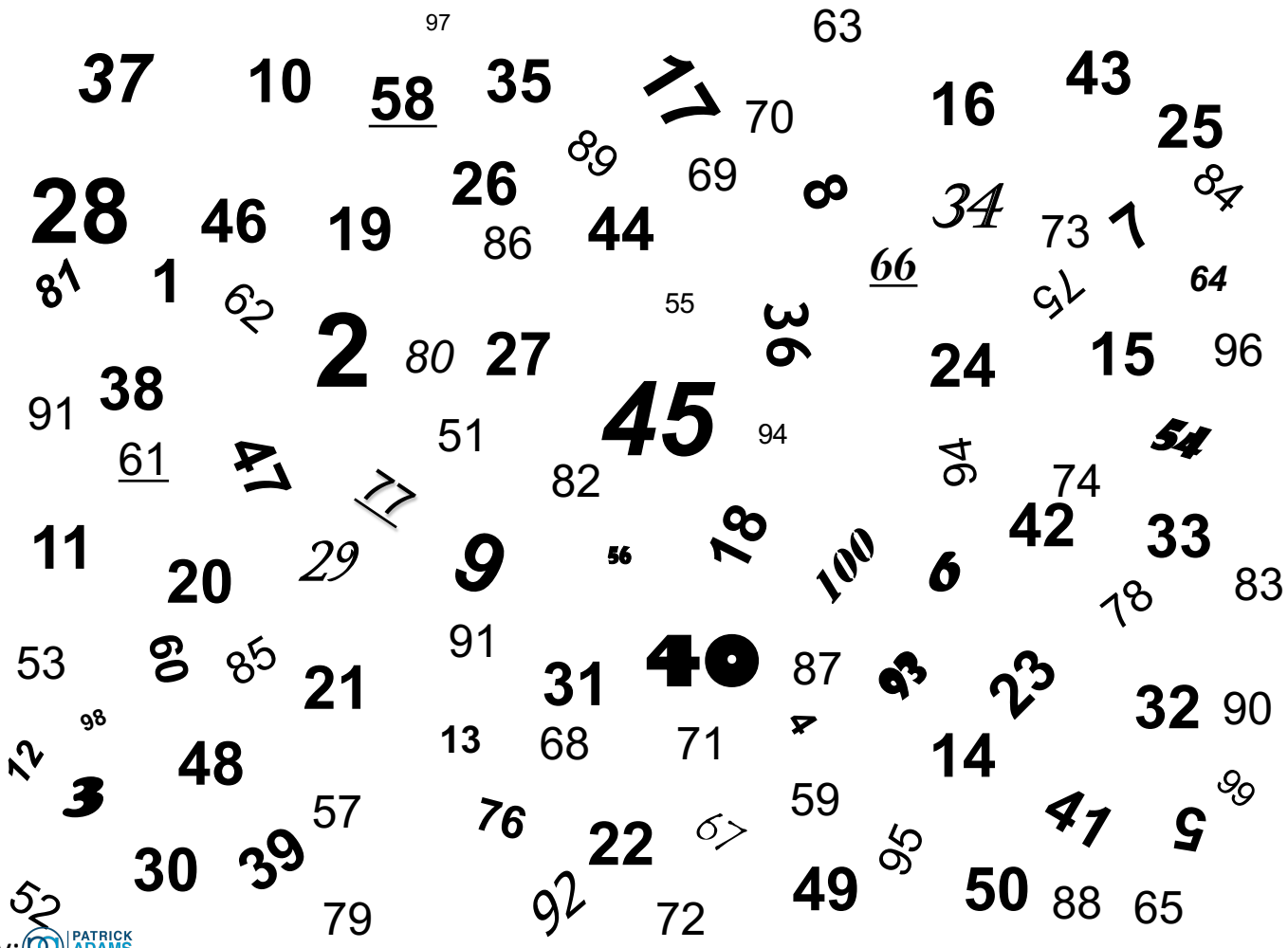
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EXERCISE #1

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SOLUTIONS



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SORT

- Critically examine everything
- Red Tag Process
  - Always use-Have a place for it
  - Sometimes use-Tag and Date
  - Never use-Red tag area
- Need a 6mm Hex? Keep only the 6mm Hex, not a whole set
- Members know best what is needed
- Everything in the area should have a purpose





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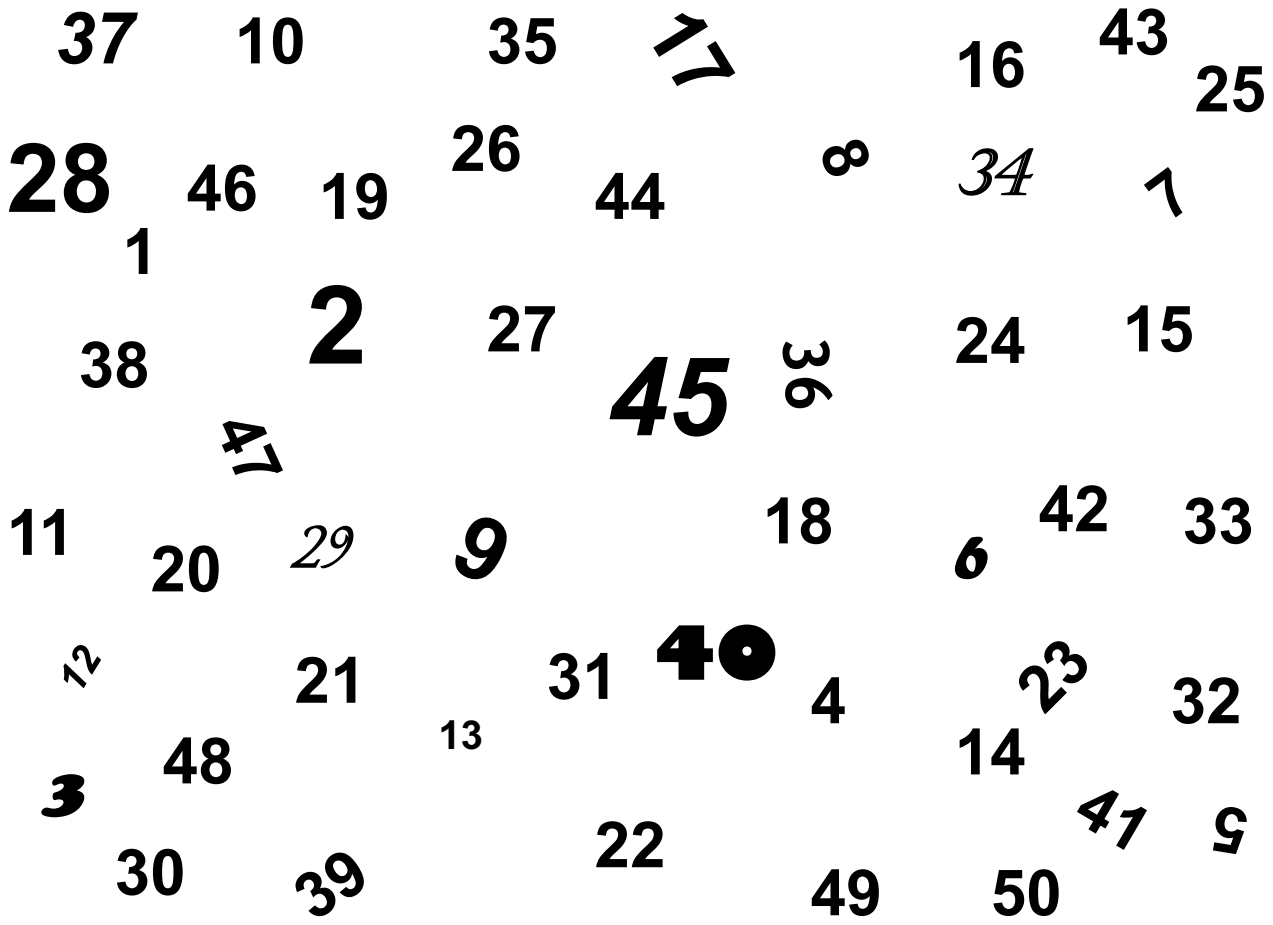
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EXERCISE #2

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STRAIGHTEN or SET IN ORDER

- For what's left, where does it go?
- Be mindful of frequency of use and how much is used
- Be Visual
- Arrange so things are easy to find and readily retrieved.
- "A place for everything and everything in it's place."

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SHINE

- Clean the area (tools, equipment, lighting, etc.)
- Re-painting may be required
- Implement regular housekeeping so that any dirt or grease is immediately obvious.
- Always use your 5S Color Standards

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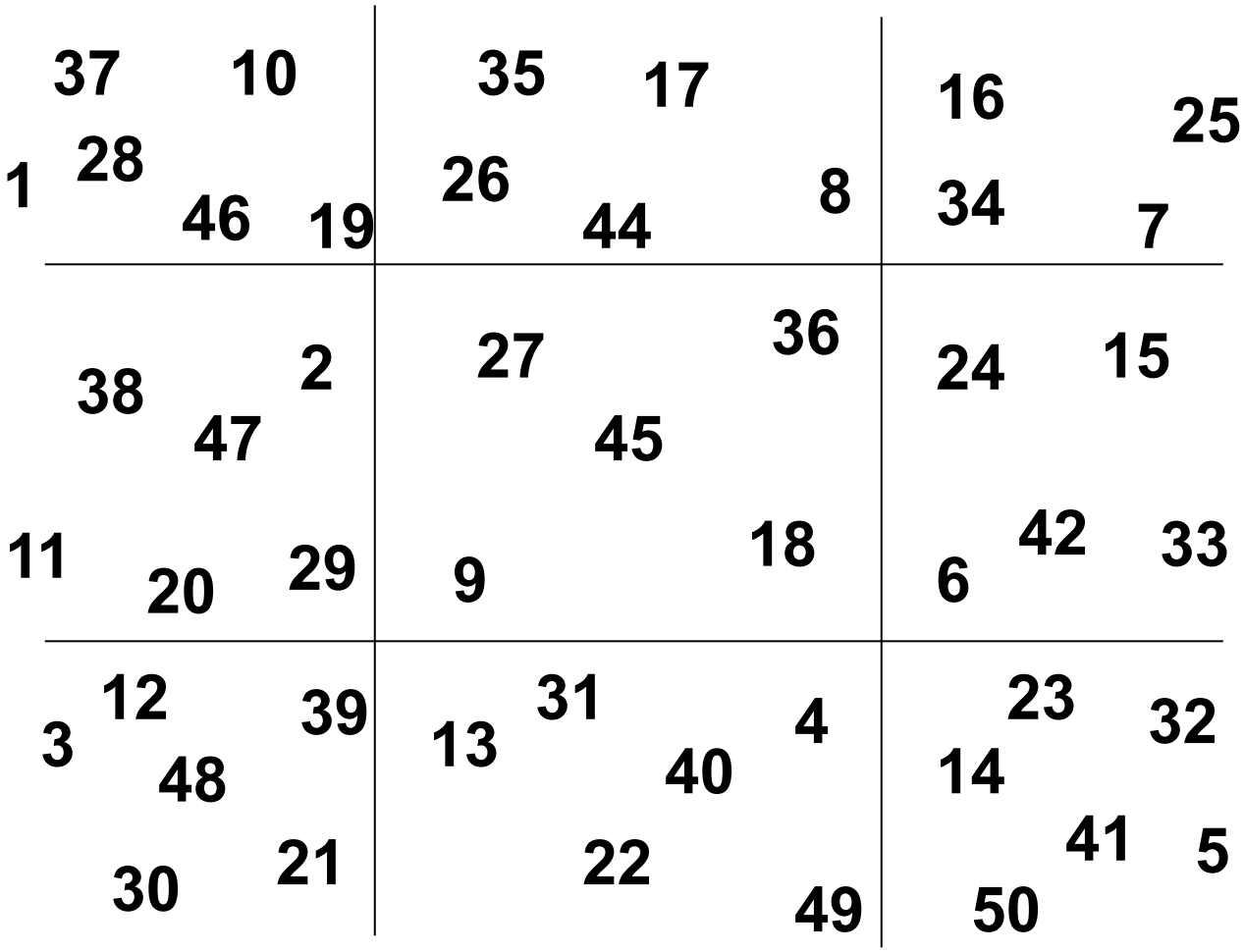
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EXERCISE #3

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STANDARDIZE

- Implement Work Center 5S Board
- Take a picture of the area
- Assign an area owner
- Develop standard work for regular housekeeping
- Implement Daily End of Shift Checks

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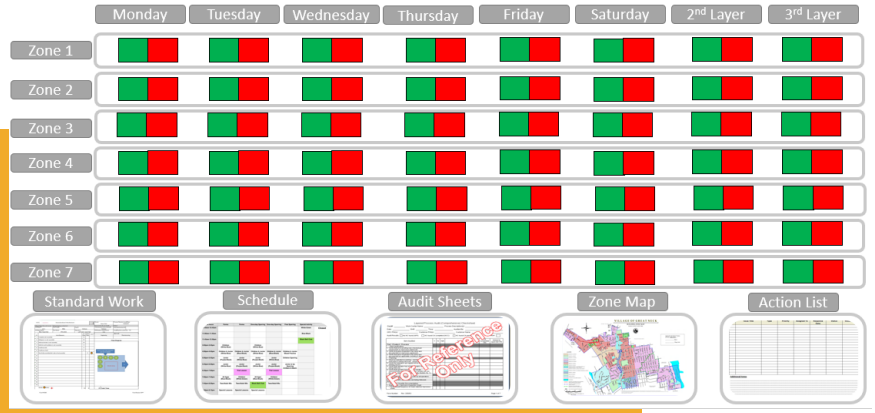
EXERCISE #4

LEAN
SOLUTIONS

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50

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SUSTAIN

- Implement Layered Process Audit

  in order to sustain improvements

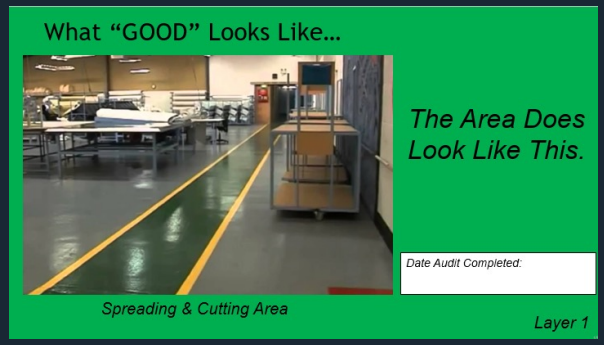
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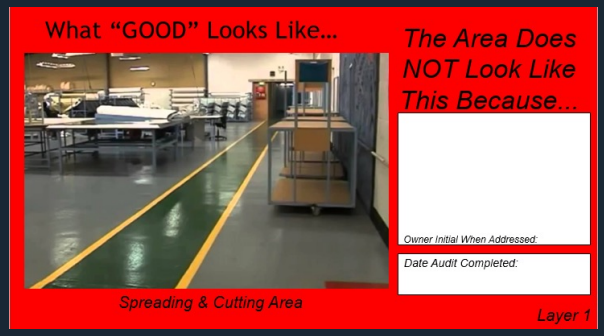
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SUSTAIN

LAYER 1 AUDIT

- Layer 1 audits are completed daily by team leaders based on a posted schedule
- Area owner is responsible for any red items on Layer 1.
- Layer 1 checks that the area matches the picture and the work center 5S board is being completed





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SUSTAIN

LAYER 2 AUDIT

- Layer 2 audits completed by the area Supervisor one time per week.
- The Layer 2 audits are specifically auditing audit completion to schedule.
- The area Supervisor is responsible for any red items in Layer 2.



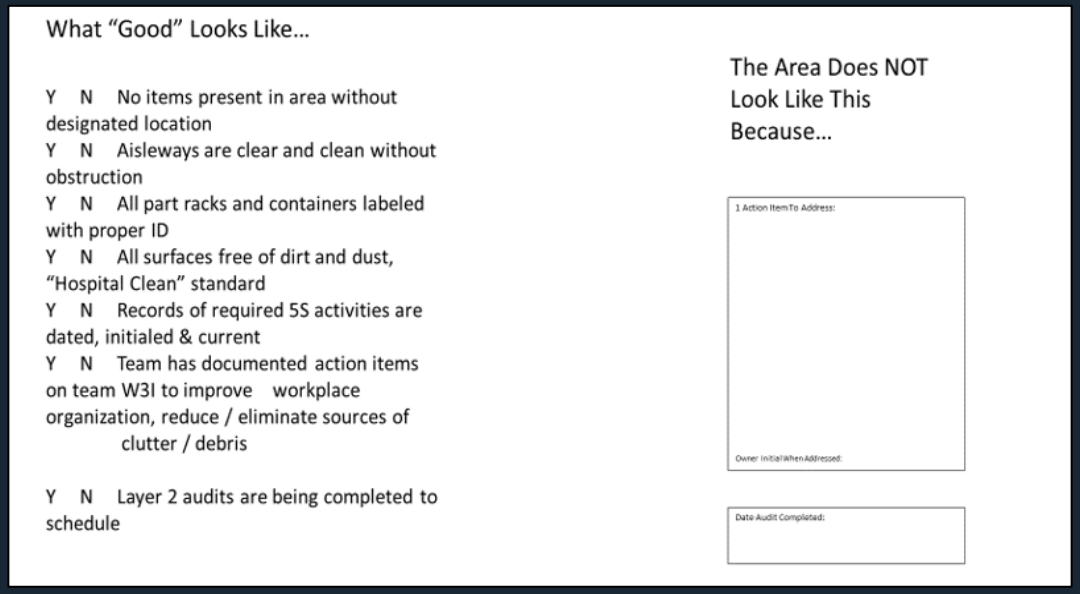


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SUSTAIN LAYER 3 AUDIT

Layer 3 audits are completed by the Operations Manager or Plant Manager once per month.



What "Good" Looks Like...

Y N No items present in area without designated location
Y N Aisleways are clear and clean without obstruction
Y N All part racks and containers labeled with proper ID
Y N All surfaces free of dirt and dust, "Hospital Clean" standard
Y N Records of required 5S activities are dated, initialed & current
Y N Team has documented action items on team W3I to improve workplace organization, reduce / eliminate sources of clutter / debris

Y N Layer 2 audits are being completed to schedule

The Area Does NOT Look Like This Because...

1 Action Item To Address:

Owner Initial When Addressed:

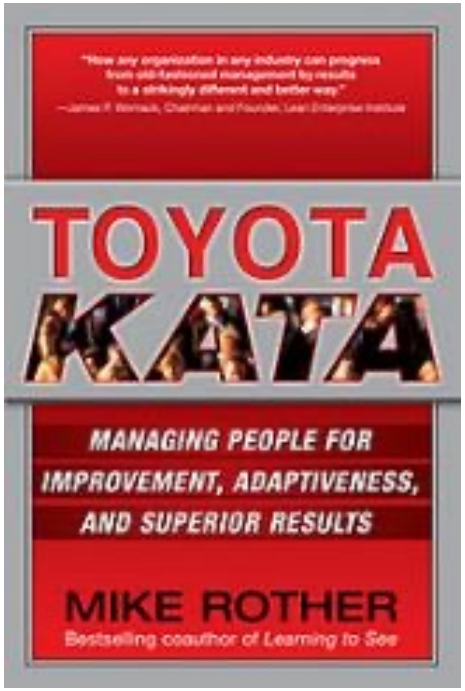
Date Audit Completed:

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Kata for Sustain

"A routine that is practiced so that it becomes second nature"



TOYOTA KATA by Mike Rother
(Lean Enterprise Institute)

https://www.youtube.com/watch?v=F6mhirDTLpA



TOYOTA KATA
What is the Improvement Kata?

Lean Enterprise Institute
lean.org/kata

&

MICHIGAN ENGINEERING
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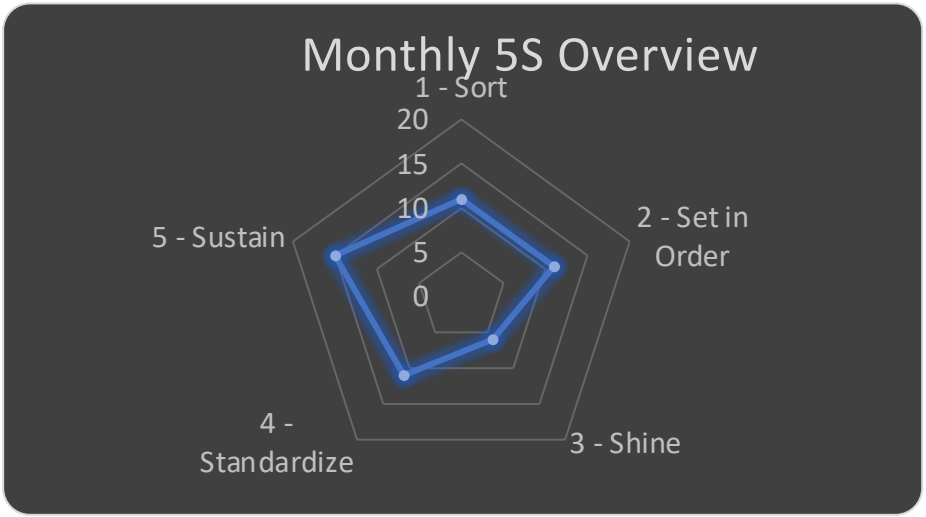
5S Audit & Results

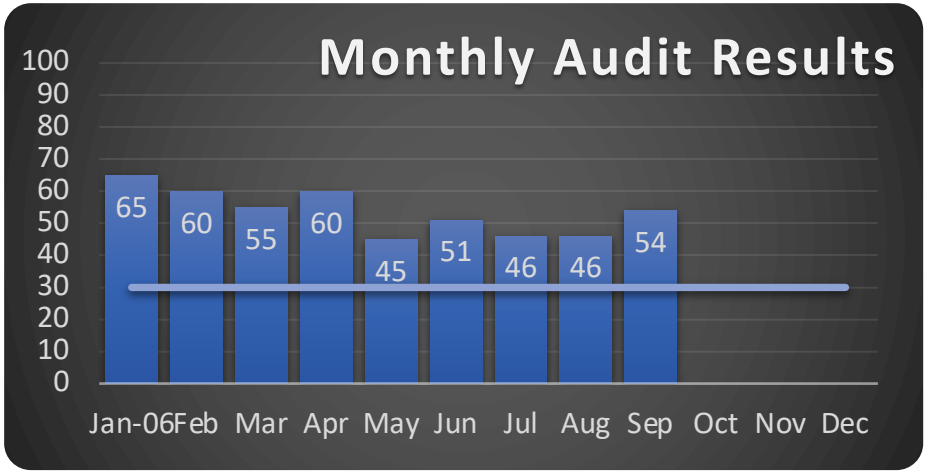
5S Workplace Scan Checklist

Department: | Date: | Scored By: | Place an "x" in the appropriate box based on number of issues observed.

		Number of Observations >>	0	1-2	3-4	5-6	>6
Sort	**Distinguish between what is needed and not needed**						
	1	Unneeded equipment, tools, furniture, etc. are present			x		
	2	Unneeded items are on walls, notice boards, etc			x		
	3	Items are present in walkways, stairways, corners, fire exits etc.				x	
	4	Unneeded inventory, supplies, parts, or materials are present				x	
	5	Safety hazards (water, oil, chemical, machines) exist		x			
		Subtotal >>	0	1	4	6	0
Set in Order	**A place for everything and everything in it's place**						
	1	Correct places for items are not obvious			x		
	2	Items are not in their correct places			x		
	3	Walkways, workstations, equipment locations are not indicated				x	
	4	Items are not put away immediately after use				x	
	5	Height and quantity limits are not obvious		x			
		Subtotal >>	0	1	4	6	0
Shine	**cleaning, and looking for ways to keep it clean and organised**						
	1	Floors,walls stairs, and surfaces are free of dirt, oil, and grease			x		
	2	Equipment is not kept clean and free of dirt, oil, and grease			x		
	3	cleaning materials are not easily accessible		x			
	4	Lines, labels, signs, etc are not clean and unbroken	x				
	5	Other cleaning problems of any kind are present		x			
		Subtotal >>	0	2	4	0	0
Standardize	**Maintain and monitor the first three categories**						
	1	Necessary information is not visible			x		
	2	All standards are not known and visible			x		
	3	Checklist don't exist for all cleaning and maintenance jobs				x	
	4	All quantities and limits are not easily recognizable				x	
	5	How many items can't be located in 30 seconds		x			
		Subtotal >>	0	1	4	6	0
Sustain	**Stick to the rules**						
	1	How many workers understand the 5s principals					x
	2	How many times last week was daily 5s not performed					x
	3	Number of times that personal belongings are not neatly stored				x	
	4	Number of times job aids are not available or up to date				x	
	5	Number of times last week daily 5s inspection were not performed		x			
		Subtotal >>	0	1	0	6	8
		Total >>	0	6	16	24	8

Grand Total 5S Score	54





5S your computer hard/shared drive

5S Principle	Description
Sort	• Check all your files and software, and get rid of any that are unnecessary
Set In Order	• Organize your files and optimize the use of file folders • Keep in mind how often you need them and how much time you need to store them • Create specific shortcut icons for the most used files or programs
Shine	• Eliminate any files under deleted items, sent items and the recycle bin
Standardize	• Establish procedures for maintaining your computer 5S system
Sustain	• Include hard drives in 5S audits • Focus on how people maintain files and program organization, and the time they spend ding so

5S 3-Star Manufacturing Inc.



5S in your company (Discuss)

- What areas of your work could do with 5S ?
- Who do you need to get involved ?
- When are you going to try 5S ?

Quiz 3 :

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- Which stage of the 5S method is used to ensure that the workers have the good habits and discipline to continue the other 4S tasks.
- **SUSTAIN**

- In 5S the action of removing unnecessary tools, equipment and materials from the workspace is called _____.
- **SORT**

- Cleaning the workplace of dirt, dust and litter is called what in 5S ?

- **SHINE**

- Give one example of a 5S method used for **SET IN ORDER / STRAIGHTEN** ?
- **SHADOW BOARDS**
  RACKS
  COLOURED LABELS, FLOOR MARKING etc

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Lean Principles and Tools

Value

Remember the 6 fundamentals of Lean ?

1. Value 
2. Value Stream
3. Flow
4. Pull
5. Perfection

Who is your customer ?

In Lean Six Sigma …

- Value is always viewed “Through the eyes of the Customer”
  - Who is our customer ?
  - What is The Voice of our Customer (VOC) ?
  - What is Critical to Quality (CTQ) to our Customer ?

Who is your Customer ?

'Internal Customers' vs 'External Customers'

- An internal Customer could be a different department or operation. It could be the next downstream operation in the process.

- Can you name some different types of ' External Customers' ?

What is a CTQ?

Critical to Quality (CTQ's) are measures we use to capture VOC properly.

- Also referred to in some literature as :
  - CTC's – Critical to Customer
  - CTS's – Critical to Satisfaction
  - CTQC - Critical to Quality Characteristics

- CTQ's are a tool to help to break down VOC into well defined and measurable terms.

Defining CTQs

Customer CTQs usually fall into one of 4 categories :

1. ***Functions and Features***
   - Does the product or service provide what the customers expect and need?
   - Is the right colour, texture, taste, variety available ?
2. ***Reliability and Quality***
   - Does the customer experience or find defects in the product or service?
   - Is there consistency in your product or service ?
   - Can they trust your product not to break down ?
3. ***Delivery Speed / Responsiveness***
   - Does the process meet the customer's time frame for delivery ?
   - Is the customer always able to obtain the product or service when they need it ?
4. ***Expense / Price***
   - Does the customer perceive value for price?
   - What is the price elasticity of demand for the product or service ?

Developing CTQ's

Step 1

Identify Your Customers

- Listing
- Segmentation
- Prioritization

Step 2

Capture VOC

- What is important to your customers ?
- Tools include **KANO ANALYSIS**

Step 3

Develop CTQ's

- Translate VOC to CTQ's (measurable)
- Determine **Specification Limits** for each CTQ from customer
- Prioritize the CTQs according to customer

Specification Limits

"Specification Limits" are Lean Six Sigma's way of defining your customer expectations

USL = Upper Specification Limit

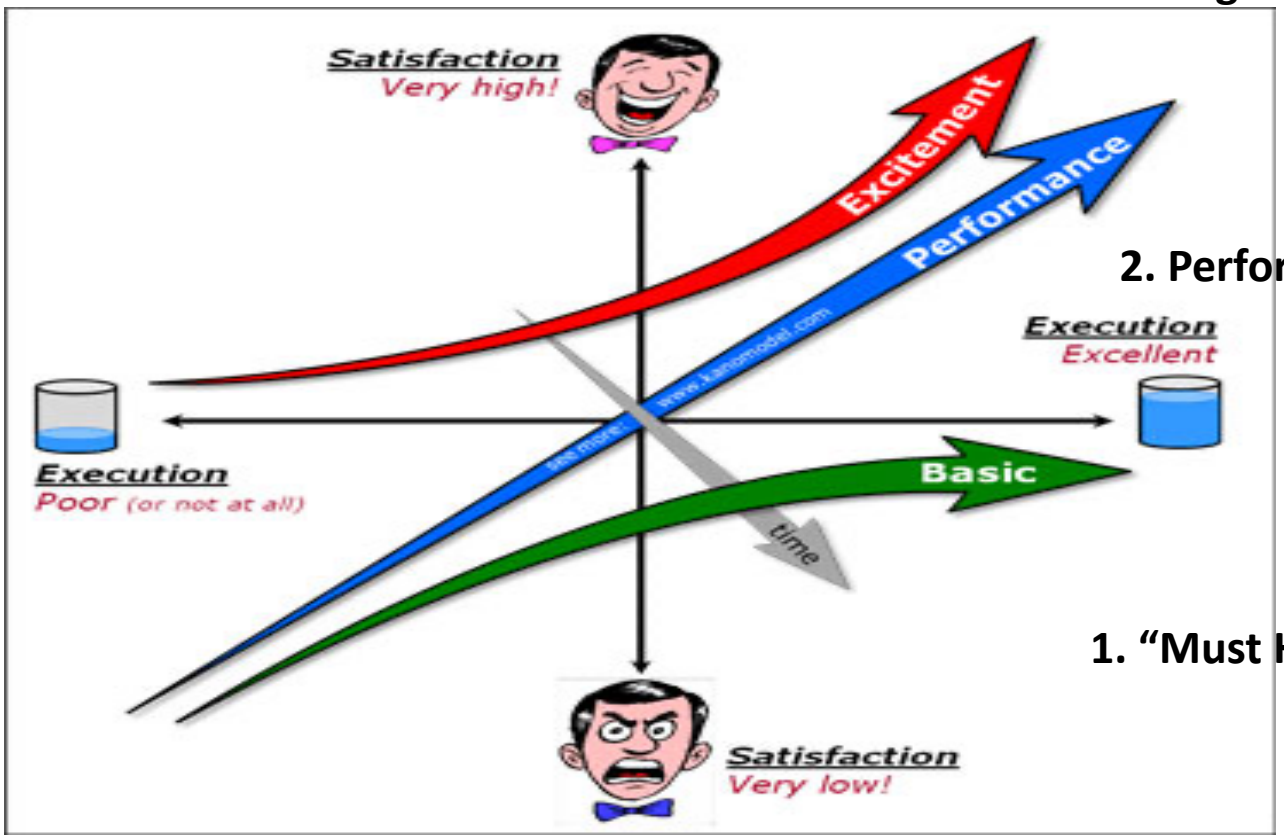
LSL = Lower Specification Limit

Also called 'Tolerance limits' in some businesses

Kano Analysis

- Developed in the 1980s by Professor Noriaki **Kano**, which classifies customer preferences into three main categories

3. Delighters



2. Performers

1. “Must Haves”

Kano Analysis

The Kano Model has three main categories of attributes:

Threshold or Basic Attributes:

These are the basic attributes in a product or service.
The product/service is believed to be incomplete without them.
Their presence will not ensure the satisfaction of the customers; however, their absence can lead to dissatisfied customers.

Performance or Linear Attributes:

Companies generally schedule their investments and decisions using performance attributes.
A customer's willingness to pay for a product is directly related to the performance attributes.
The higher the performance attributes, the more the customer is willing to pay.

Excitement or Delighter Attributes:

The excitement attributes help in driving the hidden needs of the consumers that they have never thought about before.
Building in excitement attributes in the product or service can help organizations create a competitive advantage over their market competitors.

CTQs and KANO

Consider a 3-Star Manufacturing



- What are the CTQs for the process ?
- What at the Basic Requirements ?
- What are Performers ?
- What at Delighters ?



Customer

3-Star Manufacturing Inc

CTQs : _____

_____

_____

_____

- Basic Requirements

  _____

- Performers

  _____

- Delighters _____

Quiz 4 :

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- What Tool is used to understand what is Critical to Quality (CTQ) by Forming 3 categories, 'Basic Requirements' , 'Performers' and 'Delighters' ?
- **KANO ANALYSIS**
- Splitting Customers into groups according to different needs or behaviours is called _____.
- **SEGMENTING**
- CTQs are also sometimes called CTCs or CTSs. What does CTS stand for ?
- **CRITICAL TO SATISFACTION**
- Give one example of a method used to understand the **Voice of the Customer** ?
- **SURVEYS**
  FEEDBACK
  FOCUS GROUPS , REPEAT SALE METRICS etc

Value Stream

Remember the 6 fundamentals of Lean ?

1. Value
2. Value Stream 
3. Flow
4. Pull
5. Perfection

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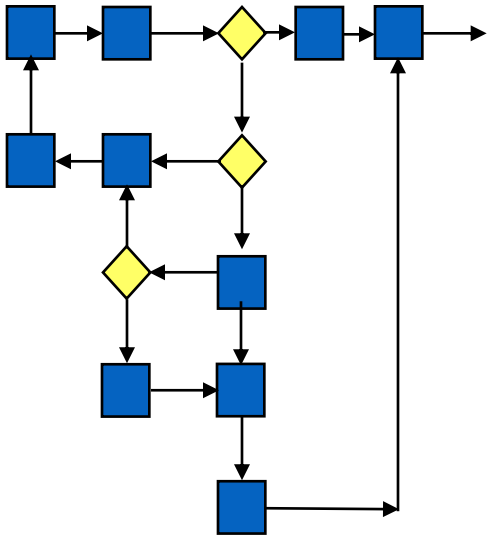
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The Value Stream
&
Value Stream Maps

Understanding the process

We must first understand the Process Flow and the Value Stream before Process Problems can be understood.

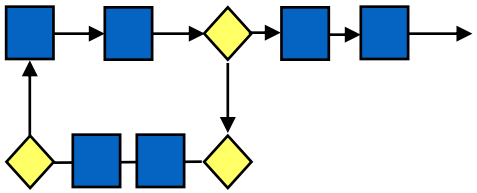


Process Mapping

There are usually three views of a process:

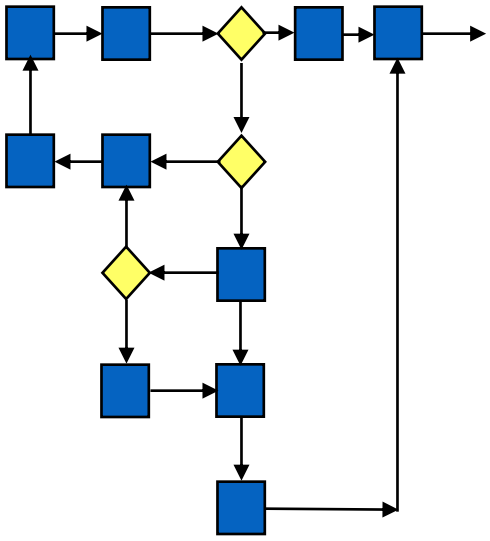
1

What people *THINK* it is..



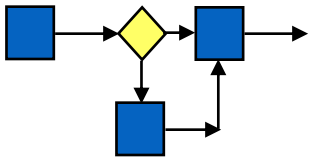
2

What it *ACTUALLY* is..



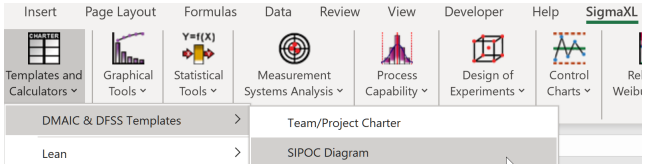
3

What it *SHOULD* be..



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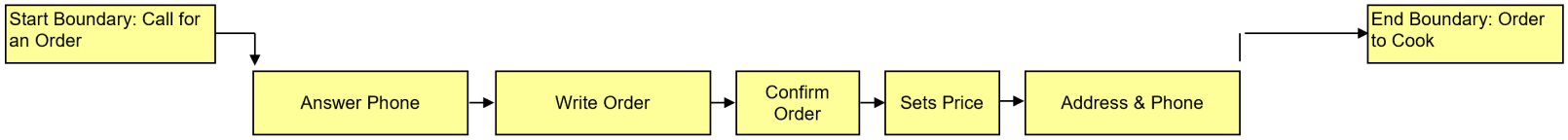
SIPOC



SIPOC DIAGRAM for Customer-Order Process

Process/Project Name:	**Customer Order Process**
Date:	
Prepared By:	
Notes:	

Suppliers	Inputs		Process	Outputs		Customers
Provider	Input Description	Input Requirements (optional)		Output Description	Output Requirements (optional)	Recipient of Output
ATT Phones	Pizza Type		See High Level Process Steps Below	Price		Cook
Office Depot	Size			ConfirmOrder		Accounting
TI Calculators	Quantity			Bake Order		
NEC Cash Regiser	Extra Toppings			Data on Cycle Time		
Customer	Special Orders			Order Rate Data		
	Drink Types/Quantities			Order Transaction		
	Other Products			Delivery Info		
	Phone Number					
	Address					
	Name					
	Time/Day/Date					
	Volume					



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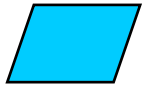
Standard Process Mapping Symbols

Standard symbols for Process Mapping:

(available in Microsoft Office™, Visio™, iGrafx™ , SigmaFlow™ and other products)



*A **RECTANGLE** indicates an activity. Statements within the rectangle should begin with a verb*



*A **PARALLELAGRAM** shows that there are data*



*A **DIAMOND** signifies a decision point. Only two paths emerge from a decision point: No and Yes*



*An **ELLIPSE** shows the start and end of the process*



*An **ARROW** shows the connection and direction of flow*

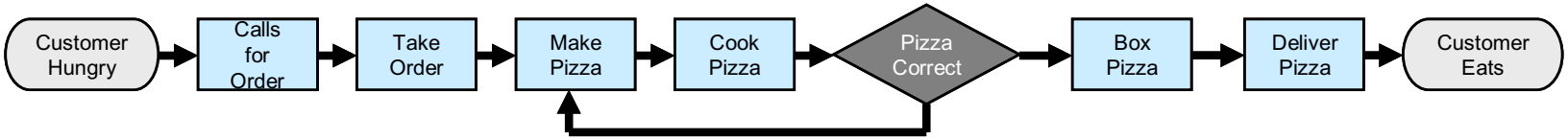


*A **CIRCLE WITH A LETTER OR NUMBER INSIDE** symbolizes the continuation of a flowchart to another page*

FYI : Frank and Lilleth Gibreth produced the first Process Flow diagram with standard symbols in 1921

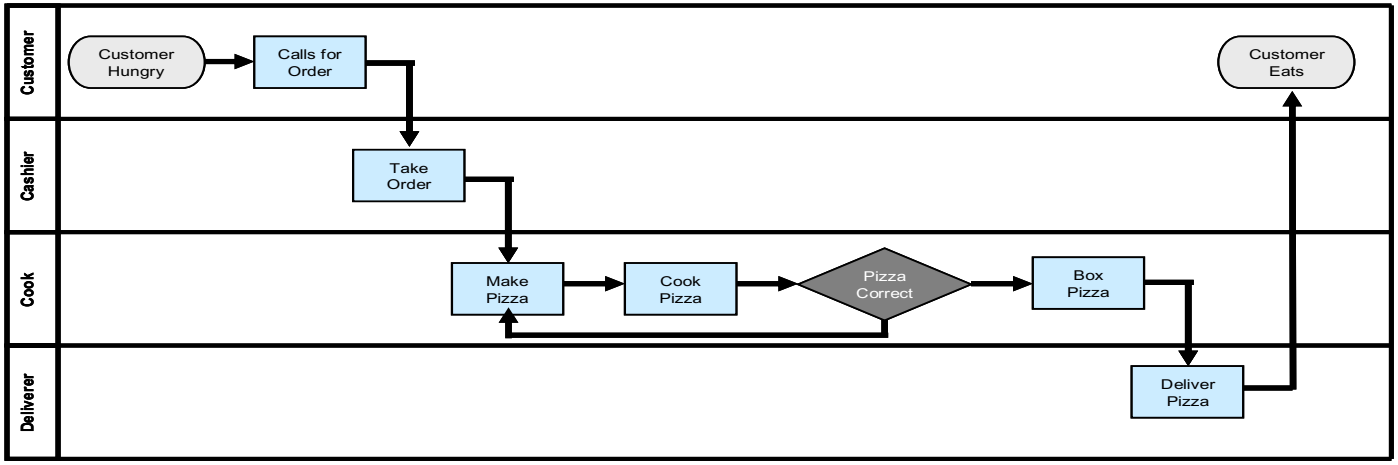
Types of Process Maps

The Linear Flow Process Map



As the name states this diagram shows the process steps in a sequential flow, generally ordered from an upper left corner of the map towards the right side.

The Deployment-Flow or Swim Lane Process Map

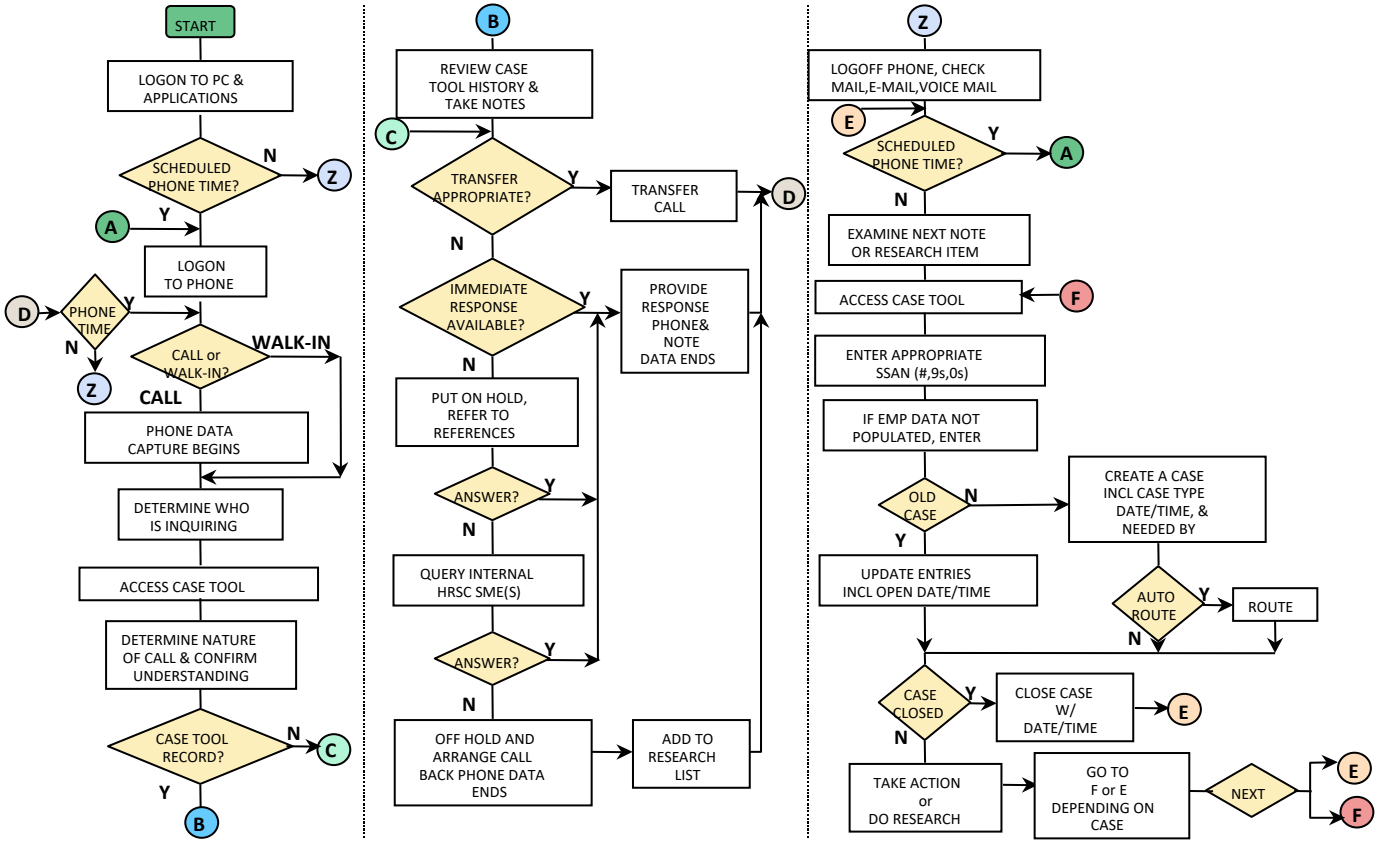


The value of the Swim Lane Map is that is shows you who or which department is responsible for the steps in a process. A timeline can be added to show how long it takes each group to perform their work. Also each time work moves across a Swim Lane there is a "Supplier – Customer" interaction. This is usually where bottlenecks and queues form.

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Process Map Example

Example : Process Map for a Call Center -



Value Stream Map

- A **Value Stream Map** traces all the processes all the way from the suppliers to your customers. It shows information (data), times (Value Add time and Non-Value Add time), costs and quantities of resources used at each stage.

- Map the “AS-IS” State as well as the “TO-BE” State

- Used to identify WASTE in your system

- Value Stream Maps start with a **High Level Process Map**
- Add:
  - **QUANTITIES** (Inventory, Scrap, Number of Operators etc)
  - **TIMES** (Cycle Times, Takt Times, Value Add Time, NVA Time)
  - **COSTS** ($ / unit, $ per delivery, $ per sale, $ of returns etc)
  - **DATA** (Calculated metrics such as OEE, Activity Ratio, Yields)

Value Stream Map

What Moves in a Value Stream ?

In Manufacturing?
….materials flows

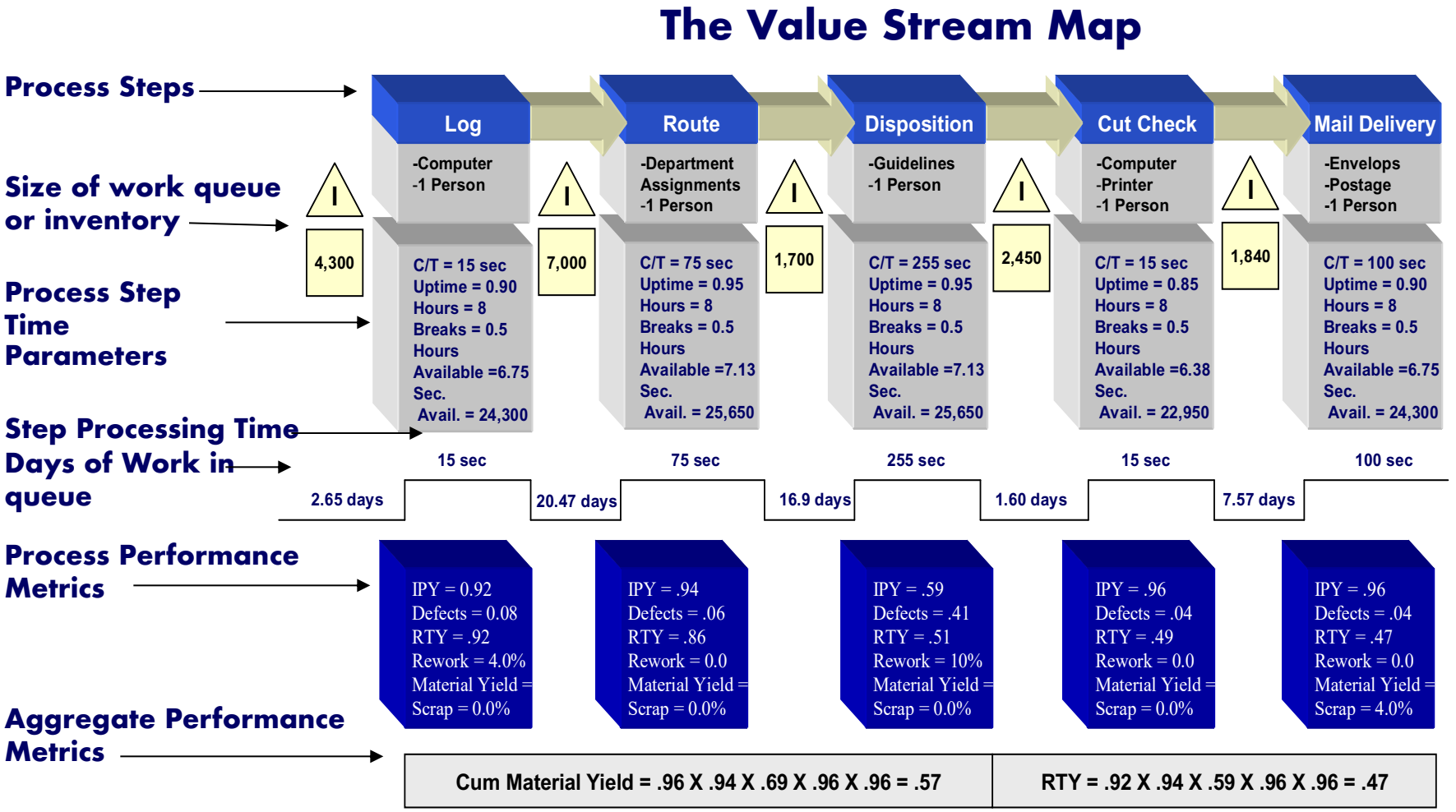
In Shops and markets?
….finished goods and money flows

In Design, Marketing and Financial Services?
….data flows

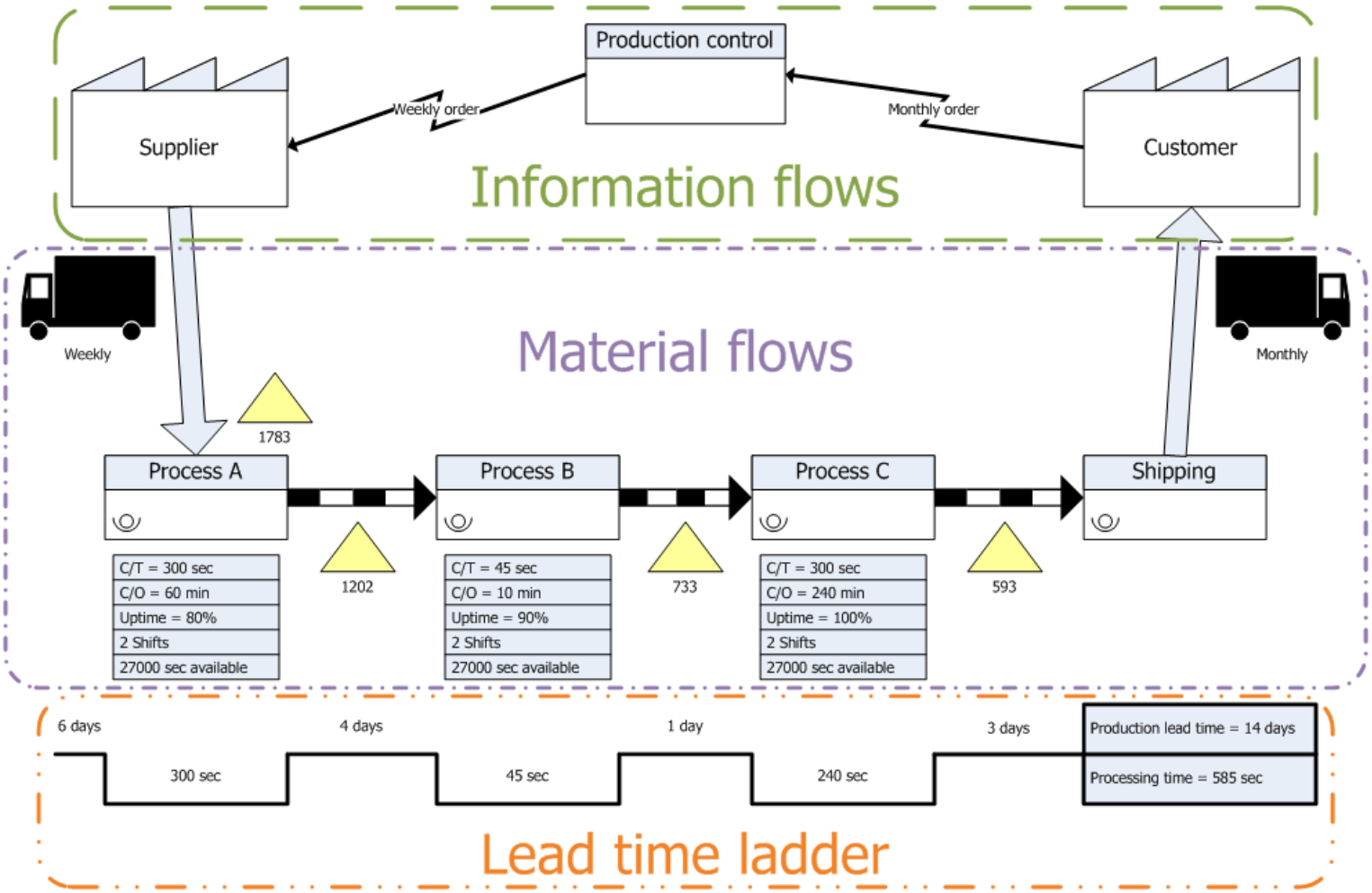
In Transport, Hospitals and Human Services?
….people flow

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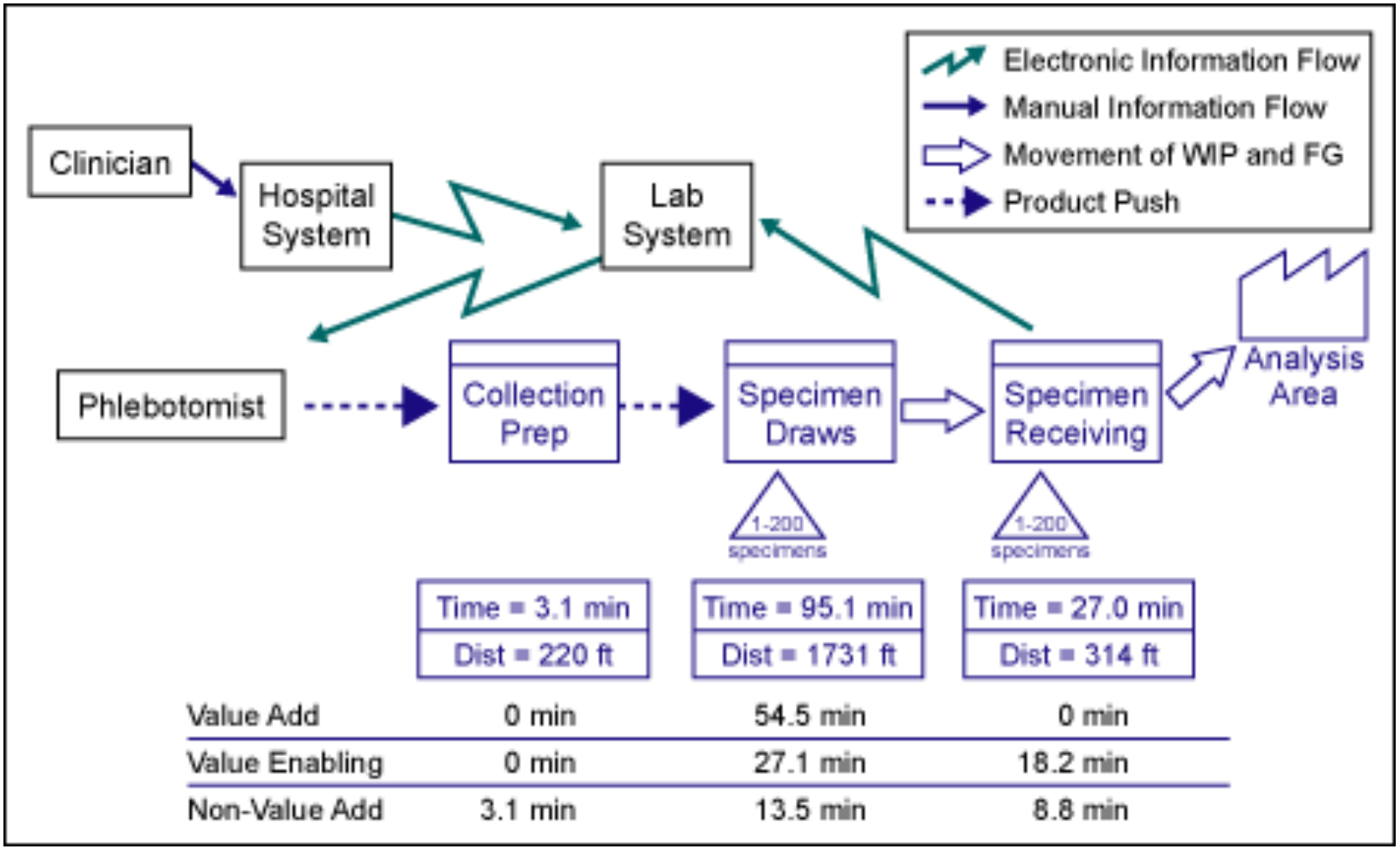
Value Stream Map – Style 1



Value Stream Map – Style 2



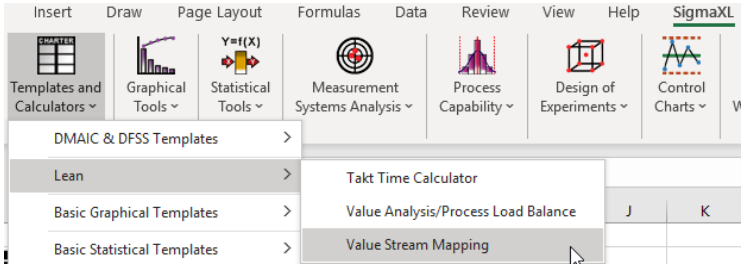
Value Stream Maps in Service Organizations



Value Add	0 min	54.5 min	0 min
Value Enabling	0 min	27.1 min	18.2 min
Non-Value Add	3.1 min	13.5 min	8.8 min

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Value Stream Map Symbols



SigmaXL Value Stream Mapping Symbols

Process, Material Flow & General Symbols

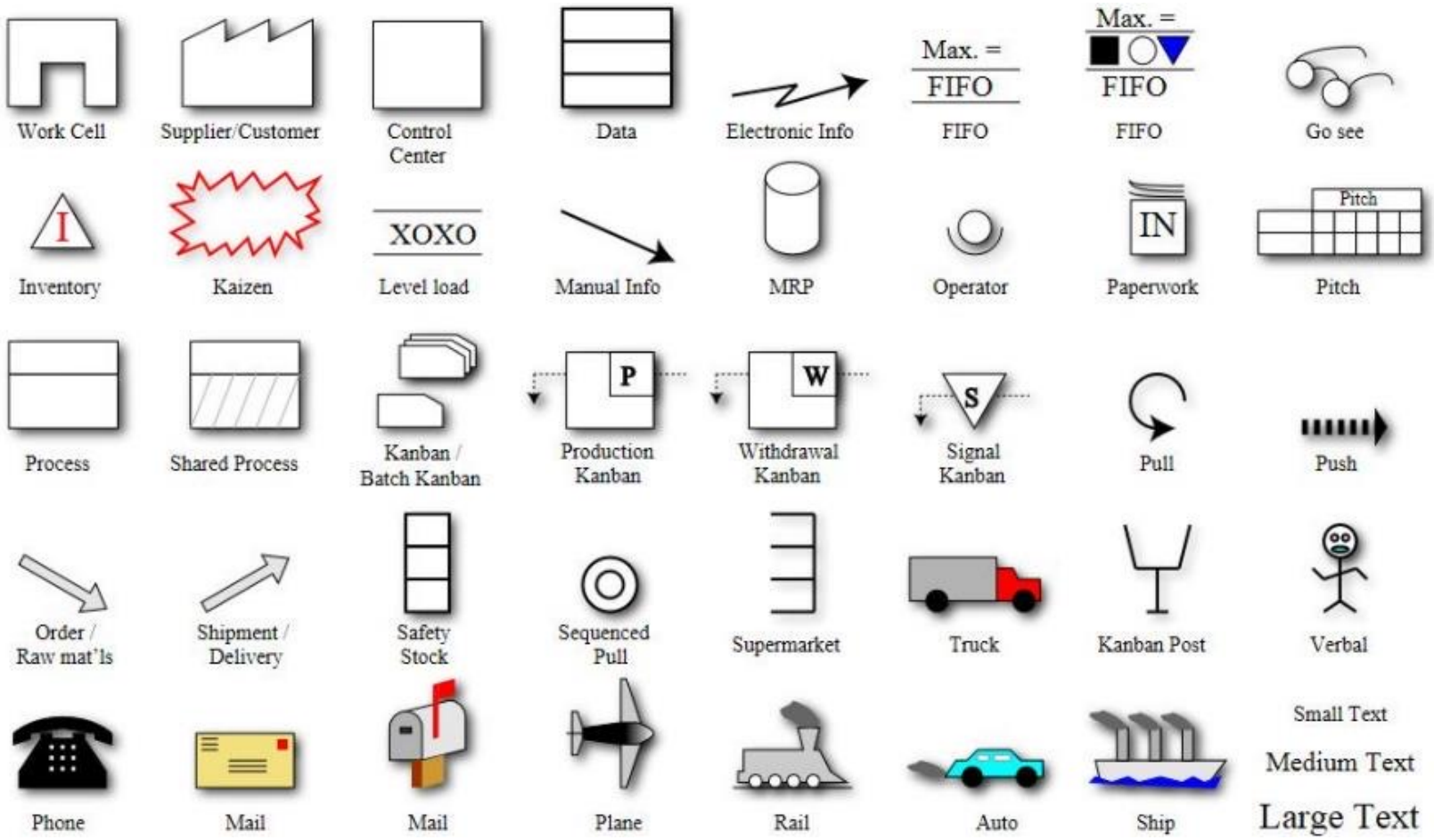
Customer/Supplier Company Supplier when placed in the upper left of VSM; Customer when in the upper right	**External Shipment** Frequency External shipment from suppliers or to customers (truck, rail or boat)	**Supermarket** Small inventory used when continuous flow is not practical
Process Process Resources Process, department, operation or machine, through which material flows	**External Shipment (Air)** Frequency Air shipment from suppliers or to customers	**Safety Stock** Temporary safety stock
Data Box C/T = C/O = Batch = % Uptime = FPY = Typical data includes: Cycle Time (C/T), Operator Cycle Time, Auto Cycle Time, Changeover Time (C/O), Batch Size, % Uptime, Available Capacity, First Pass Yield (FPY), Rolled Throughput Yield (RTY), Value Added Time (VA), Scrap Rate, Distance Travelled	**Inventory** I Quantity Inventory count	**Material Pull** Physical removal from supermarket
Data Box data Miscellaneous data or other information	**Push Arrow** Movement of material that are "pushed" by the production process regardless of the needs of the downstream process	**Warehouse** Inventory storage (goal should be to reduce or eliminate)
Work Cell Multiple processes integrated in a workcell	**Material Movement** Finished goods or raw material movement	**Kaizen Burst** Kaizen Highlight area for improvement, to be addressed in a Kaizen Blitz Event
Operator/People 1 Number of operators or employees required to perform an operation	**FIFO Lane** FIFO Maximum Quantity First-In First-Out inventory	**VA/NVA Timeline** VA time NVA time Highlight value added cycle times versus non-value added wait times

Information Symbols

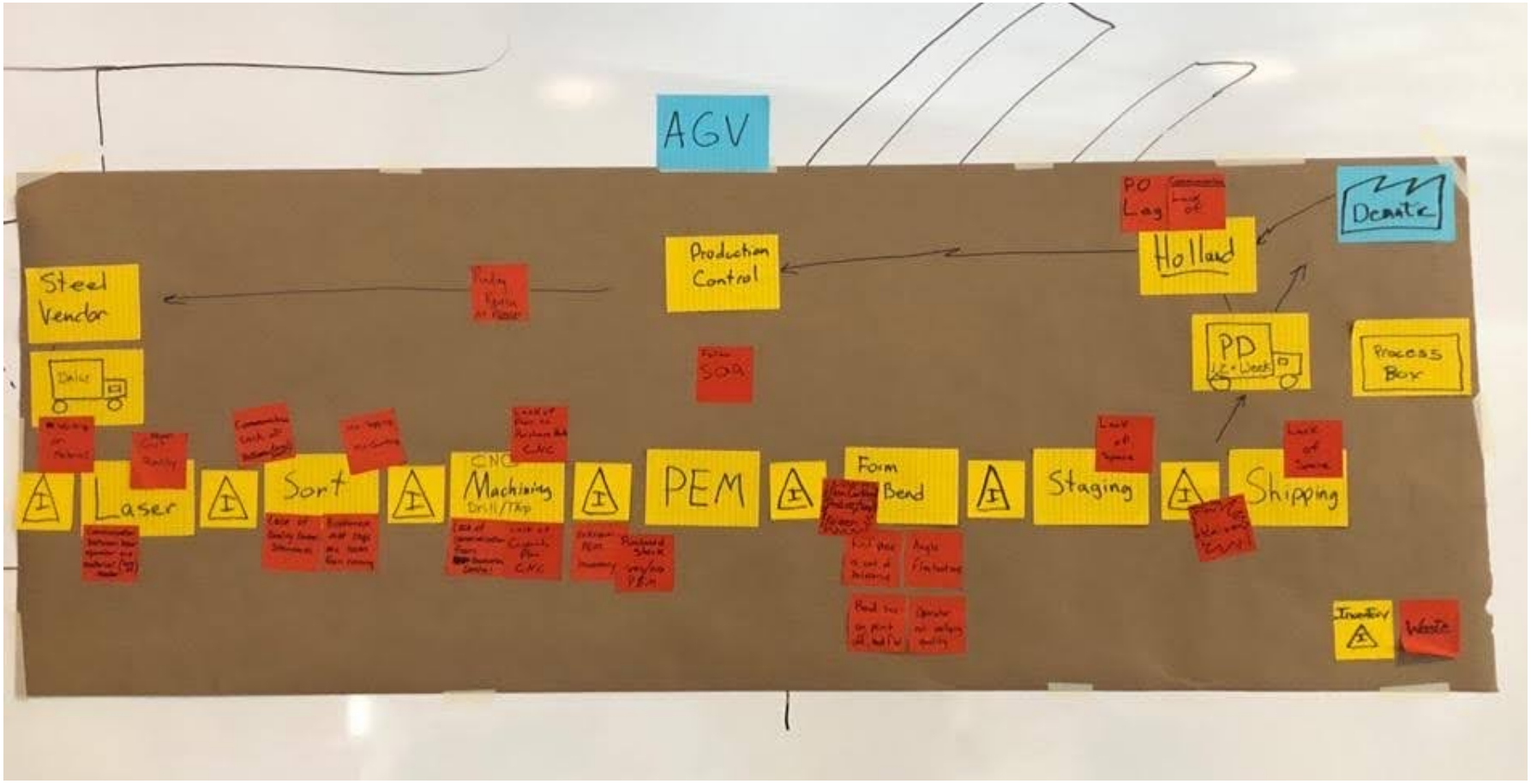
Production Control PRODUCTION CONTROL Central production scheduling or control	**Production Kanban** Quantity Triggers production of a pre-defined number of units.	
Information Type Weekly Schedule Monthly Forecast Information type includes: Monthly Forecast, Weekly Orders or Schedule, Daily Orders or Schedule	**Withdrawal Kanban** Quantity Instruction to obtain items from the supermarket	
Manual Information Flow Manual information flow from memos, reports, or verbal. Add information type icon above as necessary.	**Signal Kanban** S Initiate a batch operation	
Electronic Information Flow Information flow via computer network. Add information type icon as necessary.	**Kanban Post** A physical location for kanban cards	
MRP/ERP MRP Schedule using MRP/ERP system	**Load Leveling** XOXO Batch kanbans to load level production	
Go See Gather information visually	**Sequenced Pull** Kanban signal, without using a supermarket	

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Value Stream Map Symbols



Value Stream Map Example



Value Stream Map Example



Value Stream Map Example



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Value Stream Mapping exercise

ROLL → WEIGH → FLATTEN → CUT → ASSEMBLE → WEIGH





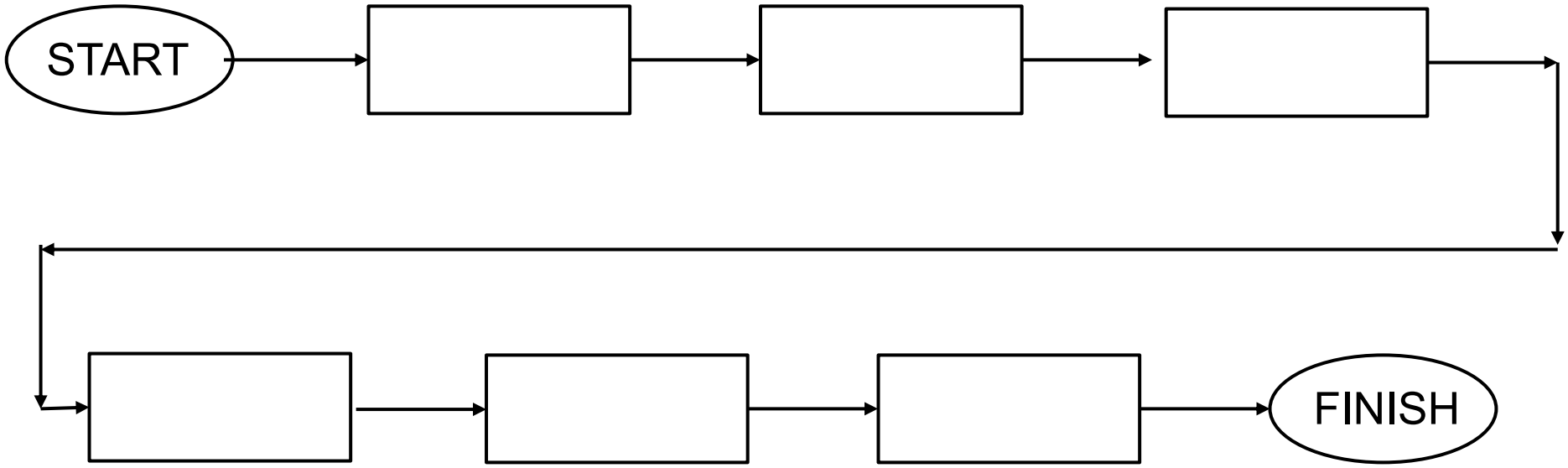




Class Exercise (In Pairs)

Draw a VALUE STREAM MAP

Including the times of each step and any waiting times



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END OF DAY 1

LEAN SOLUTIONS ACADEMY



Lean Six Sigma Training

Green Belt

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Class Schedule

Day 1

- What is Lean Six Sigma ?
- 8 Wastes
- 5S
- Voice of the Customer (VOC) and CTQs Process
- Mapping, Value Stream Mapping

Day 2

- Pull, Kanban and Flow
- Visual Management
- Poka Yoke
- Standarized Work
- SMED
- Kaizen / Kaikaku
- **Define Phase**
- Problem and Project Selection and Definition
- Business Case Project Charter
- **YELLOW BELT EXAM (as Homework)**

Day 3

- **Measure Phase**
- **Introduction to SigmaXL**
- Fishbone Diagram, Pareto Charts
- FMEA
- Six Sigma Statistics
- Measurement System Analysis

Day 4

- Process Capability
- **Analyze Phase**
- Correlation and Regression Analysis
- Introduction to Design of Experiments (DOE)

Day 5

- Hypothesis Testing
- **Improve Phase**
- **Control Phase**
- Control Plans
- Statistical Process Control (SPC)
- Control Charts
- **Revision and Rework of Mock Exam Questions**
- **GREEN BELT EXAM (In own time)**

Flow and Pull

Remember the 6 fundamentals of Lean ?

1. Value
2. Value Stream
3. Flow 
4. Pull
5. Perfection

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Flow

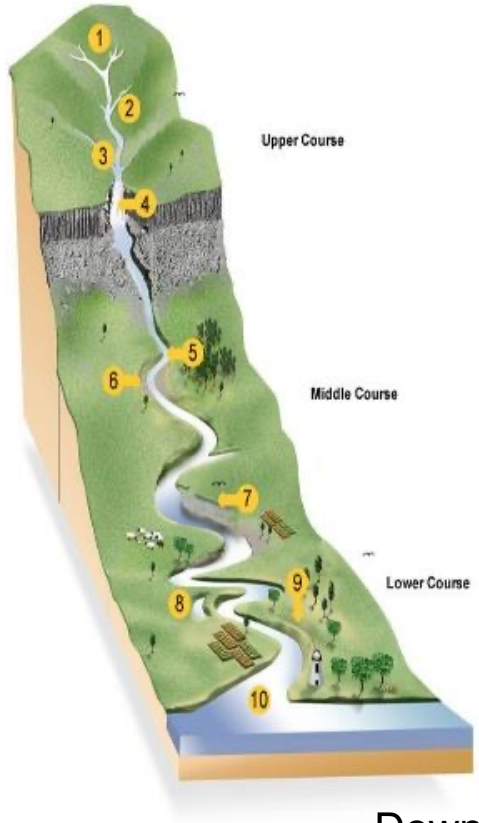
(Keeping the value stream moving)

Flow

- Flow is sometimes referred to as **‘Continuous Flow Production’**

Flow Production

Upstream (Suppliers)



"The ideal arrangement for Flow production should resemble a watershed: the river being the main assembly track, fed by tributaries in the shape of sub-assembly lines which, in turn, would be supplied by streams representing the machine lines fed by brooks typifying the material conveyors. Each part should flow continuously forward … ultimately to the sea - the customers."

Downstream (Customers)

Frank Woollard, *Principles of Mass and Flow Production*, 1954

Flow and Pull

Enablers for Flow

1. Use Single Piece Flow or Smaller Batches
2. Total Productive Maintenance (TPM)
3. Line Balancing (Cycle Times and Takt Times)
4. Theory of Constraints
5. Mistake Proofing (Poka Yoke)
6. Jidoka
7. SMED (Quick Change Over)

One Piece Flow vs Batch

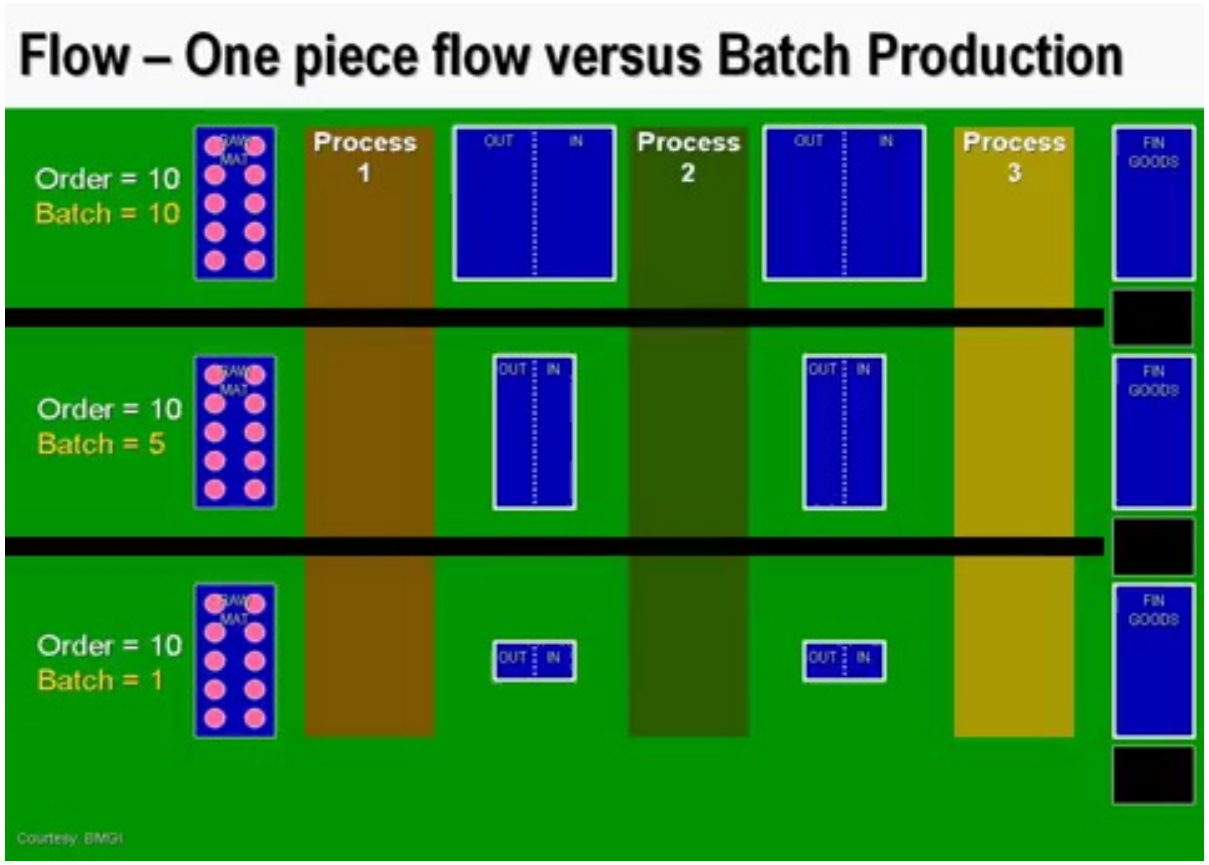
One Piece Flow



Batch



https://www.youtube.com/watch?v=cnLuztl-aGg



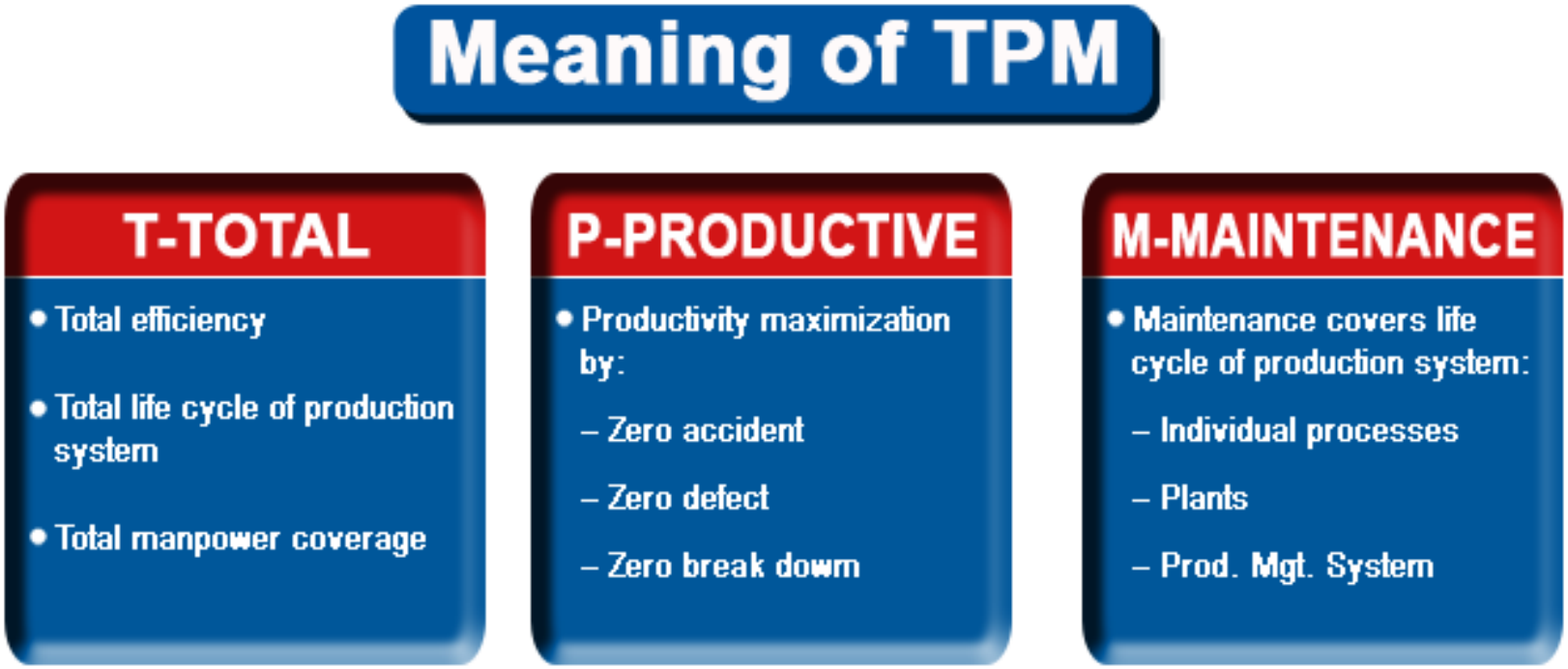
https://www.youtube.com/results?search_query=single+piece+flow+vs+batch

Batch vs Single Piece Flow



https://www.youtube.com/watch?v=cu9CVFEHee4&list=PLGvZFHF27rGzmn1iFmj8v_3rCn07ytImO

TPM



"**TPM** is a new way of thinking about equipment maintenance to prevent accidents, defects, breakdowns or stoppages. **TPM** engages the operators and workers to improve equipment effectiveness with an emphasis on proactive and preventative maintenance."

Six Big Losses

TPM Six Losses

- There are six equipment losses identified within TPM that are used to calculate your OEE (**OVERALL EQUIPMENT EFFECTIVENESS**).
    - Availability
        - **1. Breakdowns**
        - **2. Changeovers**
    - Performance
        - **3. Minor Stoppages**
        - **4. Reduced Speed**
    - Quality
        - **5. Defects**
        - **6. Setup Scrap**

Line Balancing

- Understand the TAKT TIME and CYCLE TIMES of the operations in your process and BALANCE your line. The goal is :

CYCLE TIMES = TAKT TIME

Definitions:

- TAKT TIME = Demand Time = Time needed to produce each unit of product or service in order to keep up with customer demand

- CYCLE TIME = Actual time taken for production of each unit or service

Note: Always be aware for the specific definition of Cycle Time in your work or business because there can be subtle differences between companies

Line Balancing example

- Demand is 4,800 units per month. Assuming 30 days per month and 8 hours per day.

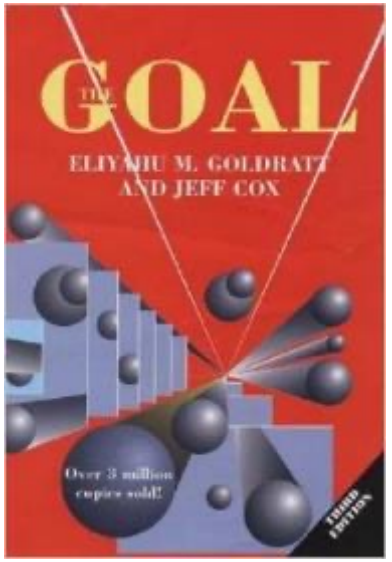
- Therefore TAKT TIME in minutes is :

  Total time period in minutes ÷ total number units demanded

  (30 x 8 x 60) ÷ 4800 = 3 minutes

Theory of Constraints

Theory of Constraints (TOC)



Focusing on any operation in a process that is not the constraint will not improve the overall Flow of the process.

1. Identify the constraint
2. Optimize the constraint
3. If necessary reallocate resources from other operations in the process to the constraint
4. If necessary bring in more resources from outside the process
5. Once the constraint is ‘fixed’, look for the New constraint in the process

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Poka Yoke
&
Jidoka

Poka Yoke and Jidoka prevent Defects

- **Create no defects / errors**
- **Accept no defects / errors**
- **Pass no defects / errors**



Jidoka

- **Work** stops immediately when a problem first is detected.
- The **Root Cause** of the defect is discovered and corrected before work continues
- This prevents defects being passed on downstream
- This short term disruption to FLOW will improve both FLOW and QUALITY in the long term

JIDOKA
"Automation with a human touch"

Poka Yoke

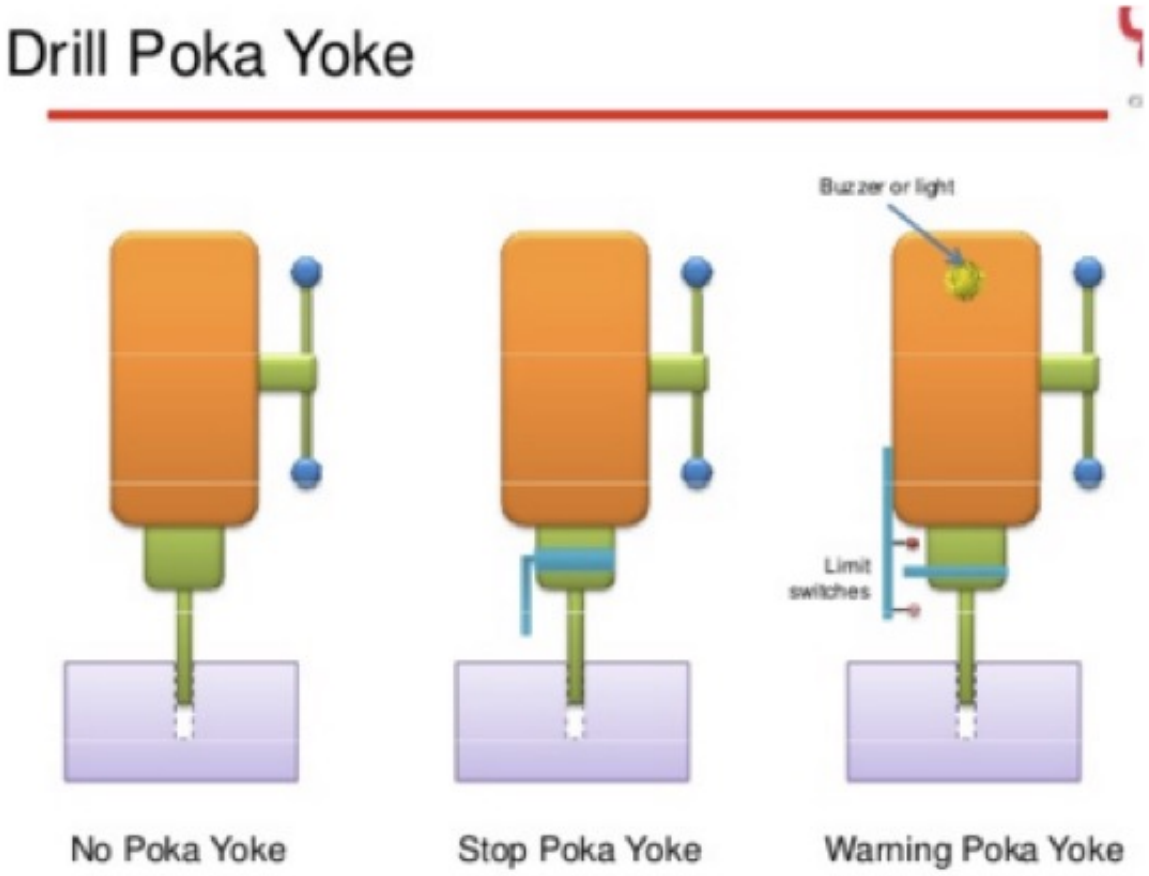
Originally called Baka Yoke (Idiot Proofing) it was changed to Poka Yoke (mistake proofing) by Toyota in 1963's so as not to dishonor anyone to be labeled as an "Idiot".

Poka Yoke = Mistake Proofing

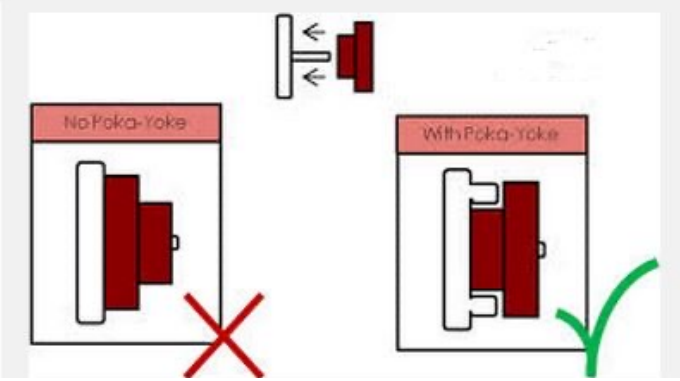
- *Prevent mistakes rather than correct mistakes*
- *Prevent defects rather than correct defects*

Poka Yoke example

Example:



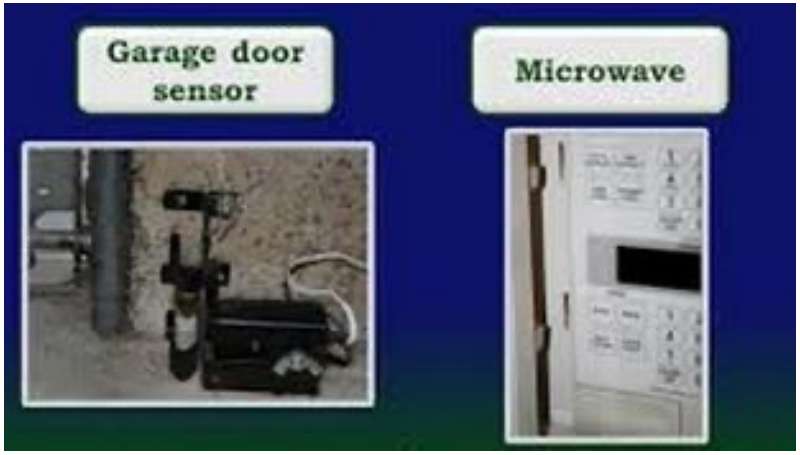
Poka Yoke Examples



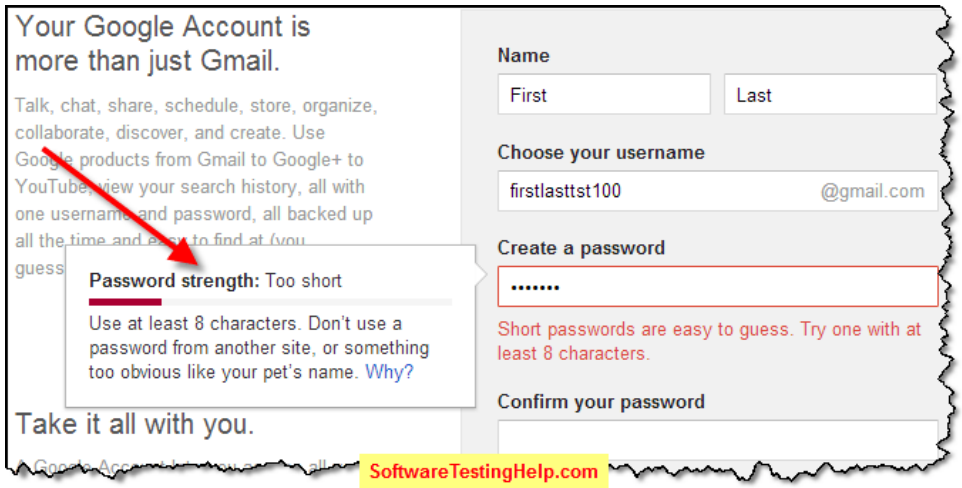


Andon

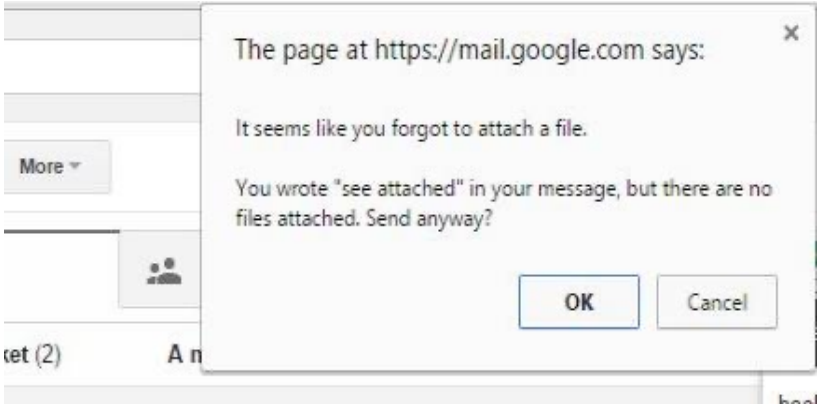




Poka Yoke Examples in the Office







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How many Poka Yoke devices can you see in the following video ?

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Quality at Source (upstream Quality)

- Quality means meeting requirements of the customer (or next step in the process) and not creating defects.

- We can use tools such as **poka yoke** (mistake-proofing) and **visual control** to prevent errors

Poka Yoke in your work

- List some examples of Poka Yoke (Mistake Proofing) that you use in your company.

- Can you think of some new areas of your work that could use a Poka Yoke ?

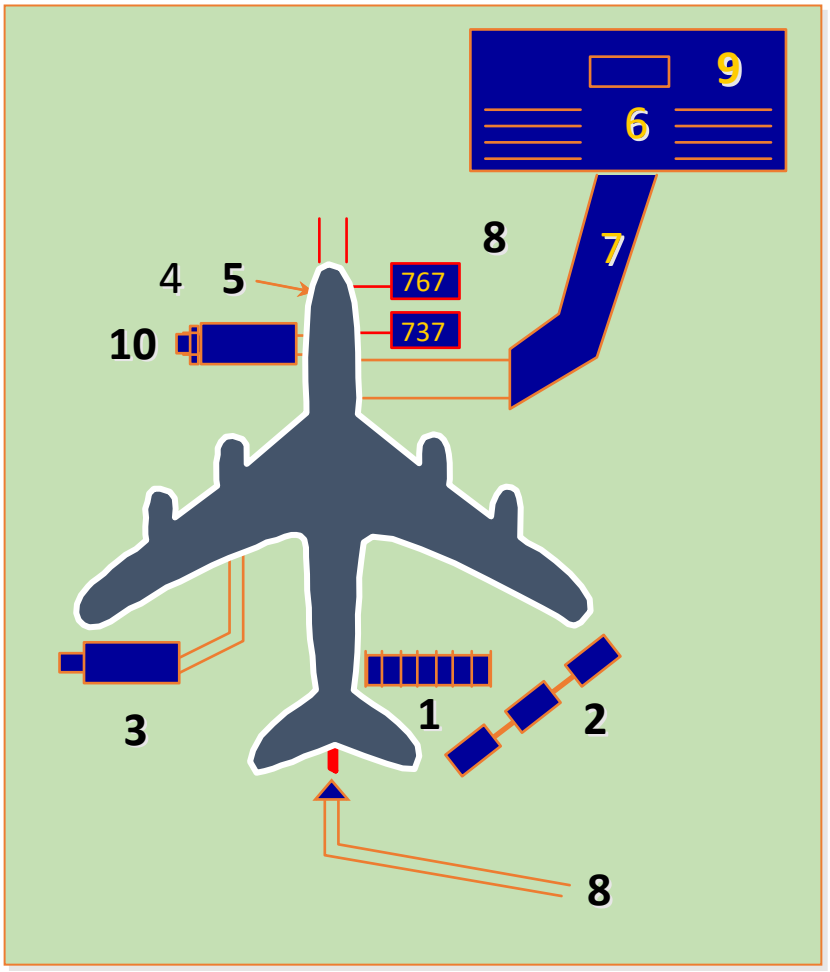
Quick Change Over

(SMED)

Quick Changeover / SMED

- Quick changeover and new setup. The faster the changeover times, the less downtime of equipment.
- Quick changeover principles can be used and applied in almost any operation or process.
- It was originally developed to improve die and machine tool setups.
- **SMED = Single Minute Exchange of Dies**
- **Change over of an Auto Body Panel Die (mould) in less than 10 minutes.**

Classic Quick Changeover: Airport Arrival/Departure



Goal: Fast turnaround of aircraft with minimum delay to departing and arriving passengers

1. Unload/load baggage on roller conveyer with bar-coded baggage tracking
2. Preposition full and empty baggage carts
3. Preposition fuel truck for high-speed fuel dump
4. Prebrief pilots
5. Precook, package, and load meals
6. Perform computer-assisted plane preflight check
7. Use flexible ramp jet way
8. Use marked taxi and park lines
9. Precheck passengers and position close to gate
10. Use 2nd service door to enable parallel food and passenger loading

QUICK CHANGE OVER / SMED VIDEO



F1 Pit Stops 1950 vs 2013: Quick Changeover / SMED

https://www.youtube.com/watch?v=UlIGI3laGAo

Stage 1: Observe & Measure Total Changeover Time

What is the correct method of measuring changeover time?

Changeover time should be recorded as the interval between the stopping and full-speed restart of operations - normally between the last good part produced in a production run and the *first good part* produced in the next production run

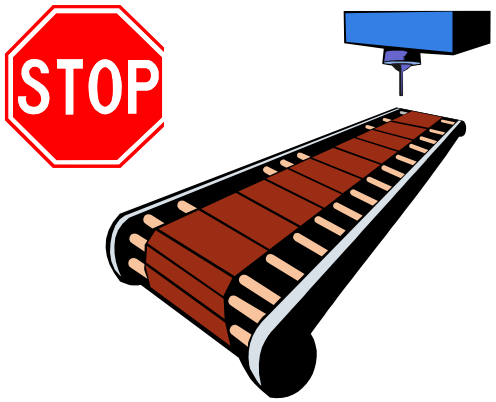
Actual shop floor measures and recording of changeover times often provides the only picture of the current conditions on the floor.



Stage 2: Separate Internal & External Steps

Internal steps

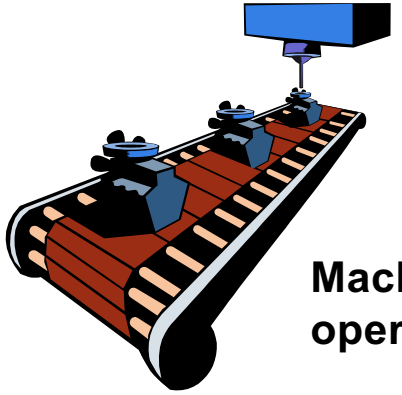
Activities occurring during the changeover that *can only be performed when production is shut down*



- Changing Screens
- Change Miner Picks
- Loosening/tightening critical bolts

External steps

Activities that *could be performed during a production run*



Machine is operating

- Cleanup
- Tool preparation and retrieval
- Assemble subcomponents
- Paperwork

Stage 3: Convert Internal steps to External steps



Stage tools in the area before the changeover so time will not be spent retrieving them during the changeover process



Wait until the changeover is complete to fill out paperwork or data entry into computer.

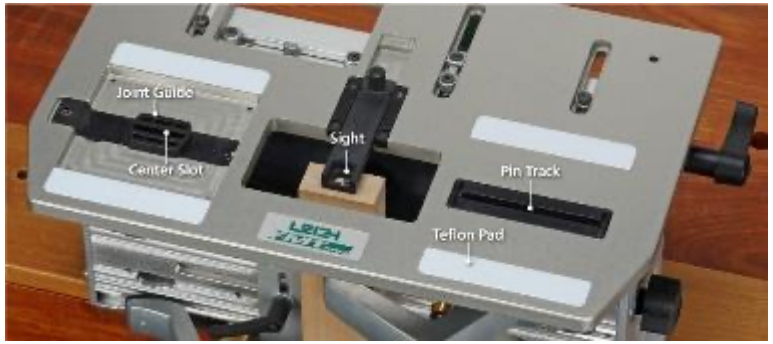




Examples: Eliminate Waste from Internal Steps

	Current method	Improved method
Fastening	• Loosen attachment bolts • Use manual tools (wrench, screwdriver, etc.) • Use bolts and nuts	• Use fewer or shorter bolts • Use air tools • Use quick (1-turn) fasteners
Positioning	• Adjust to center manually • Adjust front-to-back position manually	• Use center pins and guides • Use stop-blocks to ensure proper position
Adjustments	• Manually adjust temperature and speed (using trial and error) • Manually set programs for automated equipment	• Set temperature and speed at pre-determined standard • Pre-load programs

Examples: Eliminate Waste from Internal Steps



Use locator pins and guides



Use Quick Release Mechanisms



Use Snap-On connections

Quiz 5:

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- What is the standard symbol used to indicate a decision point in a Process Map ?
- **DIAMOND**
- There are 2 types of Value Stream Map. Once is a 'Current State' (as-is) map and The other is a _____ (_____) map.
- **FUTURE STATE MAP (To-Be)**

- Name one measurement that you would see on a **Value Stream Map** that you
- would not see on a Process Map ?
- **TIME, REWORK, WASTE, OPERATOR NUMBERS, INVENTORY**

- What is the Japanese name used for 'Mistake Proofing' of a process step ?
- **POKA YOKE**

- FLOW is critical to any process? What needs to Flow in an Airport or Hospital ?
  PEOPLE flow in Airports and Hospitals
- **SMED** is an acronym used in Lean Manufacturing. What is a good name this same principle when used in Service Organizations ?
- **QUICK CHANGE OVER**
- A fundamental concept of any Lean Process is that it has no delays, constraints,
- Waiting or Queues. This Lean concept is call _____
- **FLOW**

Case Study of improved FLOW PRODUCTION

Purever Industrial Solutions (Nelas-Portugal)

PRODUCTS



Shelves for Food Sector



Modular Cold Rooms

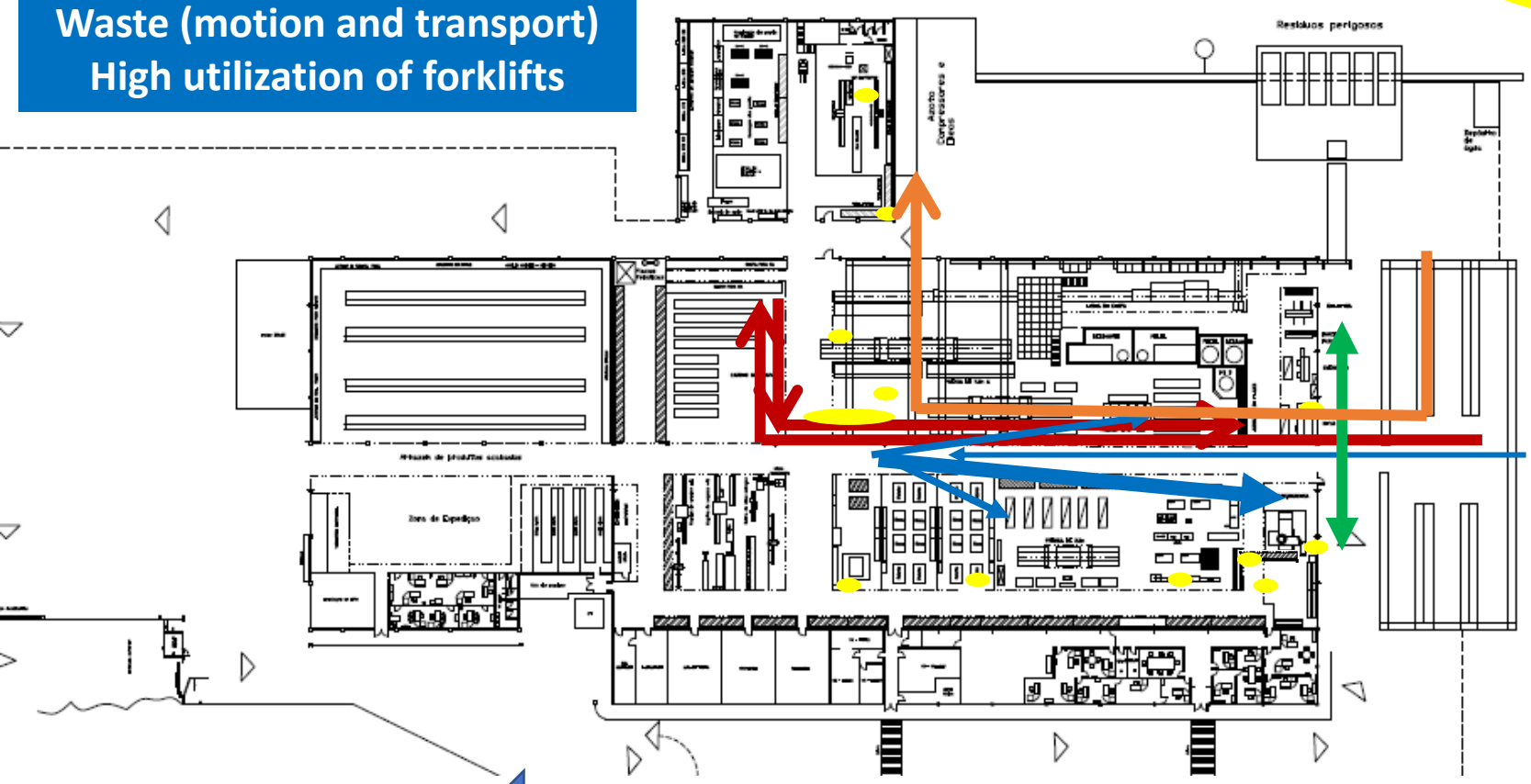
The Plant





Analysis of Flows in Jan-2017

Flow Analysis
Long distances
Waste (motion and transport)
High utilization of forklifts



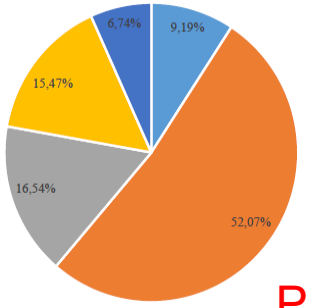
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Data Analysis in Jan-2017

Collection of times and distances

Materials transported by Operator from:

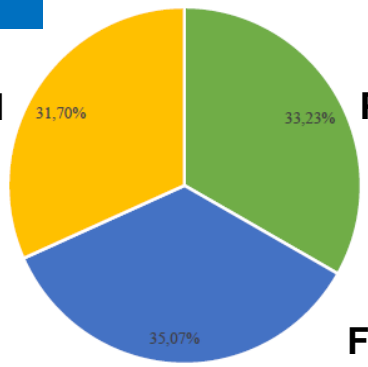


Logistics: 26%

Not adding value

Production!! 52%

How is transported:



From \ To	Armazém	Linha Chapa	Armazém Chapa	Puncionadora	Máquinas Tradicionais	Preparação da prensa de 3,2m	Prensa 3,2m	Prensa 5,2m	Prensa 6m	Prensa 12m	Ferragem Pivotantes	Ferragem Deslizantes	Corte PVC	Ângulos	Máq. Madeiras	Alumínios	Salas Limpas	Coolblok	Estabilização	Expedição	Rua
Armazém					I	II	=				𝍸	𝍸 II	𝍸 II	III	=	III	𝍸	𝍸 II		𝍸 𝍸 𝍸 𝍸 III	
Linha Chapa			𝍸 𝍸 I	𝍸 IIII				IIII	I	II							II				𝍸
Armazém Chapa		𝍸						IIII	𝍸	𝍸 𝍸 I											
Puncionadora					𝍸 𝍸 𝍸 III	II					I						I				III
Máquinas Tradicionais				I		𝍸 𝍸 𝍸 𝍸 IIII		𝍸 II		I	𝍸 II	I								III	
Preparação da prensa de 3,2m					I						I									I	III
Prensa 3,2m											IIII	𝍸					II				
Prensa 5,2m		IIII	𝍸 I																𝍸 III	II	I
Prensa 6m		I	II					I		III	I				I				IIII	𝍸 II	I
Prensa 12m		III	II																II	𝍸 II	𝍸 I
Ferragem Pivotantes	II				I										I	II	I		𝍸 𝍸 𝍸 III	𝍸	
Ferragem Deslizantes						I	I									III	II		𝍸 I		II
Corte PVC	II					III		I			𝍸	III									
Ângulos			I			II	I												II	III	I
Máq. Madeiras	I								II			I				II					I
Alumínios						III				I	𝍸 II	𝍸 𝍸 I								I	
Salas Limpas			I	I		I		I						I						I	I
Coolblok																				I	
Estabilização										I										𝍸 𝍸 𝍸 𝍸 𝍸 III	
Expedição								I			I			II					IIII		𝍸 𝍸
Rua	I	𝍸 II		IIII	III	I	I	II	III	IIII	III	II		I	I					𝍸	

Matrix of all production flows and their frequency

Data for layout changes, milk-run and raw-material storage

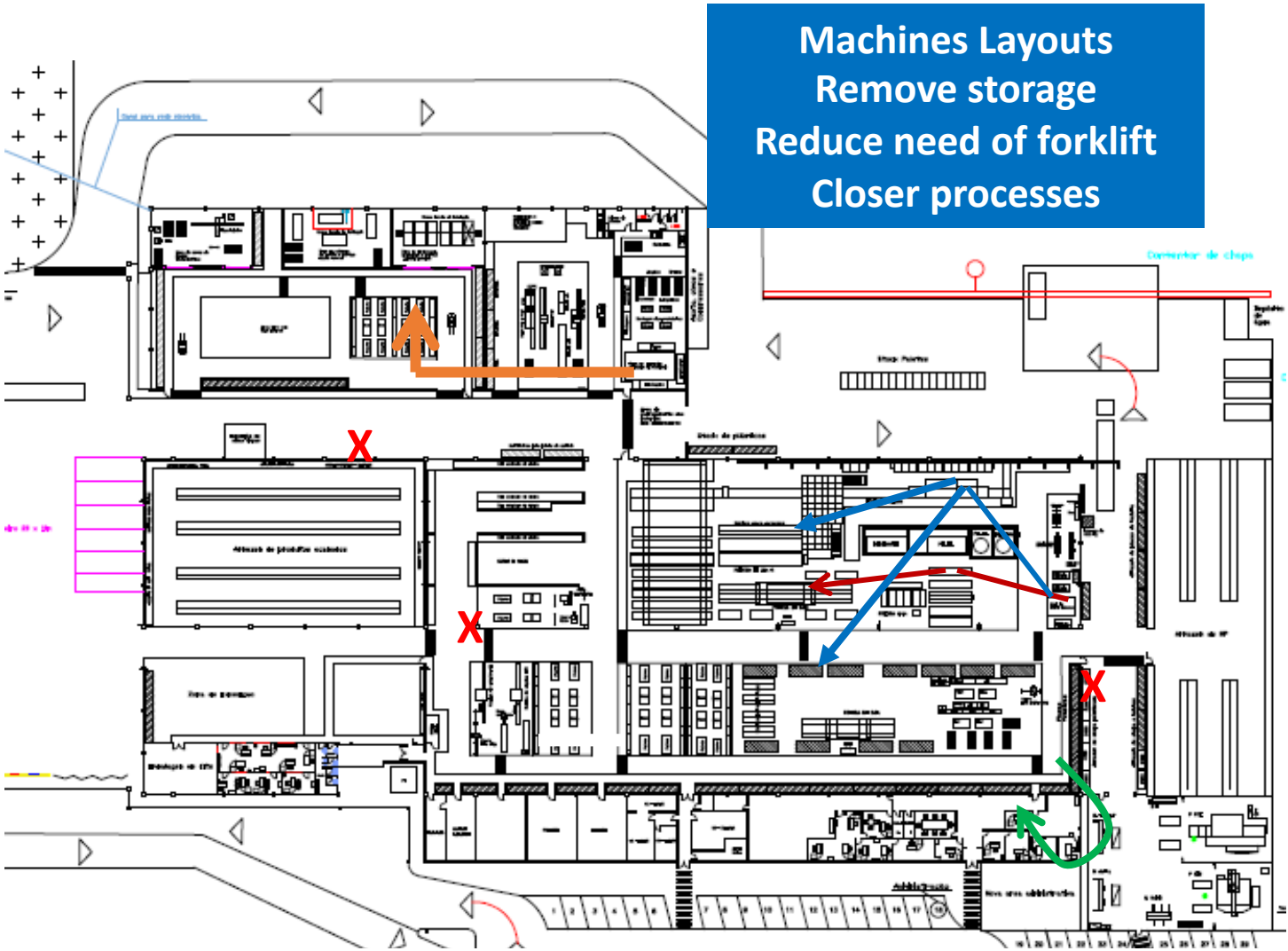
Improvement of Flows in 2018

Aluminium profiles

Steel plates

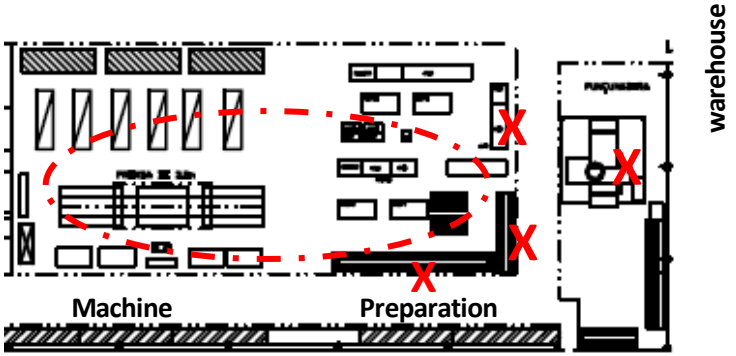
Wood pannels

Plastic and rubber profiles



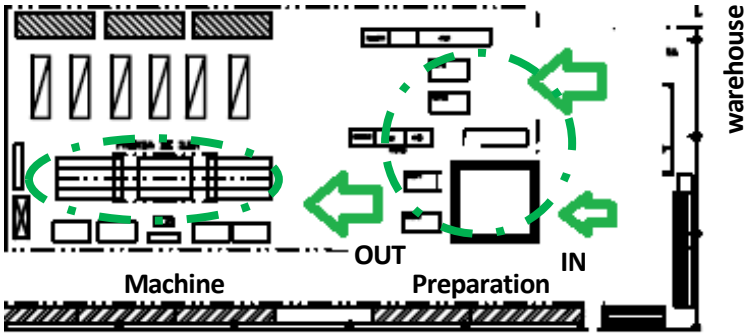
Creating Flow – Door Injection Press

Before



- No material Flow
- Machine stopped due to lack of prepared parts.
- Preparation stopped due to lack of components.
- Push production. No balance.
- Use of forklifts. Rack storage.
- 4 shifts (7 days / week) – total of 14

After



- Material Flow
- Machine is **pulling** production from Prep
- Preparation with Kanban system from warehouse.
- Reduced use of forklifts. Materials in conveyors or pallets.
- 3 shifts (5 days / week) – total of 13
- Tools: 5S, Kanban, Create Flow, Kaizen

Make space for Flow

- CLEAR AISLES



5S & Organization also played an important role in reducing waste

- No Need for Forklifts



From “we need more forklifts trucks!” to “we need more wheels and trolleys”

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Layout Changes: more flow – less waste

- Change Layouts (team work)



Changed machine position so that material could flow directly to warehouse or next process

- Reduce stock / increase flow



Remove pallet racking storage => material needs to flow + less use of forklifts

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Remove WIP – more flow, more space

Before

- Prodution Area Shelves /WIP



After

- Flow, space and less WIP



Removing this racks was one of the first actions. Benefits helped to reduce resistance to change!

The next step was changing machines and giving a fresh look to the shopfloor!

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Reducing the need of forklift trucks

- Milk-run for long profiles



Long aluminium profiles (6m / 20ft) were now simple to deliver to cutting machine

- Materials moved in trolleys



Build trolleys to materials that are difficult to transport, assuring no damages or scratches

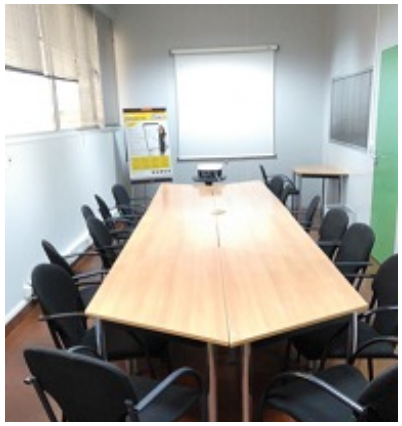
LEAN SOLUTIONS

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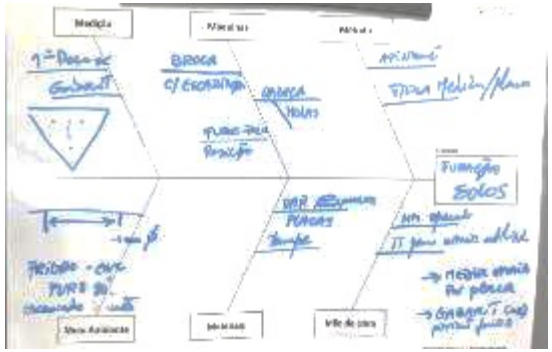
Quality Actions

• PROBLEM SOLVING TRAINING

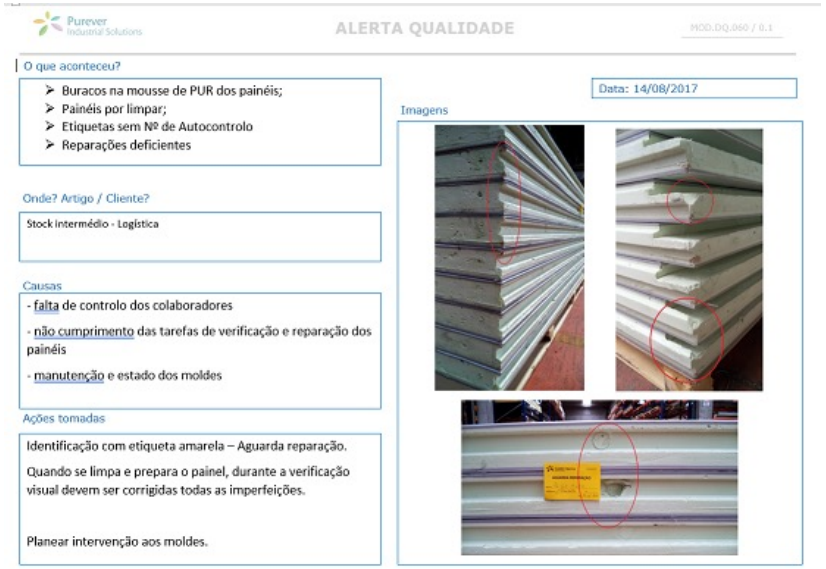
Train and Practice



Basic Quality Tools!!



• QUALITY ALERTS



Purever Industrial Solutions

ALERTA QUALIDADE

MOD.DQ.060 / 0.1

O que aconteceu?

- Buracos na mousse de PUR dos painéis;
- Painéis por limpar;
- Etiquetas sem Nº de Autocontrolo
- Reparações deficientes

Data: 14/08/2017

Imagens

Onde? Artigo / Cliente?

Stock intermédio - Logística

Causas

- falta de controlo dos colaboradores
- não cumprimento das tarefas de verificação e reparação dos painéis
- manutenção e estado dos moldes

Ações tomadas

Identificação com etiqueta amarela – Aguarda reparação.

Quando se limpa e prepara o painel, durante a verificação visual devem ser corrigidas todas as imperfeições.

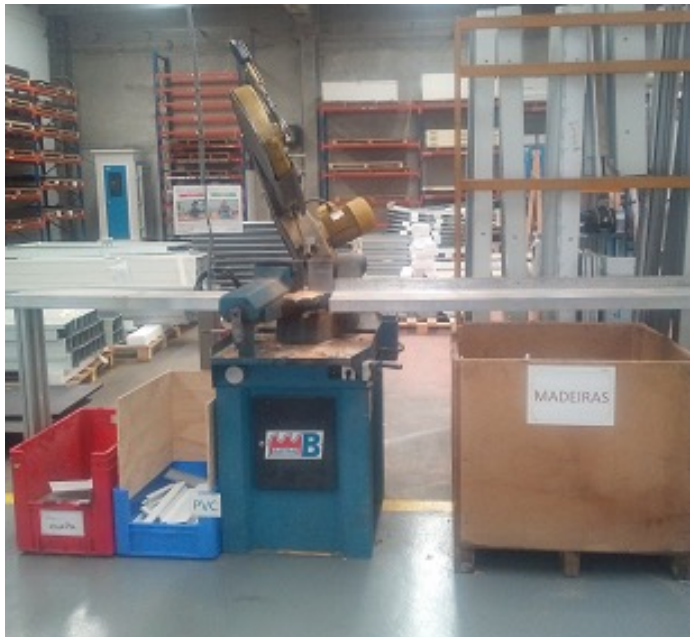
Planear intervenção aos moldes.

Visually displayed in all areas

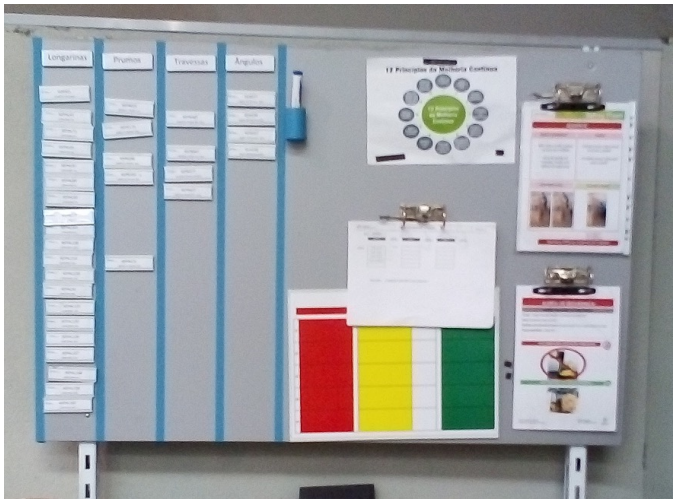
More Improvements Examples



Ergonomic
No pallet.
No Forklift.
No damages.



Kanban Board
near operator



Colour code to
prevent mistakes

LEAN SOLUTIONS

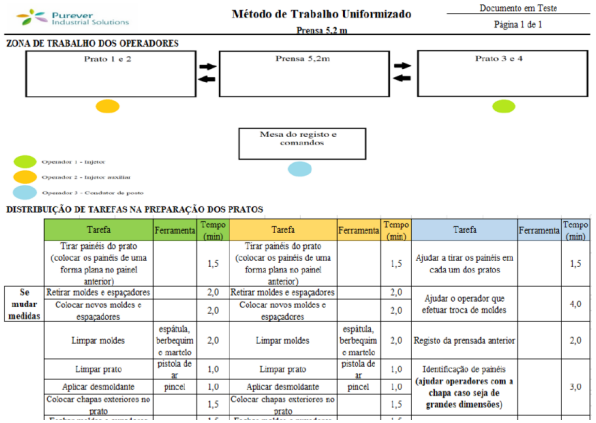
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SMED (Rapid Change Over)



Organization and Visual Management



Purever Industrial Solutions

Método de Trabalho Uniformizado

Prensa 5,2 m

Documento em Teste

Página 1 de 1

ZONA DE TRABALHO DOS OPERADORES

Prato 1 e 2 | Prensa 5,2m | Prato 3 e 4

Mesa do registo e comandos

Operador 1 - Injetor

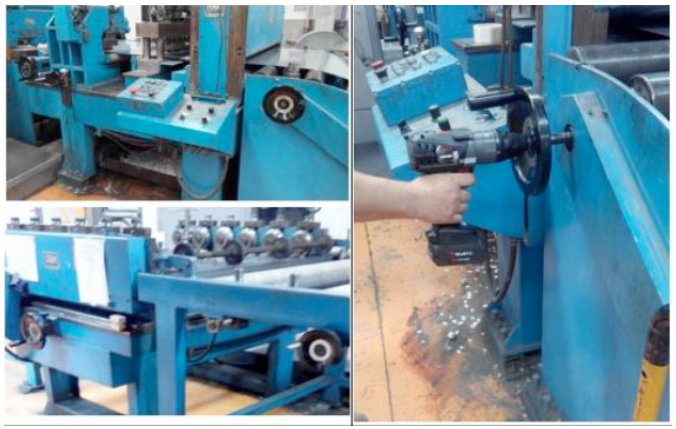
Operador 2 - Injetor auxiliar

Operador 3 - Condutor de posto

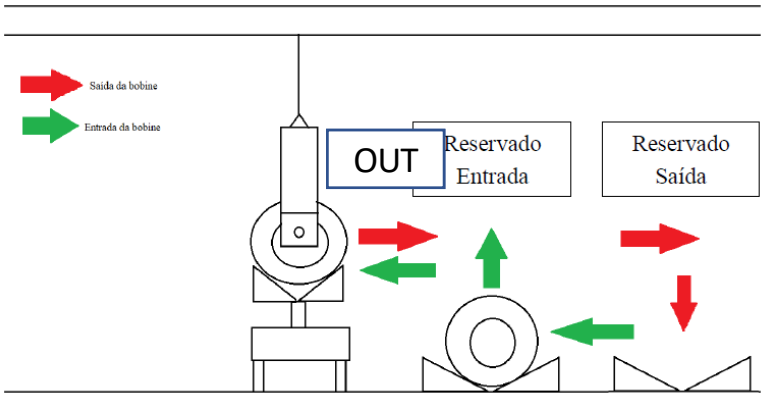
DISTRIBUIÇÃO DE TAREFAS NA PREPARAÇÃO DOS PRATOS

	Tarefa	Ferramenta	Tempo (min)	Tarefa	Ferramenta	Tempo (min)	Tarefa	Ferramenta	Tempo (min)
	Tirar painéis do prato (colocar os painéis de uma forma plana no painel anterior)		1,5	Tirar painéis do prato (colocar os painéis de uma forma plana no painel anterior)		1,5	Ajudar a tirar os painéis em cada um dos pratos		1,5
Se mudar medidas	Retirar moldes e espaçadores		2,0	Retirar moldes e espaçadores		2,0	Ajudar o operador que efetuar troca de moldes		4,0
	Colocar novos moldes e espaçadores		2,0	Colocar novos moldes e espaçadores		2,0			
	Limpar moldes	espátula, berbequim e martelo	2,0	Limpar moldes	espátula, berbequim e martelo	2,0	Registo da prensada anterior		2,0
	Limpar prato	pistola de ar	1,0	Limpar prato	pistola de ar	1,0	Identificação de painéis **(ajudar operadores com a chapa caso seja de grandes dimensões)**		3,0
	Aplicar desmoldante	pincel	1,0	Aplicar desmoldante	pincel	1,0			
	Colocar chapas exteriores no prato		1,5	Colocar chapas exteriores no prato		1,5			

Standards and Team Work



Reduce time



Preparation – External activities

Results 2017 vs 2018

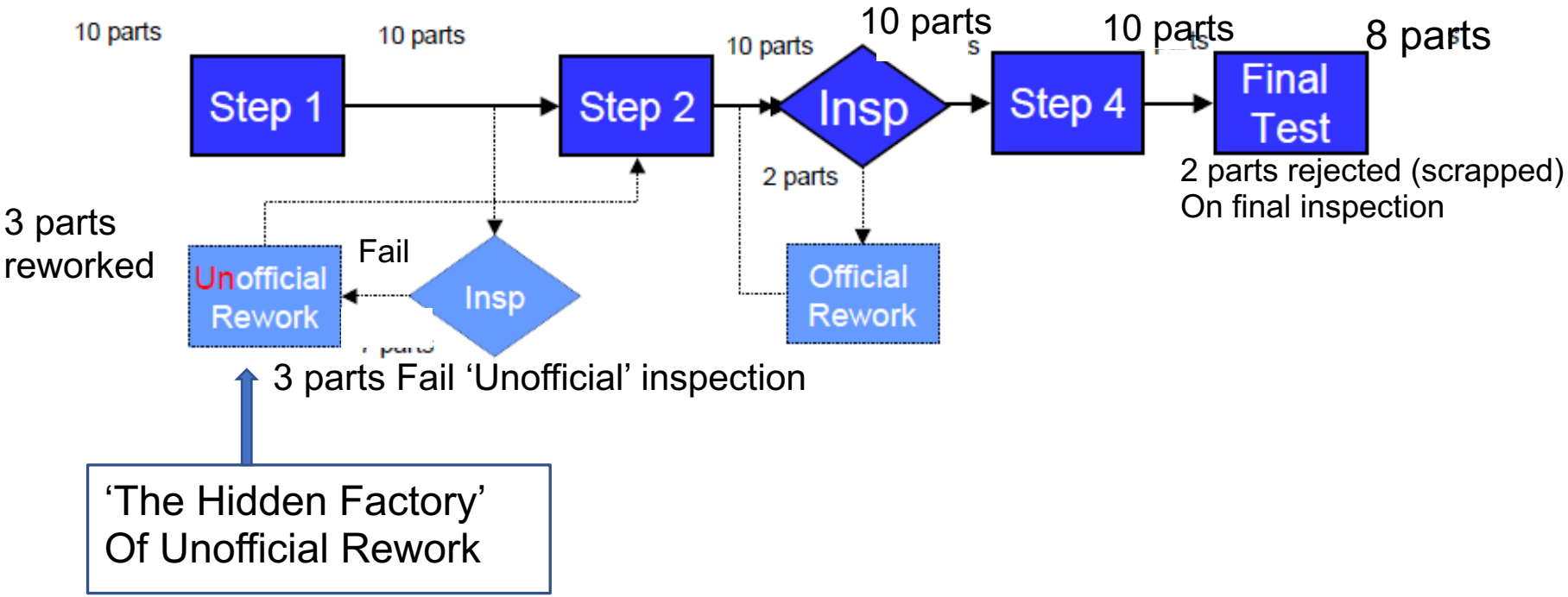
Weekly Results

RESULTS	Jun-17	Nov-18
OUTPUT (m2/week)	500	1500
OEE	41.7 %	78.9 %
Defects	1.5%	0.2%
Average WIP	50 Units	25 Units

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Rolled Throughput Yield (RTY)

Rolled Throughput Yield (RTY)
RTY is the best measure of YIELD and is a true LEAN METRIC because it accounts for all WASTE (rework and scrap).



3 parts Unofficially Reworked + 2 parts Officially reworked + 2 parts scrapped
10 parts started but only 3 good parts required no rework at all.

RTY = 30%

Flow and Pull

Remember the 6 fundamentals of Lean ?

1. Value
2. Value Stream
3. Flow
4. Pull 
5. Perfection

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Pull

(Downstream demand driven production)

Pull

Pull is sometimes referred to as
‘Just-in-time Production’

Just in Time

“PULL” and “KANBAN” are fundamental for…

…a JUST-IN-TIME process

- WHAT is needed
- HOW MUCH is needed
- WHERE it is needed
- (WHEN it is needed)

Note: ‘WHEN is usually not necessary because it assumed it is needed ASAP

Kanban

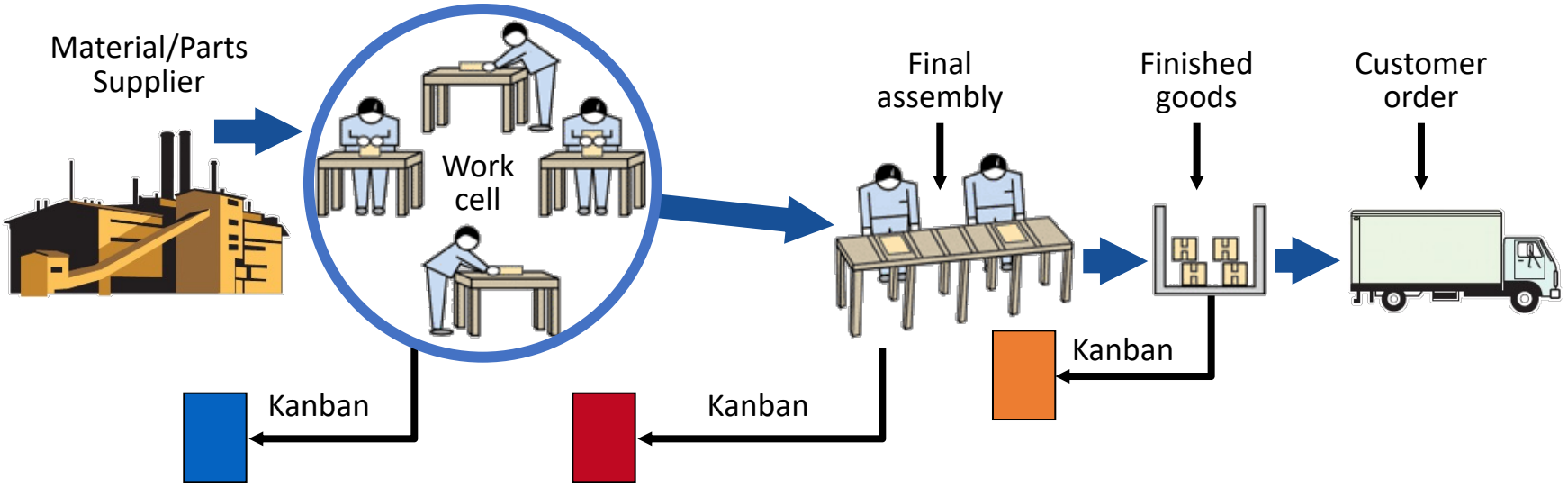
- **Kanban** is the Japanese word for ‘card’ or ‘ticket’
- The Kanban card was an authorization for materials to be moved from an Upstream location to a Downstream location. The card had printed on it What was needed How much was needed and Where it is needed.
- A sequence of Kanbans pulls material through the process
- Electronic signals are generally used today, but the system is still called a Kanban

Kanban Card EXAMPLE



Kanban

Good Kanban Systems help to minimize inventory and WIP



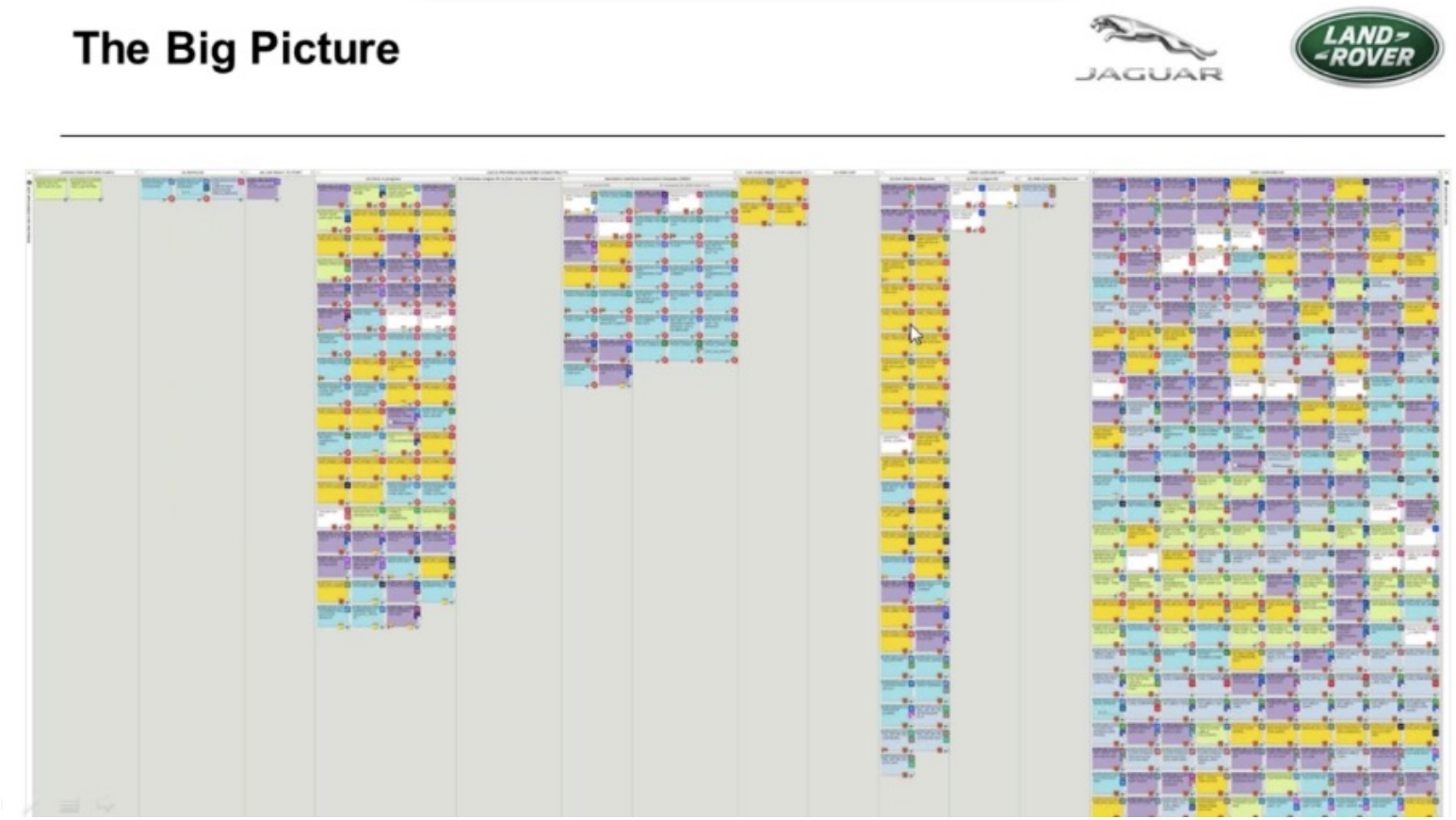
Kanban Boards

Tool to track the FLOW of work on a project.
Use white-board and Post-it notes or software such as LeanKit.com



Kanban Boards

Visual Management



Kanban Boards

See how KANBAN is improving time, cost and quality across new vehicle development projects at Jaguar Land Rover (Software and Hardware).

See Video at: https://vimeo.com/172780037



Flow and Pull

Remember the 6 fundamentals of Lean ?

1. Value
2. Value Stream
3. Flow
4. Pull
5. Perfection 
6. Involve and Respect Workers

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Kaizen
Small Steps to Perfection

Kaizen



Kaizen : The Key to Japan's Competitive Success : 1986. Masaaki Imai

Kaizen and Kaikaku

Definition of Kaizen:

Kaizen

"Change for the Better"

The philosophy of continual improvement, that every process can and should be continually evaluated and improved in terms of time required, resources used, resultant quality and other aspects relevant to the process. Step by step leads to BREAKTHROUGH Improvement.

"BreakThrough" Improvement

Definition of Kaikaku:

Kaikaku

A RADICAL, BREAKTHROUGH project that is needed when a Radical redesign of our business model or processes is needed



What is the difference between Lean Kaizen, Kaikaku en Kakushin?

Kaizen	Kaikaku	Kakushin
Improvement for the better	Radical change	Change through innovation
Operational	Strategic	Strategic
This forms the basis of lean organization. Continuously improve the existing way of working in small steps.	New product, service or service within existing organization. Reform of existing business model. These changes cannot be achieved with smaller incremental steps (from Kaizen).	Transform through the advent of new innovation. used terms: out-of-the-box thinking; design thinking. game changers

Kaizen Events

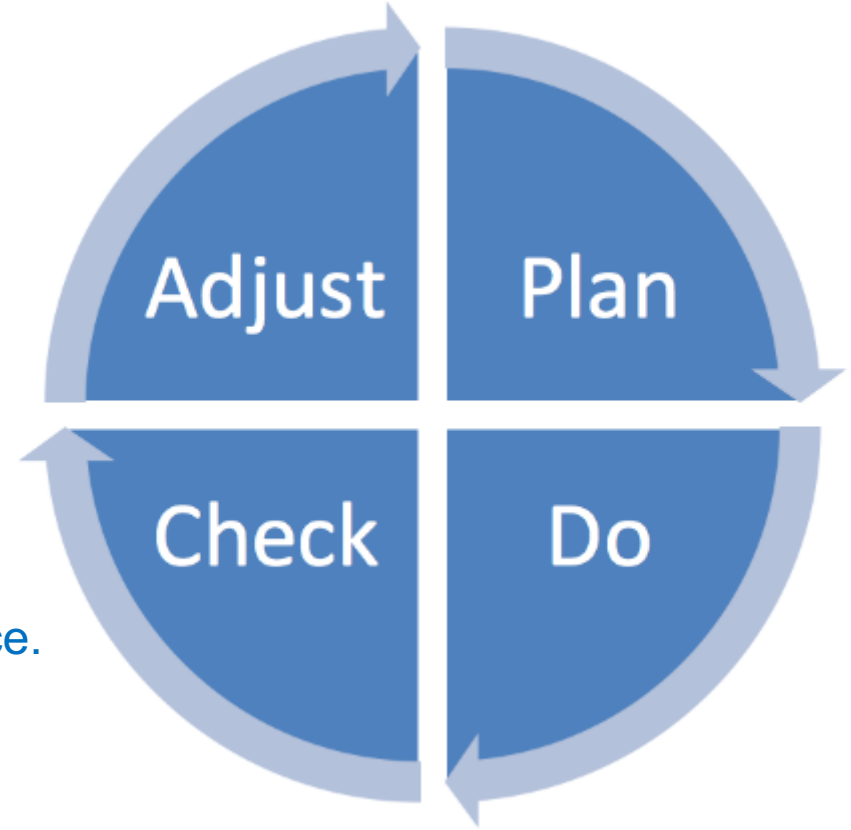
Kaizen Events

- *Simple and Low Risk Improvements that can be done in less than 1 week.*
- *Less “overhead” in project management needed.*
- *Can be done regularly and low cost.*
- *A “Kaizen Board” keeps track of Kaizen Events*
- *Team performing the Kaizen can be organized by a Green Belt or Black Belt.*
- *Pre-Kaizen Event Planning meeting (Plan)*
- *Kaizen Event (Do)*
- *Post Kaizen Control / Monitor period (Check and Adjust)*

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PDCA for Kaizen Events

Modify and Adjust as necessary.

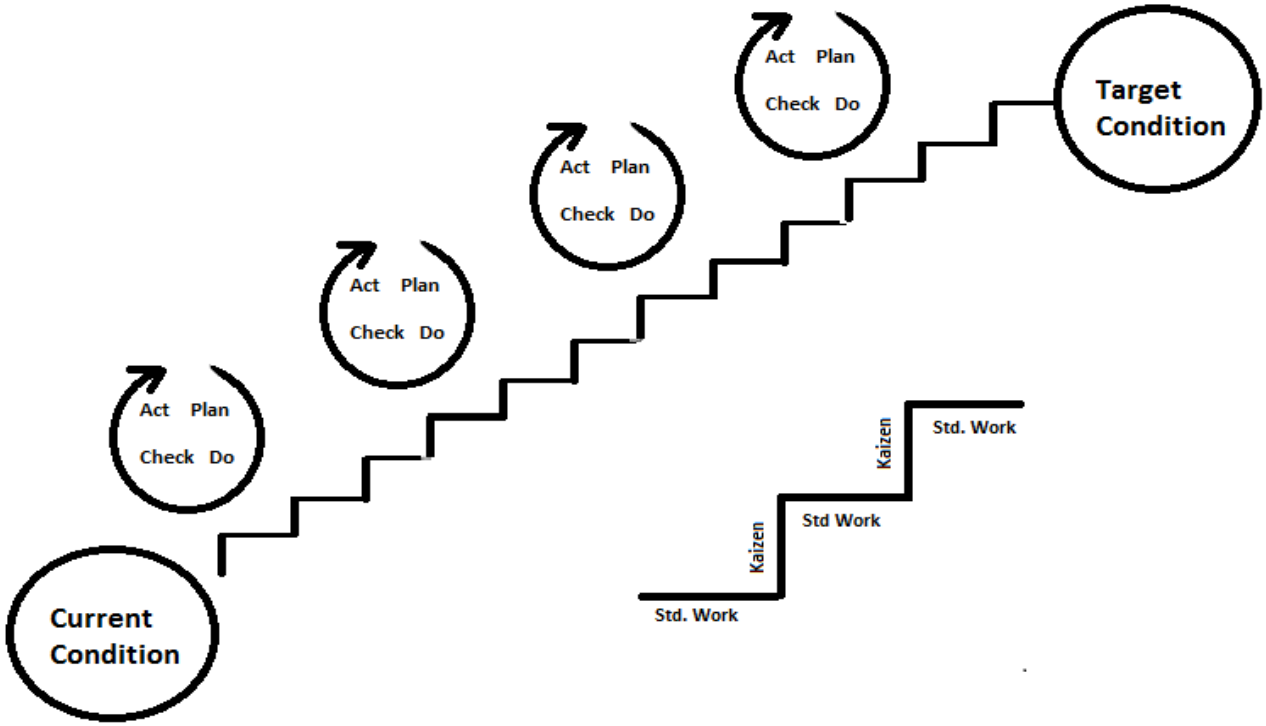


Understand the problem and arrive at a team consensus of the root cause

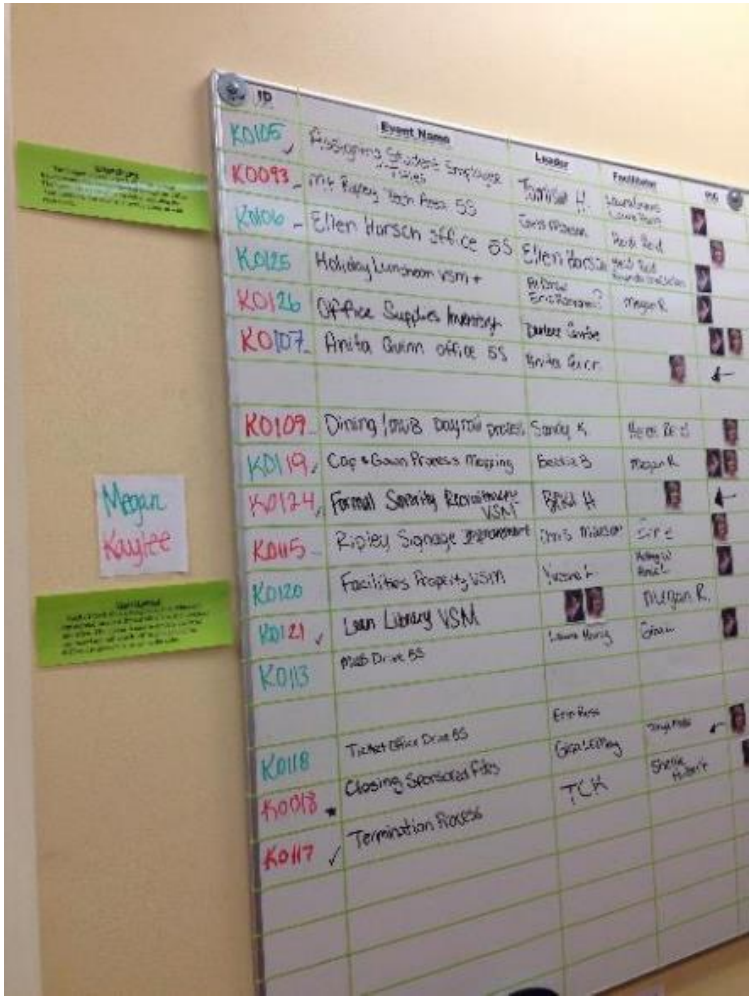
Monitor performance. Does it work ?

Implement the Fix / Improvement

Continuous Improvement (Kaizen)



Kaizen Event Boards





Kaizen in your work

- What areas of your work needs a Kaizen Event ?

- Develop the Plan for your Kaizen Event ?
    - Who ?
    - When ?
    - What is needed (tools/ materials) ?
    - Who do you need permission from ?

Quiz 6:

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- If you are part of a Kaizen Event team, what is the approximate number of days you would expect to work on it ?

- **BETWEEN 1 and 5 days**

- What does PDCA mean ?

- **PLAN**
- **DO**
- **CHECK**
- **ADJUST / ACT**

- TRUE or FALSE ?
  We re-standardise Operating procedures every time we find a new and better way to operate.

- **TRUE**

Flow and Pull

Remember the 6 fundamentals of Lean ?

1. Value
2. Value Stream
3. Flow
4. Pull
5. Perfection
6. Involve and Respect Workers



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Involve the Worker
Respect the Worker

Gemba

GEMBA = Where the Real Work is Done

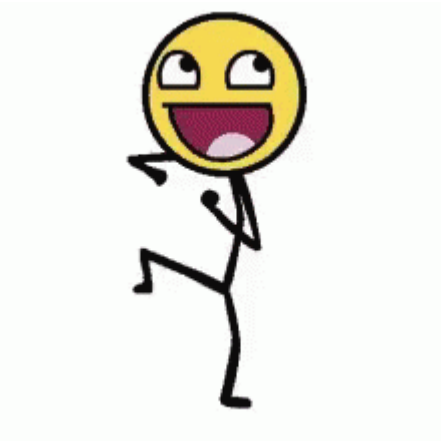
- Japanese translation "The Place where Value is Created"
- GEMBA describes the physical places at work where workers ADD VALUE for the CUSTOMER.

- **ANSWERING CUSTOMER PHONE CALL**
- **PACKING**
- **WELDING**
- **ASSEMBLING**
- **PAINTING**
- **CLEANING etc**

- RESPECT of the GEMBA and the Workers is fundamental to Lean

Gemba Walks

Genchi Genbutsu



1. **Go See it for yourself at the Gemba**
2. **Ask the right questions to workers**
3. **Show Respect to the workers**

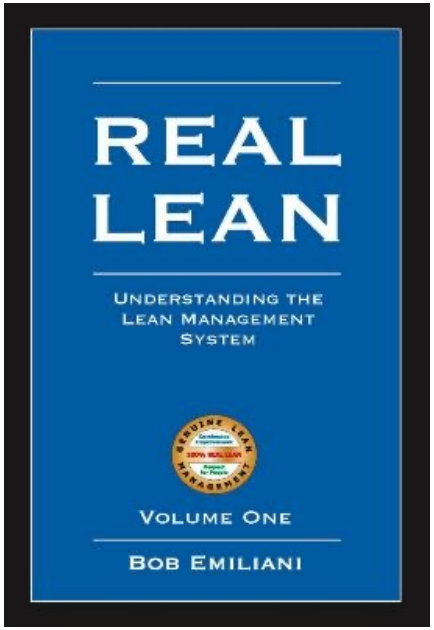
Gemba Walks are opportunities to coach and teach your workers.

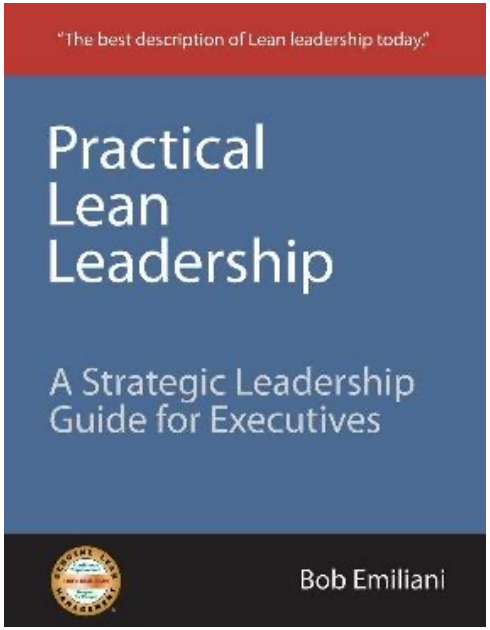
LEAN SOLUTIONS

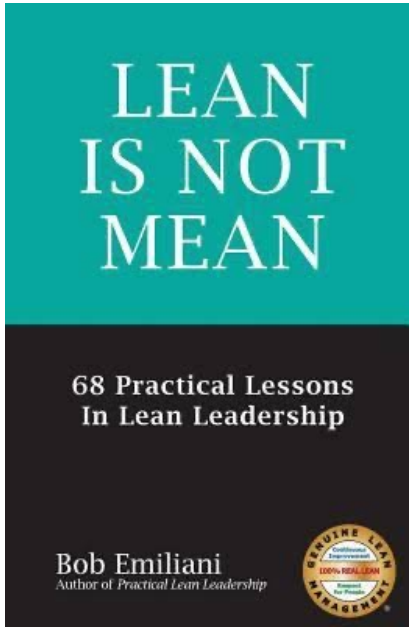
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‘ Lean Management ’ Behaviour







Professor Bob Emiliani

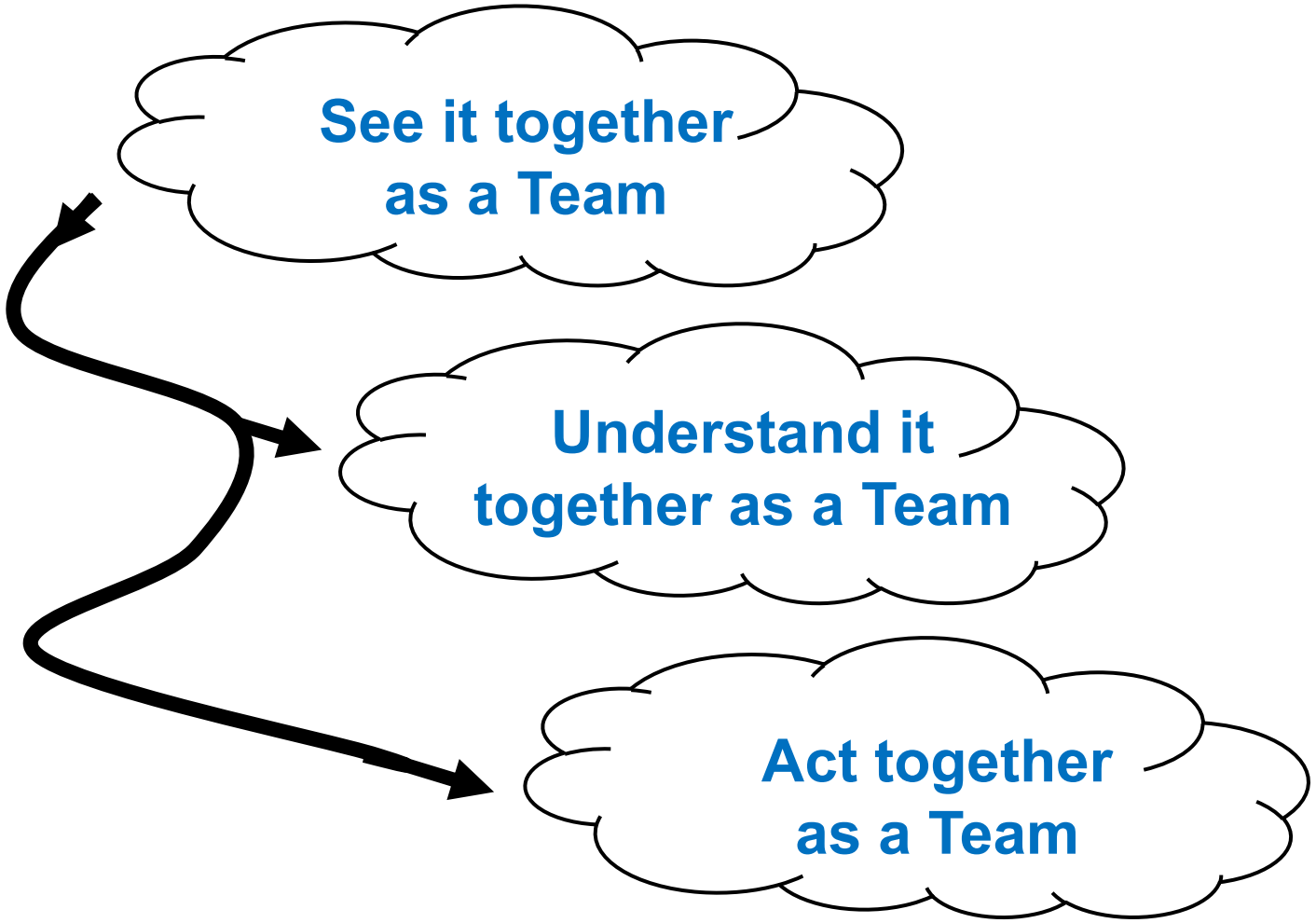
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Visual WorkPlace

The Visual Factory / Visual Management



The Visual **Workplace** / Visual Management

A Visual Workplace (Visual Management) enables a team to effectively manage its processes with clear VISUAL COMMUNICATIONS that ALL TEAM MEMBERS can clearly see!

- **Can we all clearly see when we have Downtime Issues?**
- **Can we all clearly see when there is an accident?**
- **Can we all clearly see what our team performance is ?**
- **Can we all clearly see our Tools & Supplies?**





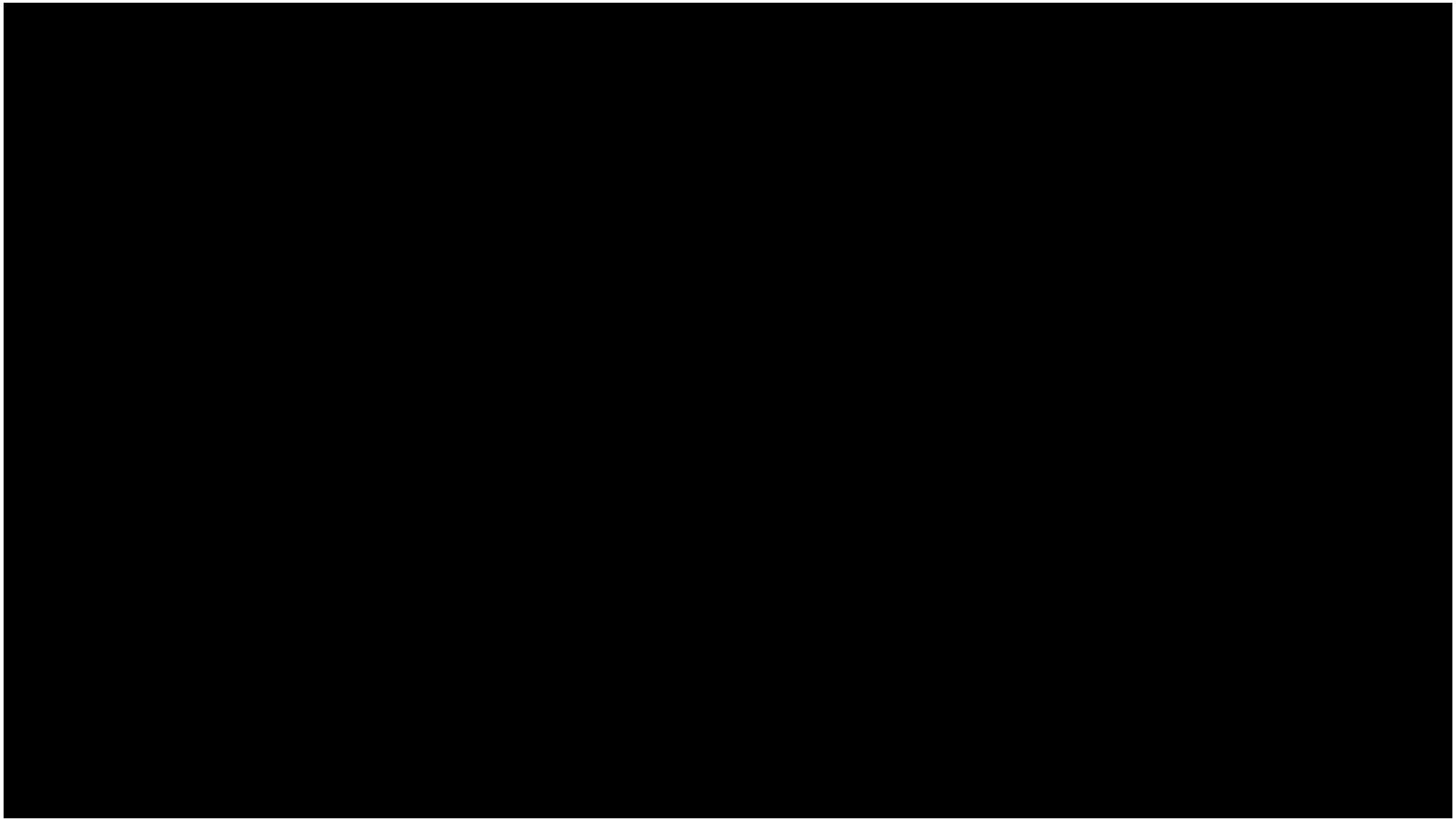
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Visual Management

https://www.youtube.com/watch?v=2NrNq9cHTBA



Visual Factory

https://www.youtube.com/watch?v=jiJSvNu87EE



Examples of Visual Workplace



A Visual Work Place



Labeling of disposal bins


E-stop



Requirements



Lock out procedure



Stop before proceeding


Shadow Board

A Visual Work Place

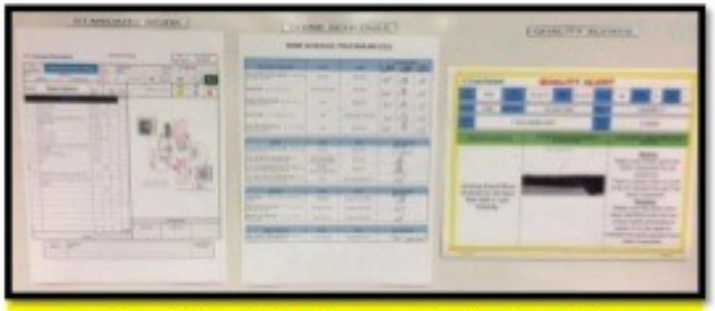


Floor markings


Scheduling



Temporary work station or activity


Labels to identify documentation locations


Bin labels for different components

Visual Management Tools

Kamishibai Board : Cards are red on one side and green on other side.



Visual Management in your work

- What areas of your work could do with Visual Management ?

- What ideas do you have for Visual Management in your work?

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Standardized Work

What is Standardized Work?

- **Standardized (Standard) work is an agreed-upon set of work procedures that establish the best and most reliable methods and sequences for each process and each staff**

- Standard work aims to maximize performance while minimizing waste in each person's operation and workload

- Standard work helps people and equipment each day to meet customer demand

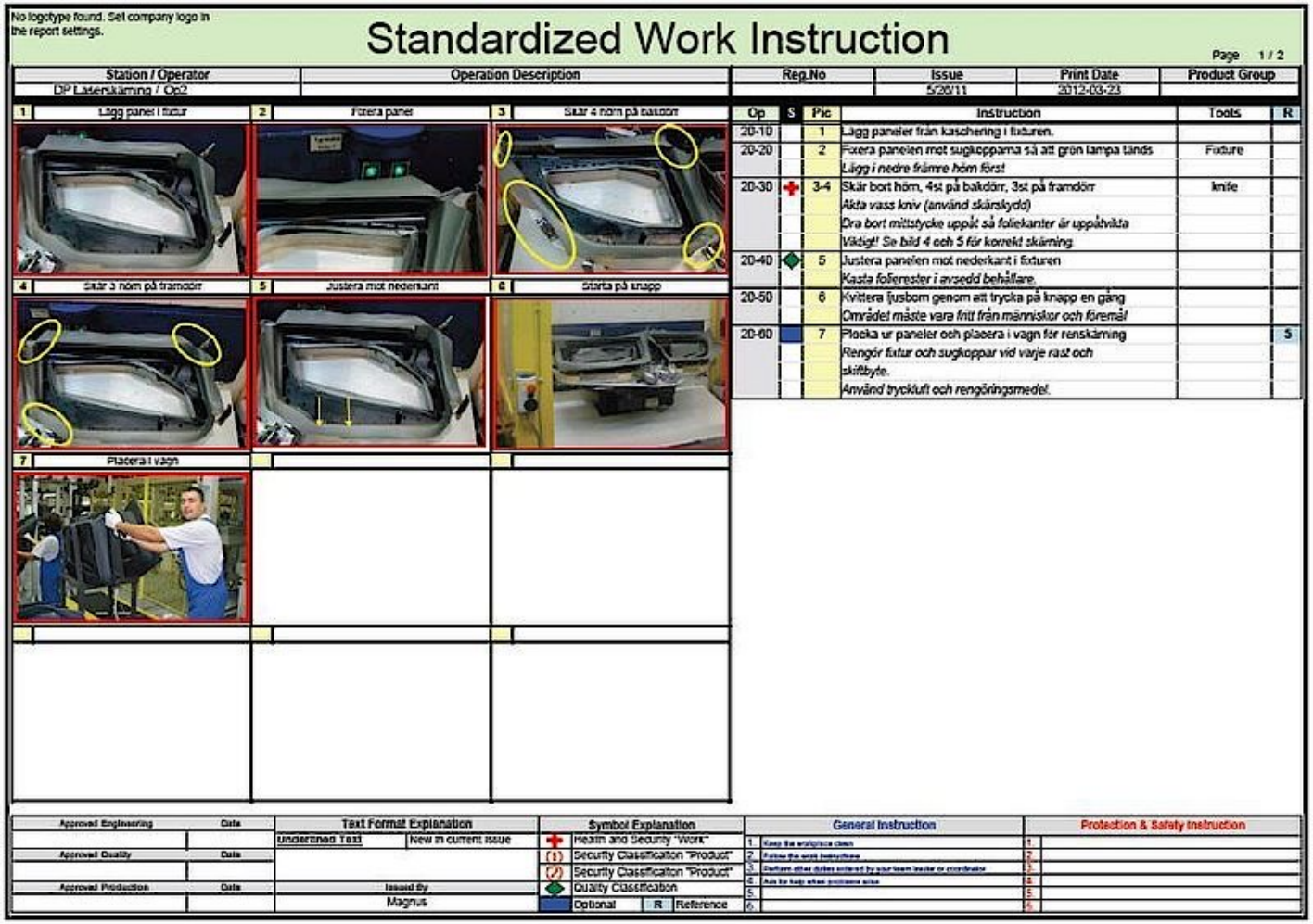
Standard Operating Procedures (SOPs)



Recipe (SOP)

1. Heat the oven to 180C/350F/Gas 4.
2. Line two 18cm/7in **cake** tins with **baking** parchment.
3. Cream the butter and the sugar together until pale. ...
4. Beat in the eggs.
5. Sift over the flour and fold in using a large metal spoon.
6. The mixture should be of a dropping consistency; if it is not, add a little milk.

Use Photos Where Ever You Can



No logotype found. Set company logo in the report settings.

Standardized Work Instruction

Page 1 / 2

Station / Operator	Operation Description	Reg.No	Issue	Print Date	Product Group
DP Lasenskärning / Op2			5/26/11	2012-03-23	

1 Lägg panel i fixtur
2 Fixera panel
3 Skär 4 hörn på bakdörr
4 Skär 3 hörn på framdörr
5 Justera mot nederkant
6 Stärta på knapp
7 Placera i vagn

Op	S	Pic	Instruction	Tools	R
20-10		1	Lägg paneler från kaschering i fixturen.		
20-20		2	Fixera panelen mot sugkopparna så att grön lampa tänds *Lägg i nedre främre hörn först*	Fixture	
20-30	✚	3-4	Skär bort hörn, 4st på bakdörr, 3st på framdörr *Akta vass kniv (använd skärskydd)* *Dra bort mittstycke uppåt så foliekanter är uppåtvikta* *Viktigt! Se bild 4 och 5 för korrekt skärning*	knife	
20-40	◆	5	Justera panelen mot nederkant i fixturen *Kasta folierester i avsedd behållare.*		
20-50		6	Kvittera ljusbom genom att trycka på knapp en gång *Området måste vara fritt från människor och föremål*		
20-60		7	Plocka ur paneler och placera i vagn för renskärning *Rengör fixtur och sugkoppar vid varje rast och skiftbyte.* *Använd tryckluft och rengöringsmedel.*		S

Approval Engineering	Date
Approval Quality	Date
Approval Production	Date

Text Format Explanation	
Underlined Text	New in current issue

Issued By: Magnus

Symbol Explanation	
✚	Health and Security "Work"
(1)	Security Classification "Product"
(2)	Security Classification "Product"
◆	Quality Classification
	Optional R Reference

General Instruction		Protection & Safety Instruction	
1.	Keep the workplace clean	1.	
2.	Follow the work instructions	2.	
3.	Perform other duties ordered by your team leader or coordinator	3.	
4.	Ask for help when problems arise	4.	
5.		5.	
6.		6.	

Team Work for Developing SOPs

Making good SOPs is a Team Activity , Not 1 person !



1. **Arrange a workshop to collect input and ideas from all workers that will be using the SOPs**

2. **Review the final SOPs with all the team and get sign-off**

3. **Conduct Training with the new SOPs before they are used in production**

LEAN SOLUTIONS

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3 key elements to good SOPs

Good Standardised Operational Procedures (SOPs) should have 4 key elements

1. **Important Steps**
   The Logical Order in which to do the Operation

What ?

2. **Key Points**
   Anything in the Step important to avoid Injury or to make the job safer and easier

How ?

3. **Reasons Why we need to do it this way**

Why ?

4. **Visual example of it done correctly**

Show me

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Example : SOP for Folding a T-Shirt

Important Step (What) **A logical segment of the operation when something happens to advance the work**	**Key Points (How)** **Anything in a step that might:** **1. Make or break the job** **2. Injure the worker** **3. Make the work easier**	**Reasons (Why)** **Reasons for the key points**
1. Lay flat	• facing up, top to the right	• consistent starting point
2. Pinch top	• right hand, halfway between collar and seam • through both layers • left hand, create vertical crease	• proper alignment • holds shirt together • visual aid
3. Pinch middle	• left hand, halfway down vertical crease	• proper alignment
4. Pinch bottom	• right hand over left hand, bottom of vertical crease	• proper alignment
5. Uncross hands	• holding pinches, shake out	• removes wrinkles
6. Flop and fold	• face down • over exposed sleeve	• exposes final fold • completes fold

Folding a T-Shirt



https://www.youtube.com/watch?v=dNV4mOK5gW4

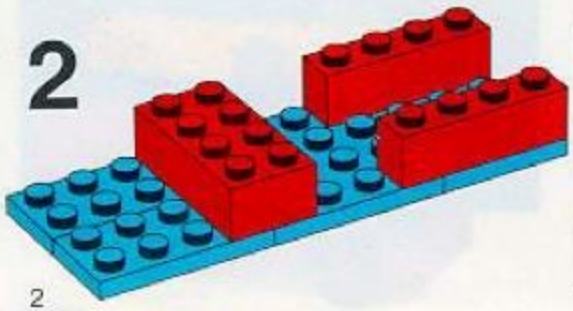
LEGO instruction download courtesy of ToysPeriod.com



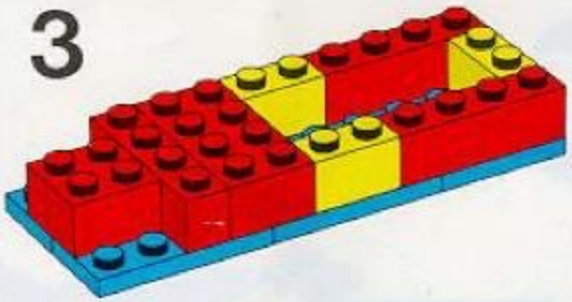
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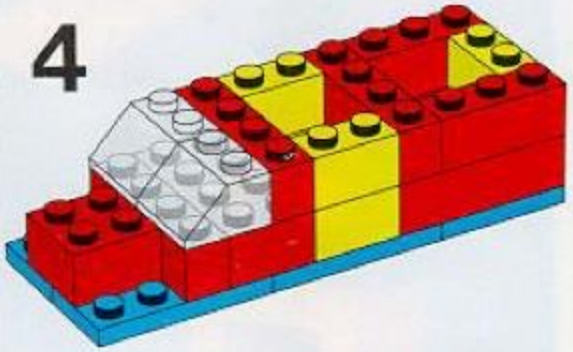
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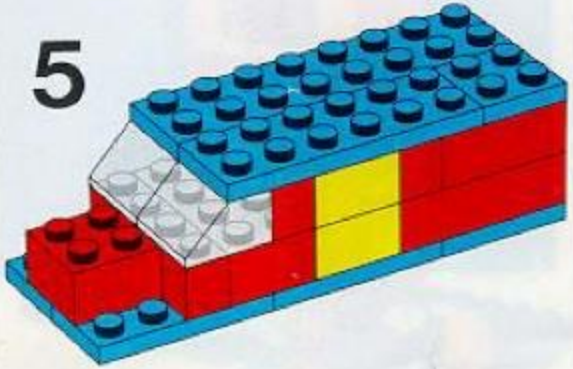
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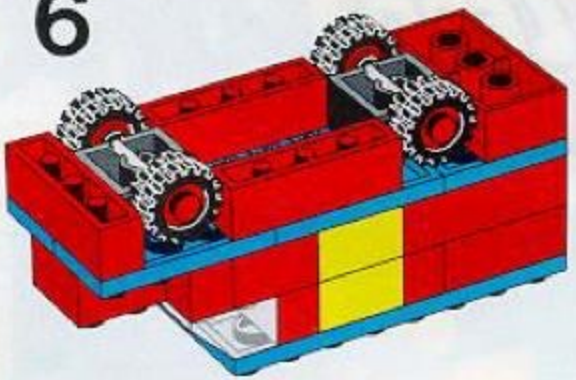
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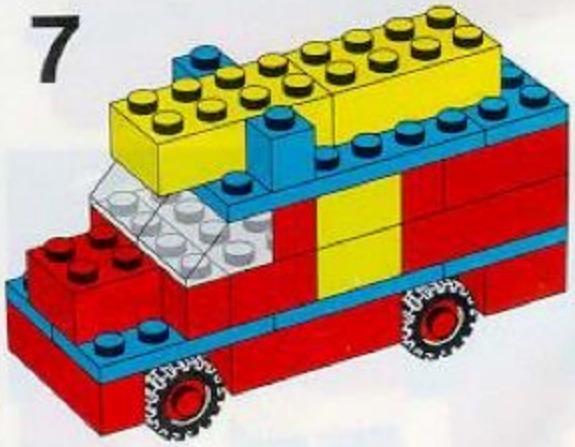
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6



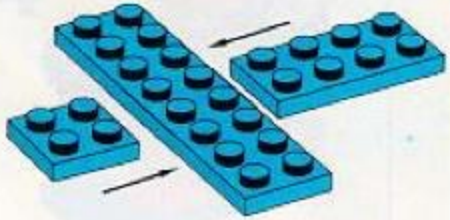
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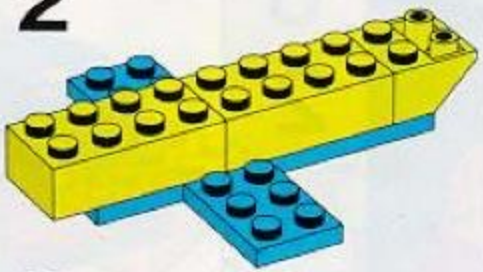
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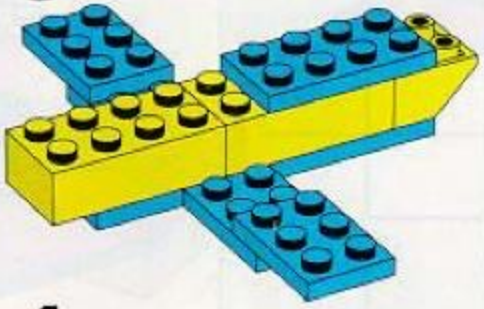
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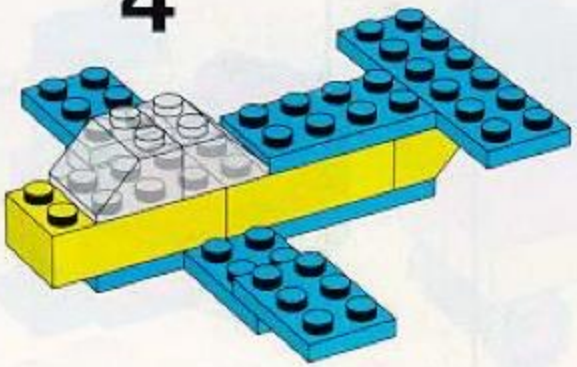
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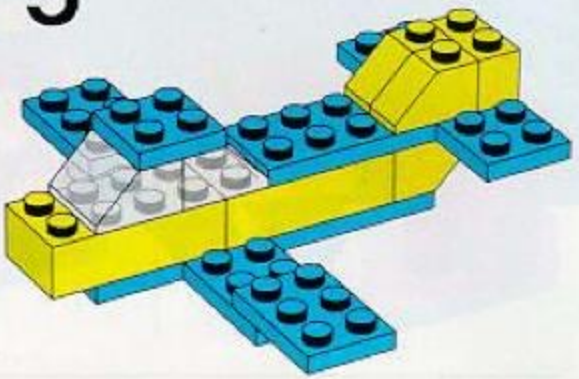
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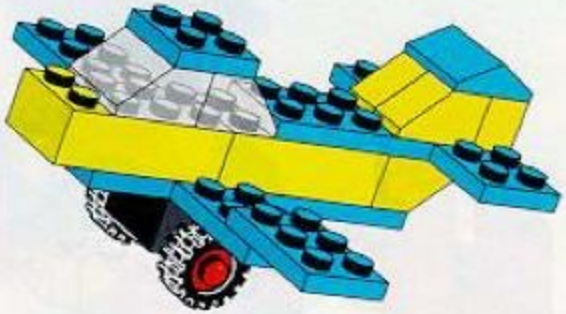
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5



6



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SOP for 3-Star Manufacturing Inc

Construct a 6 to 8 Step SOP for 3-Star Manufacturing Inc






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SOP for 3-Star Manufacturing

	Important Step (What)	Key Points (How)	Reason (Why)
1			
2			
3			
4			
5			
6			

Quiz 7:

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- What is a 'Gemba Walk' ?
- **Going to see for yourself what is happening where the real work is done**
- What is the benefit of having a Visual Work Place ?
- **All team members can see the status of work and operations easily and at the same time.**
- Give one example of a Visual Management tool or technique ?
- **Colour Coding, Notice Boards, Graphs and Charts, Good Labelling**

- What are the key components to a good SOP (Standard Operating Procedure)?
  - **What**
  - **How**
  - **Why**
  - **Use a picture or video**

- A fundamental concept of any Lean Process is that it has well defined and repeatable actions by workers. This concept is call _____work
- **STANDARDISED**

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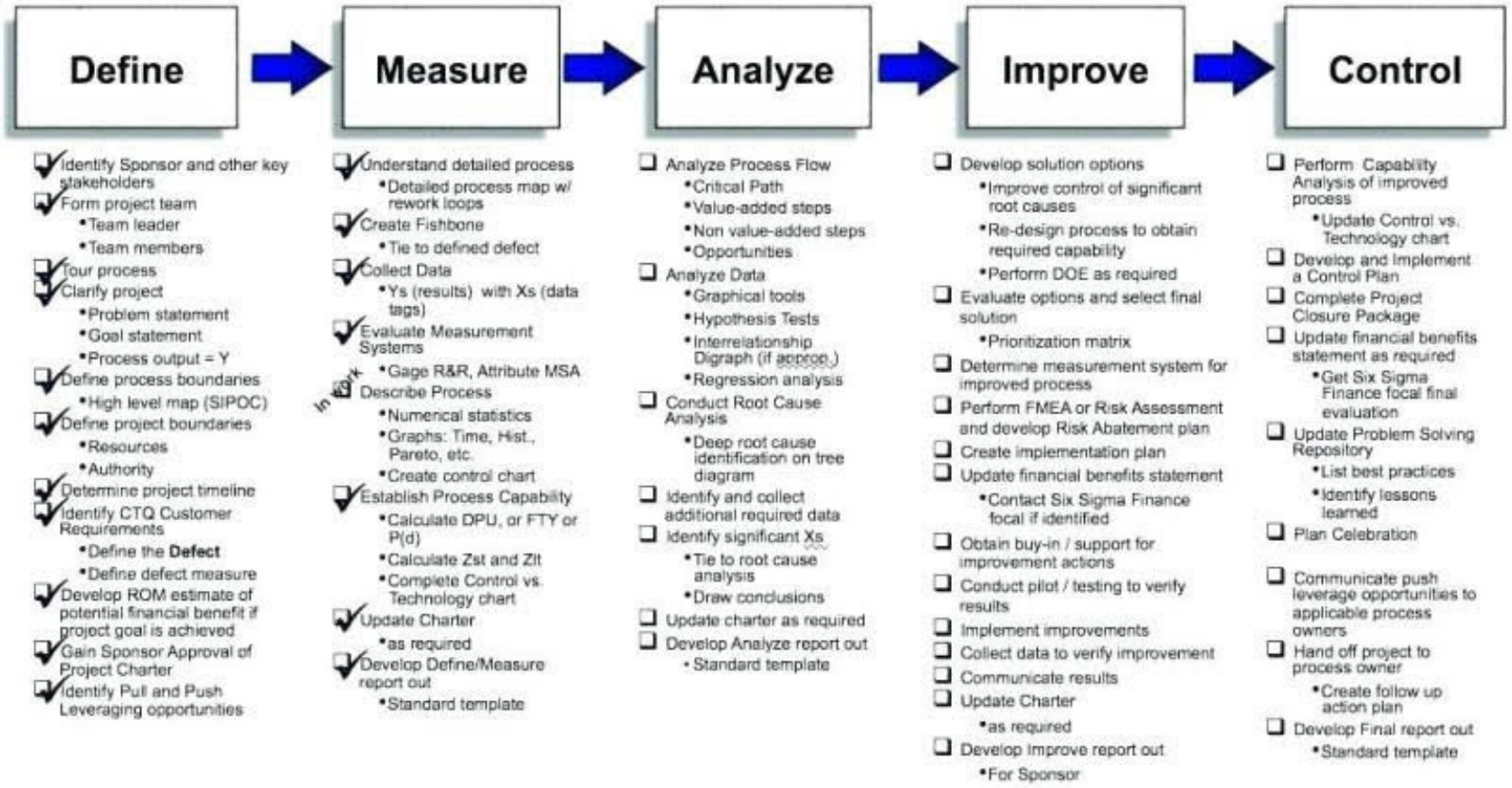
DMAIC

The Six Sigma Framework for Problem Solving

- **Define** - the business problem (or opportunity), Team and Scope
- **Measure** - the process current state (as-is) of the problem area
- **Analyze** - determine Root Cause of the problem
- **Improve** - Identify and Choose Best Solution then implement the solution
- **Control** – Ensure your solution is working. Monitor and Control.

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Project – DMAIC Roadmap



Scientific Method (1620)	DMAIC (1986)	PDCA (1939)	8D (1987)
Define Problem	Define	Plan	1. Establish the Team
			2. Describe the Problem
Formulate Hypothesis	Measure		3. Develop Interim Containment Actions (ICA)
Gather Appropriate Data	Analyze		4. Define/Verify Root Causes
Test Data			5. Choose/Verify Permanent Corrective Action (PCA)
Develop Conclusions	Improve	Do	6. Implement/Validate PCA
	Control	Check	7. Implement/Validate Preventive Action
		Act	8. Recognize the Team

Source: KAVON International, Inc. and JMP Consulting

Figure 1: *Roadmap Comparisons to the Scientific Method*

We do NOT need to use all the possible tools on every project.

Be ‘Lean’ in selecting correct tools according

a) The type of problem

b) The scale/size of problem

c) How much money and time you have

d) The skills /experience of your project team

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Define Phase

-Defining the PROBLEM

-Defining the PROJECT

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DMAIC - (D-e-e-m-a-k-e)

- **Define** - the business problem (or opportunity)
- **Measure** - the process current state (as-is) of the problem area
- **Analyze** - determine Root Cause of the problem
- **Improve** - Identify and Choose Best Solution then implement the solution
- **Control** - Ensure your solution is working. Monitor and Control.

DEFINE : Problem and Project Definition

Define

- The most important Phase of any DMAIC Project
- Choose the right problem to tackle
- Define the PROBLEM
- Identify the key TEAM members and STAKEHOLDERS
- Understand the SCOPE
- Present a good BUSINESS CASE
- Develop a PROJECT CHARTER

3 Document Outputs of Define

1. Business Case (including Problem Statement)

2. Project Charter

3. High Level Process Map or SIPOC

Project Selection – Core Components

Business Case – The Business Case defines the Problem and the Business motivation for considering the project.

The Problem is defined with a 'Problem Statement'.

Project Charter – The Project Charter is a more detailed version of the Business Case. This document further focuses the improvement effort. It can be characterized by two primary sections; one, basic project information and two, simple project performance metrics.

High Level Process Map – Used to show a high level understanding of the scope of the process that is to be measured, analyzed, improved and controlled. The SIPOC tool can also be used.

What is a Business Case ?

A Business case has 3 main parts :

1. What is the problem that the business or the customer is experiencing? This part is called the 'Problem Statement'

2. What is the target or goal we are trying to reach ?

3. What are the consequences for the business if the problem is not solved, or business benefits if it is solved ? In other words, what is the business motivation for a project to solve the problem ?

The Business Case is constructed with the help of the Process Owner / Manager or the Business Owner / Manager.

Business Case example

Problem Statement

- Customer complaints have increased by 50% in 2019. The 2017 average was 20 complaints per month with a total of 240 over the full year. 2018 average was 21 per month with a total of 252 over the year, The average for the first 5 months of 2019 is 30 complaints with a total of 150 in 5 months.

Target

- We need to reduce complaints back down to the 2017 level of an average of 20 per month.

Consequences

- We will see a drop in new customers and also customers leaving if we do not reduce the complaints and increase customer satisfaction.

What is a Project Charter?

The ***Project Charter*** expands on the Business Case, it clarifies the project's focus and the measures of project performance. The Project Charter completed by the Six Sigma Belt (Green or Black).

Example Project Charter

Lean Six Sigma Project Charter

Project Information

Project Name	
Department/Agency	
GB/BB Candidate	*Must be within the Executive Sponsor's and Champion's organization*
Champion	*Must be within the Executive Sponsor's organization*
Process Owner	*Ideally the same person as the Champion, if not then must be a direct report to the Champion*
MBB Coach	*You will be assigned an MBB Coach later.*
Executive Sponsor	*Oversees the organization within which the project is executed*

Project Overview

Problem Statement	*What is the issue that we are going to address with the project? What specifically is the negative impact of this problem on customers, employees, financials, etc. Give a very brief history and use historical data to quantify the problem.*	
Objective	*What are we trying to accomplish with this project? The objective should be stated in terms of the primary metric (below).*	
Scope	1. Project Scope (IS):	*On what process will the team will focus? What are the boundaries of the project such as agency, area, department, etc?*
	2. Out of project scope (IS NOT):	*What remains outside the area of project team work?*
Process Stakeholders	*Who will be impacted by this project? Include any customer(s) / internal and external, downstream process owners, suppliers, upstream process owners, etc. who may be affected.*	

Metrics

	description	estimated baseline	goal
Primary Metric	*Give a precise definition of the metric on which we are basing our project (the metric we are focusing on improving).*	*estimate of current level of primary metric*	*Goal for the primary metric*
Secondary Metrics	*What are the metrics that we do not want to be negatively impacted as a result of our project?*		
Project Benefits	*What will be the benefits of a successful project? Who are the customers that will see better services or products? If the benefits are financial, what are the expected annual savings? (For financials, need to include the calculations behind the savings claims.)*		

Project Team

Team Member	Role Within the Organization

Project Schedule

Project Charter Tollgate	*expected completion date (This will be filled in later)*
Measure Phase Tollgate	*expected completion date (This will be filled in later)*
Analyze Phase Tollgate	*expected completion date (This will be filled in later)*
Improve Phase Tollgate	*expected completion date (This will be filled in later)*
Final Report-Out and Certification	*expected completion date (This will be filled in later)*

Signoffs

role	name	date	signoff
Champion			☐
Process Owner			☐

Lean Six Sigma Project Charter

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Objective	*primary metric (below).*	
Scope	1. Project Scope (IS):	*On what process will the team will focus? What are the boundaries of the project such as agency, area, department, etc?*
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Signoffs

role	name	date	signoff
Champion			☐
Process Owner			☐

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SigmaXL Team/Project Charter

TEAM/PROJECT CHARTER

Project Name:	
Date (Last Revision):	
Prepared By:	
Approved By:	

Business Case:	**Opportunity Statement (High Level Problem Statement):**
	Defect Definition:
Goal Statement:	**Project Scope:**
	Process Start Point:
	Process End Point:
Expected Savings/Benefits:	In Scope:
	Out of Scope:

Project Plan:				**Team:**		
Task/Phase	Start Date	End Date	Actual End	Name:	Role:	Commitment (%):

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Project Charter - Definitions

- ***Problem Statement*** - Articulates the pain of the defect or error in the process.
- ***Objective Statement*** – States how much of an improvement is desired from the project.
- ***Project Scope*** – Articulates the boundaries of the project. (Use SIPOC diagram)
- ***Primary Metric*** – The actual measure of the defect or error in the process.
- ***Secondary Metric(s)*** – Measures of potential consequences (+ / -) as a result of changes in the process.
- **Project Black Belt & Process Owner names**
- **Start date & desired End date**
- **Division or Business Unit name**
- **Team Members**
- **Stakeholder names**

A SMART METRIC

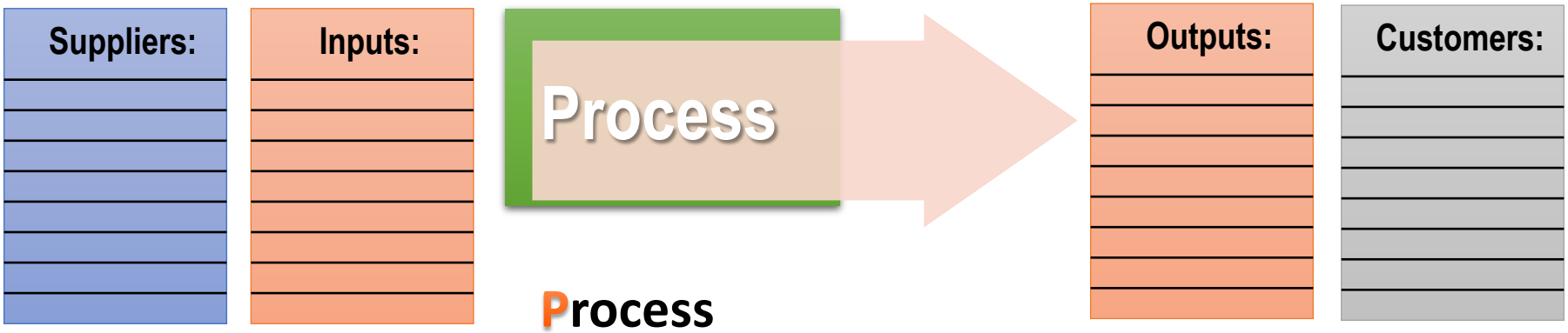
When choosing the best METRIC to use as the main measure of success of your project, consider the SMART method of choosing metrics

- ***S = Specific*** ***(Is the metric well defined)***
- ***M = Measurable*** ***(How will we measure it easily?)***
- ***A = Attainable*** ***(Can we achieve the target ?)***
- ***R = Relevant*** ***(Is the metric the related to the problem ?)***
- ***T = Time Bound*** ***(When are we going to measure it ?)***

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SIPOC for the Define Phase



Suppliers
All internal and external suppliers to the process

Inputs
All inputs to the process i.e. material, forms, information, etc.

Process
One block representing the entire process with its name

Outputs
All outputs for both internal and external customers

Customers All internal and external customers to the process

SIPOC for the Define Phase

Class exercise: Complete this SIPOC for making a PARCEL delivery of a product that a customer has purchased through your company website.

Process name : _____

Suppliers	**I**nputs	**O**utputs	**C**ustomers
1._____	1._____	1._____	1._____
2._____	2._____	2._____	2._____

Other Activities for the Define Phase

- High Level Project Plan (Schedule)
- Start of Project Documentation
  - Issues Log
  - Communications Management Plan
  - Human Resources Plan
  - Stakeholder Management Plan (hint : use RACI to assist)
- Gate review involving Stakeholders before Measure Phase

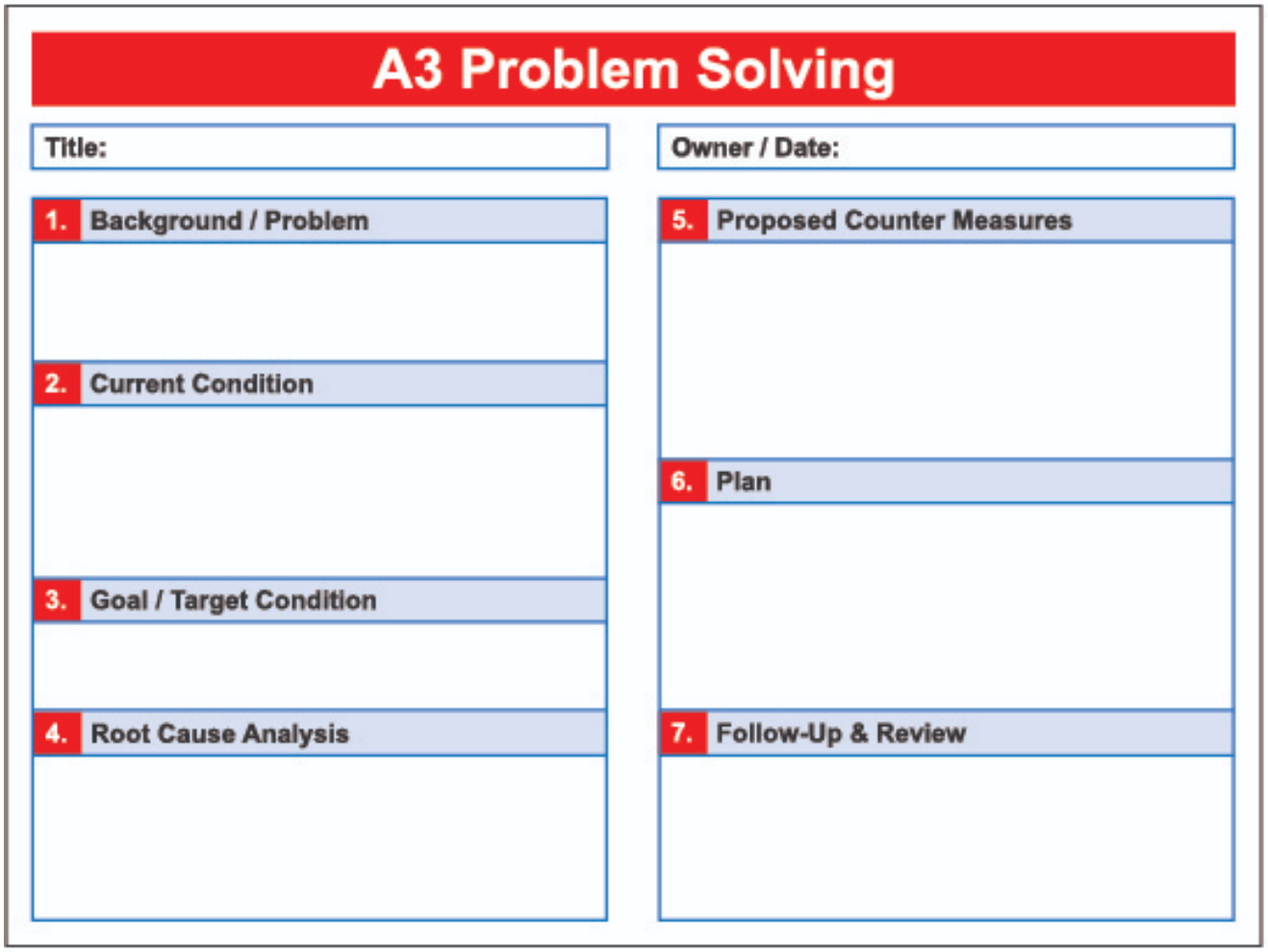
Compare with Prince2 / PMP / G8D / PDCA

PMP / Prince 2 / G8D / PDCA / A3

Prince2	PMP	G8D	PDCA	Lean6Sigma
• Starting up a project • Initiating a project • Directing a project • Controlling a stage • Managing stage boundaries • Managing product delivery • Closing a project	• Initiate • Plan • Execute • Control • Close	• Team • Problem • Contain • Root Cause • Correct • Monitor • Celebrate	• Plan • Do • Check • Adjust	• Define • Measure • Analyze • Improve • Control

A3 reporting : Used by some Lean Organizations to compliment PDCA , G8D or DMAIC
(see your folder for example)

A3 report



A3 Problem Solving

Title:

Owner / Date:

1. Background / Problem

2. Current Condition

3. Goal / Target Condition

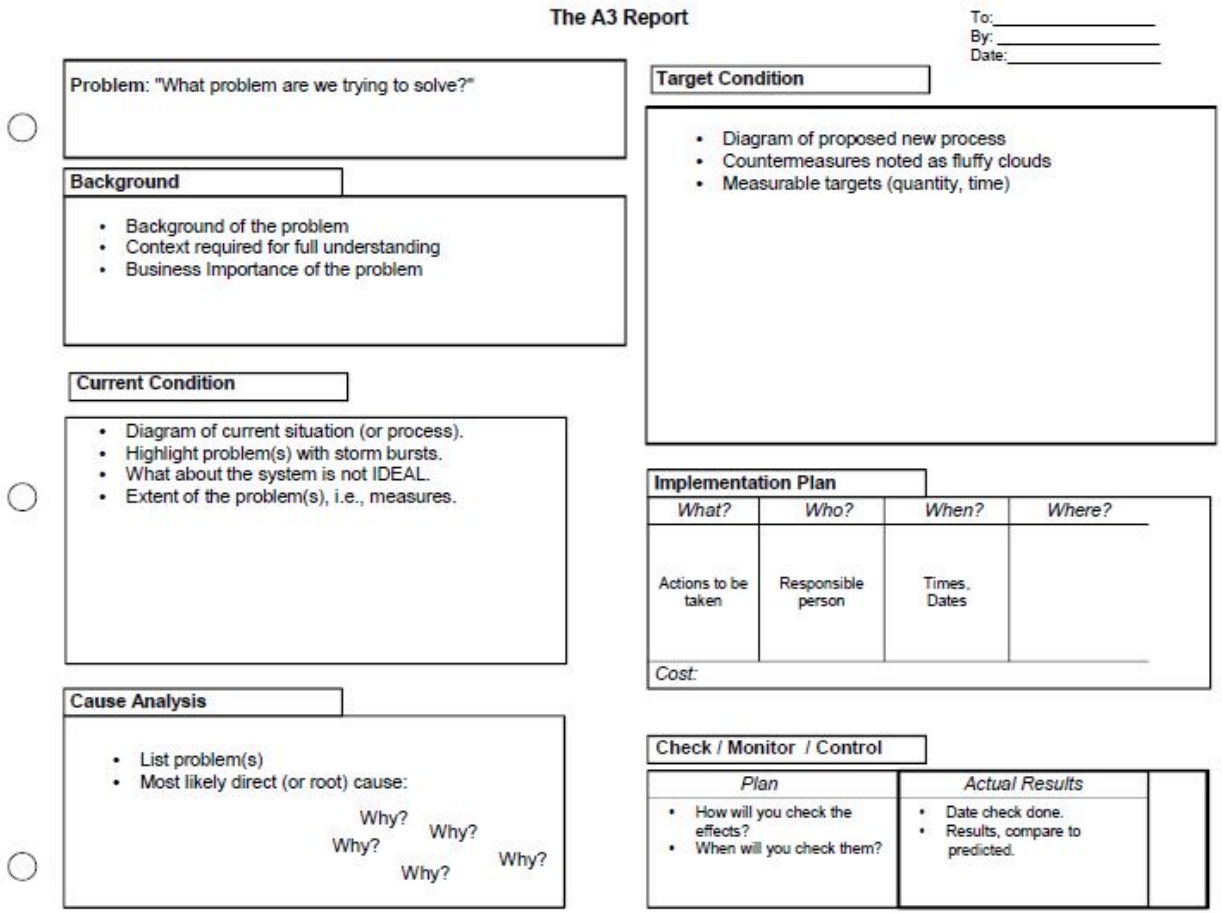
4. Root Cause Analysis

5. Proposed Counter Measures

6. Plan

7. Follow-Up & Review

A3 report



The A3 Report

To: _____
By: _____
Date: _____

Problem: "What problem are we trying to solve?"

Background

- Background of the problem
- Context required for full understanding
- Business Importance of the problem

Current Condition

- Diagram of current situation (or process).
- Highlight problem(s) with storm bursts.
- What about the system is not IDEAL.
- Extent of the problem(s), i.e., measures.

Cause Analysis

- List problem(s)
- Most likely direct (or root) cause:

Why? Why? Why? Why? Why?

Target Condition

- Diagram of proposed new process
- Countermeasures noted as fluffy clouds
- Measurable targets (quantity, time)

Implementation Plan

What?	*Who?*	*When?*	*Where?*
Actions to be taken	Responsible person	Times, Dates	
Cost:			

Check / Monitor / Control

Plan	*Actual Results*	
• How will you check the effects? • When will you check them?	• Date check done. • Results, compare to predicted.	

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Airport Improvement Case Study Video



Heathrow Airport Example

- Flight delays are being halved after the introduction of an air-traffic control system designed to eradicate gridlock in the skies.
- Rising numbers of aircraft will be able to land in strong headwinds — the biggest single cause of delays —
- The £13 million system, which is the first of its kind, allows air traffic controllers to land planes closer together by calculating the space between them based on time rather than distance.
- The change is likely to save £7.5 million per year in lost productivity and compensation claims as a result of reduced backlog on the approach to the airport
- It is hoped that 2,700 hours of delays in arrival flights will be cut in half

1. **State the business problem (Problem Statement)**
2. **Suggest a Business Case for the change?**
3. **What was the Primary Metric (KPI) being improved ?**
4. **What might be some Secondary Metrics considered ?**

Summary

At this point you should be able to:

- Understand the importance for the Define Phase.
- Understand the 3 main output documents of the Define Phase
  - Business Case
  - Project Charter
  - SIPOC of Level 1 Process Map
- Understand SMART Metrics
- Understand the Tuckman Model of Team building
- Understand other **"Initiate Project"** components of the Define Phase

Quiz 8:

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- What is the framework used in Lean Six Sigma for running Lean Six Sigma projects where we are unsure of the root cause or solution ?
- **DMAIC Define – Measure – Analyse – Improve – Control**

- What are the names of the 3 document deliverables in the DEFINE Phase ?
- **Business Case (including Problem Statement)**
- **Project Charter**
- **Scope Statement or SIPOC**

- What does the acronym SIPOC mean ?

SUPPLIERS, INPUTS, PROCESS, OUTPUTS, CUSTOMERS

- In the Define Phase we identify the Project Team Members and Stakeholders. Name some categories of STAKEHOLDERS to consider.
- **CUSTOMERS, SUPPLIERS, EXECUTIVES, PROCESS OWNERS**

- What do we call a 1-page summary document showing status of your whole project?
- **A3 Report**

LEAN SOLUTIONS ACADEMY



Lean Six Sigma Training

Green Belt

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GREEN BELT PROJECT

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Project Charter

PROJECT INFORMATION			
Project Title:	Achieve our 95% Inventory Accuracy Target	**Project Initiation Date:**	09/29/2022

Problem Statement: We have inventory inaccuracy in the factory resulting in achieving in an average 92% accuracy rate over 6 months (Apr 2022 - Sept 2022) after 4,378 individual part cycle counts. This inaccuracy has led to missed orders and waste looking for material.

Project Goals: After determining and implementing solutions, achieve 95% inventory accuracy for 3 months after the next 3 month AB inventory cycle moves through.

In Scope (Inclusions):	**Out of Scope (Exclusions):**
Inventory in the A & B inventory classification code.	Inventory classified as a C item.

Project Champion:	Dennis Patrick
Process Owner(s):	All that do inventory transactions and engineering changes to creat BOM's.
Project Manager:	Doug Saunders
Core Team Members:	Kyle Sinke, John Pham, Tracy Helmer, Managers
Target Completion Date:	March 31, 2023

PROJECT OBJECTIVES		
Objective	**Baseline**	**Target**
Objective #1 Achieve 95% inventory accuracy on A & B Items. Currently achieving 92%	92%	95%
Objective #2 Create Standard Work for inventory transaction.	No Standard Work in place.	Standard Work and training.
Objective #3		

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SIPOC

Suppliers (resource provider)	Inputs (process)	Process (high level process flow)	Outputs (from the process)	Customers (receiver an output from the process)	
Coffeemaker purchased - on countertop	>5 cup capacity coffee maker	**Making coffee**	heating to keep coffee warm for 1 hour after brewing	All of us enjoy the same brand of coffee with varying condiments	
city water supply into faucet	water supply	Add water	enough coffee to serve all of us within 15 minutes of start time.	1 cup of coffee	wife
purchase from XYZ company	1 filter	Add filter & ground coffee	one filter to prevent overflow	1 teaspoon of french vanilla creamer	
Use ABC brand beans	4 tablespoons of coffee grinds		correct amount of grinds		
Electric company	120V GFCI outlet	Plug-in and turn on		1 cup of coffee	husband
Upper left drawer next to refrigerator	measuring spoons		Source to heat water to temperature	Honey on the table	
			Pump to move water up through filter.	Dash of cinnamon	
Mugs purchased - in upper left cabinet	coffee mugs	Pour into mug	Hot coffee filled near the top of the mug.		
refrigerator and pantry	condiments and containers for sugar, creamer, honey, cinnamon.	Add condiments		1 small cup of coffee for each	
ABC brand for sugar & creamer.			coffee served in spouses favorite mug	1 teaspoon sugar	
XYZ brand for honey and cinnamon		Stir	coffee served in husbands mug	1 tablespoon french vanilla creamer	
pantry	stirrers, lids	Serve	coffee served in personalized kids mugs	Let sit for 5 minutes before serving	2 teenagers

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STRUCTURED
PROBLEM SOLVING

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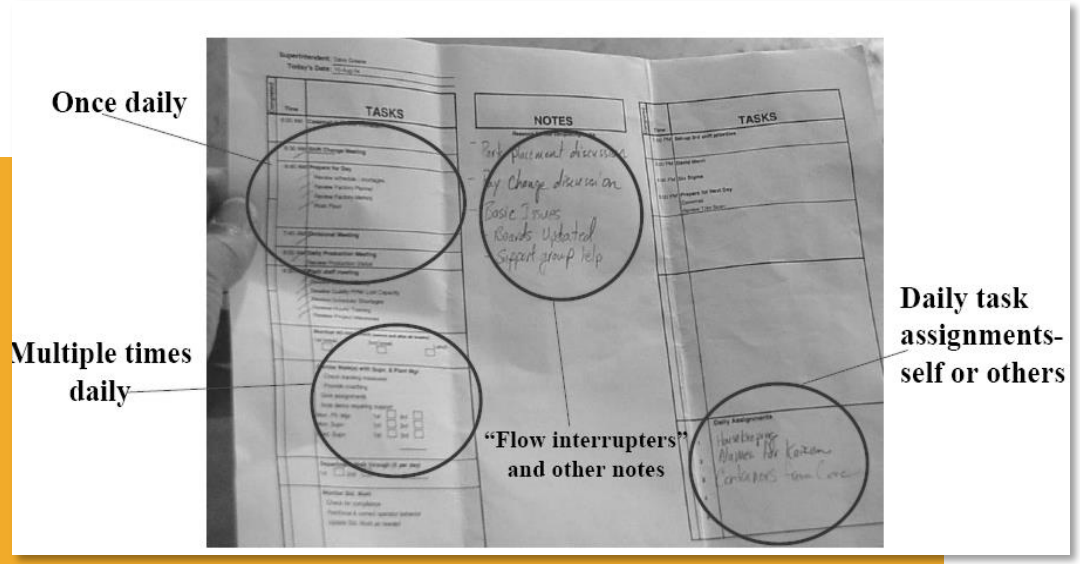


INTRODUCTION

- What types of problem solving are in use throughout your Organization?
- How effective is the problem solving in your facility at determining the TRUE root cause?

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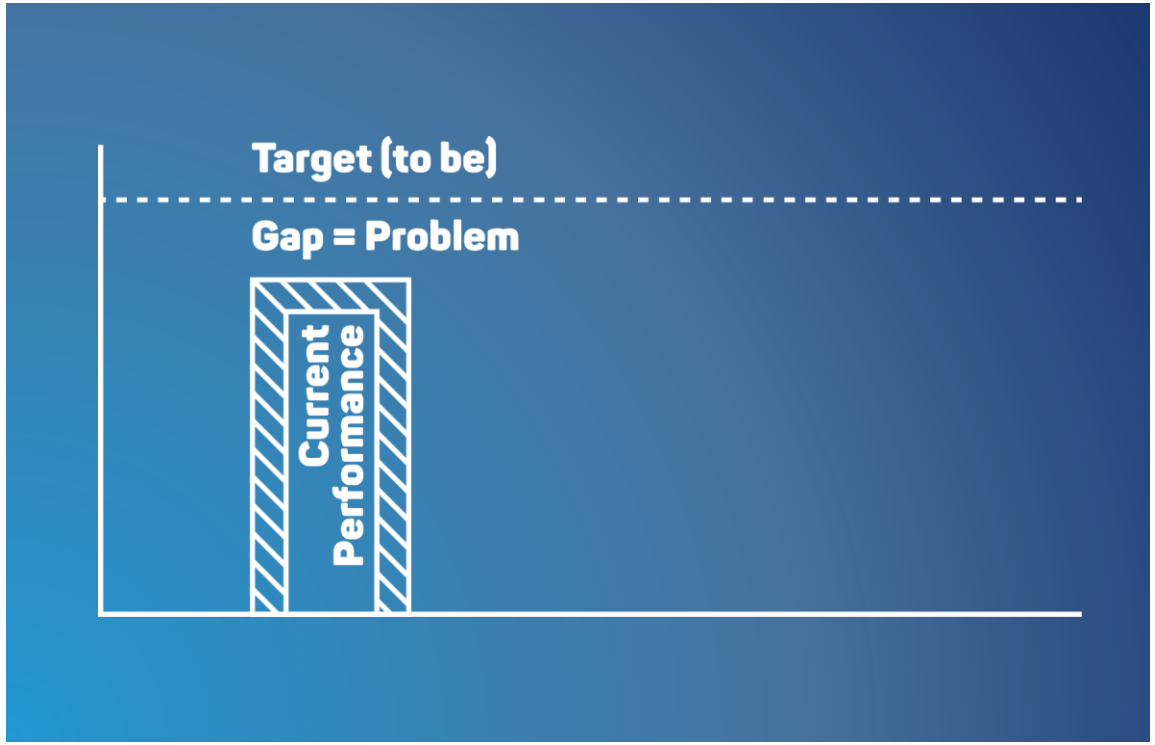
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WHY

BASIC PROBLEM SOLVING?

It's a general rule of life that we will try anything easy that doesn't work before we will embrace anything harder that does.



WHAT IS
A PROBLEM?

A problem is a “gap” - between:

Current condition – **what is actually happening**
Target or ideal condition – **what should be happening, what is needed**

WE NEED

STRUCTURED PROBLEM SOLVING

Unstructured Problem Solving	Structured Problem Solving
Time consuming	Saves time
Drags out	Has an end goal in mind
May solve a problem, but not the root cause	Identifies the actual cause of the problem, not just the symptom
May need to be repeated over and over	Fixes the problem for good

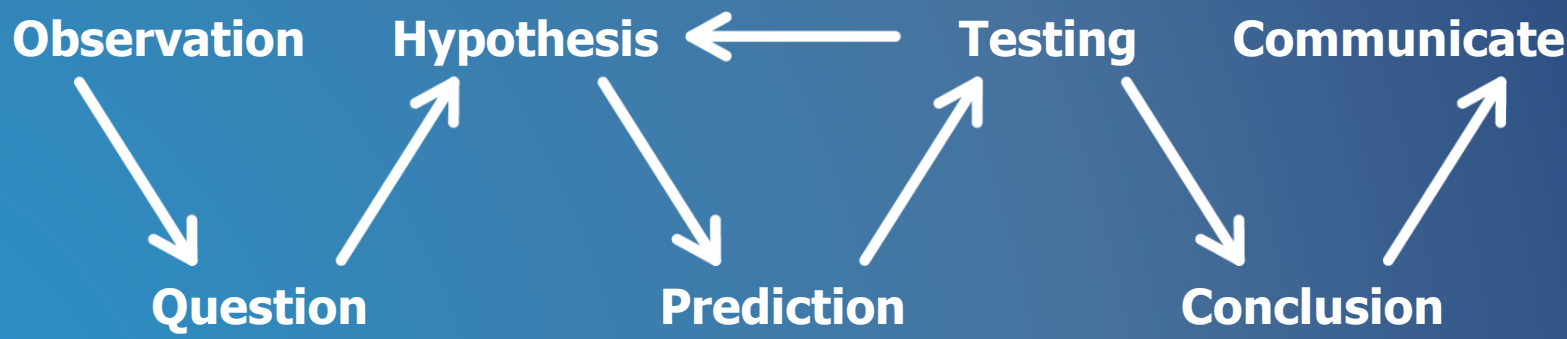
WHO SHOULD BE INVOLVED
IN SOLVING PROBLEMS?

- Members (40-400)
- Leads (3-9)
- Middle Management (2-4)
- Upper Management (1-2)



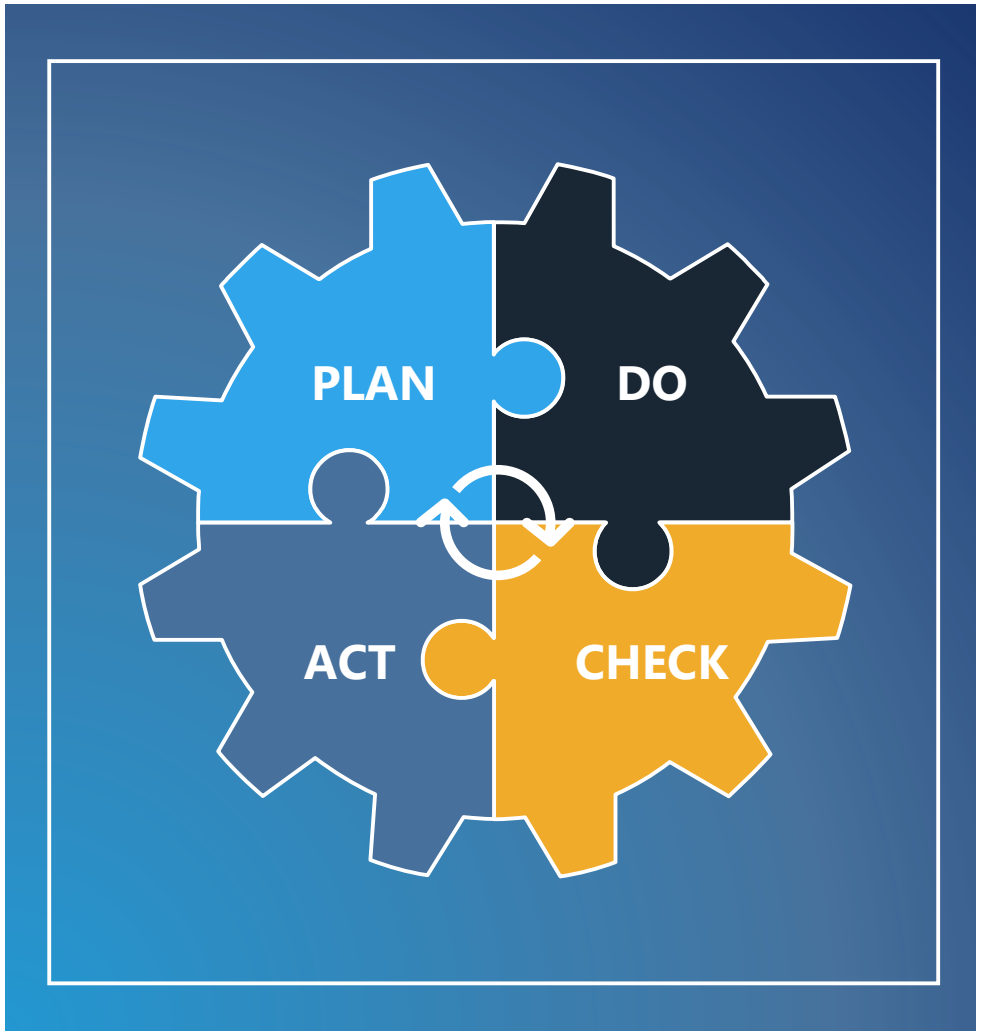
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SCIENTIFIC METHOD

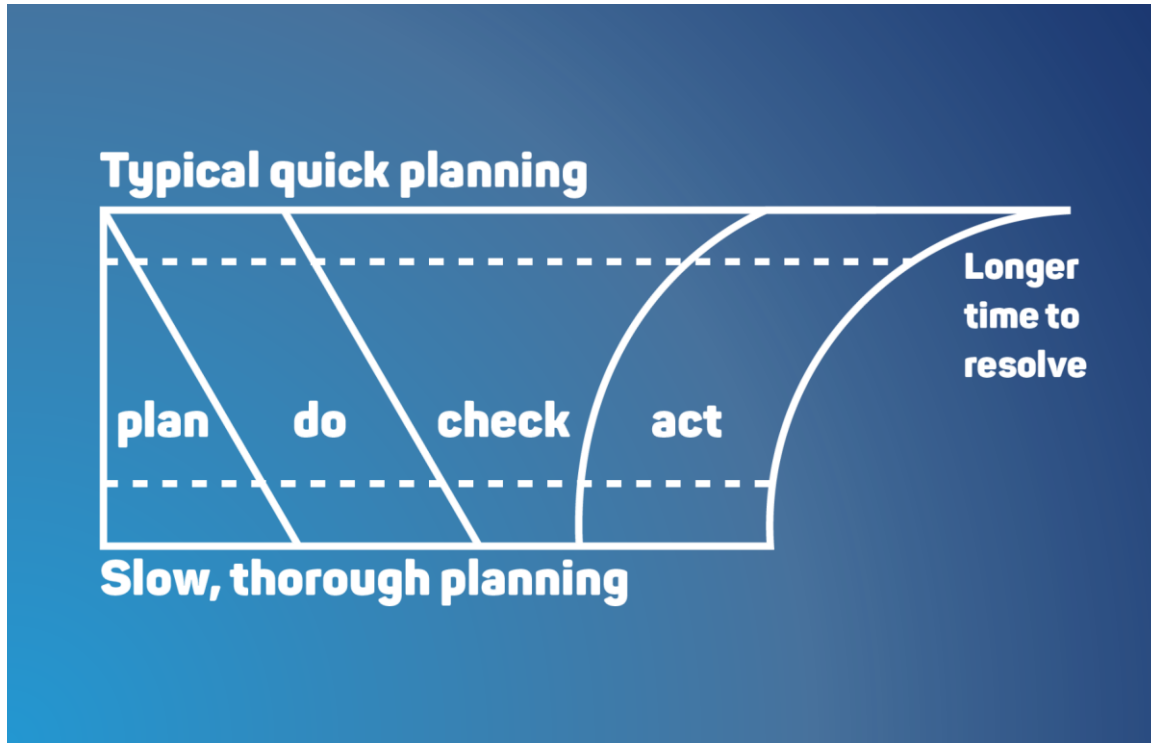


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THE ENGINE OF EXECUTION



PRACTICAL
PROBLEM SOLVING

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LEAN SOLUTIONS

10 STEP PROBLEM SOLVING METHOD

PLAN the product or process improvement:

1. Describe the problem
2. Understand needs & requirements
3. Use a team approach
4. Identify potential causes
5. Collect & analyze data (to verify root cause)
6. Identify alternatives & select solution
7. Prepare a plan of action
8. Get leadership approval & support

DO the improvement:

9. Implement the solution

CHECK the results:

10. Measure, monitor & control your results

ACT on the results: Review and recognition



STEP 1

DESCRIBE THE PROBLEM

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TAKE INTERM STEPS

- If the customer or next operation is at risk, take immediate interim action to contain the problem and prevent it from spreading.
- This step should be considered a band-aid only and not the cure.
- Examples of containment action:
  - Purge stock
  - Inspect work in process
  - Rework and fix errors
  - Alert customers
  - Apply temporary verifications

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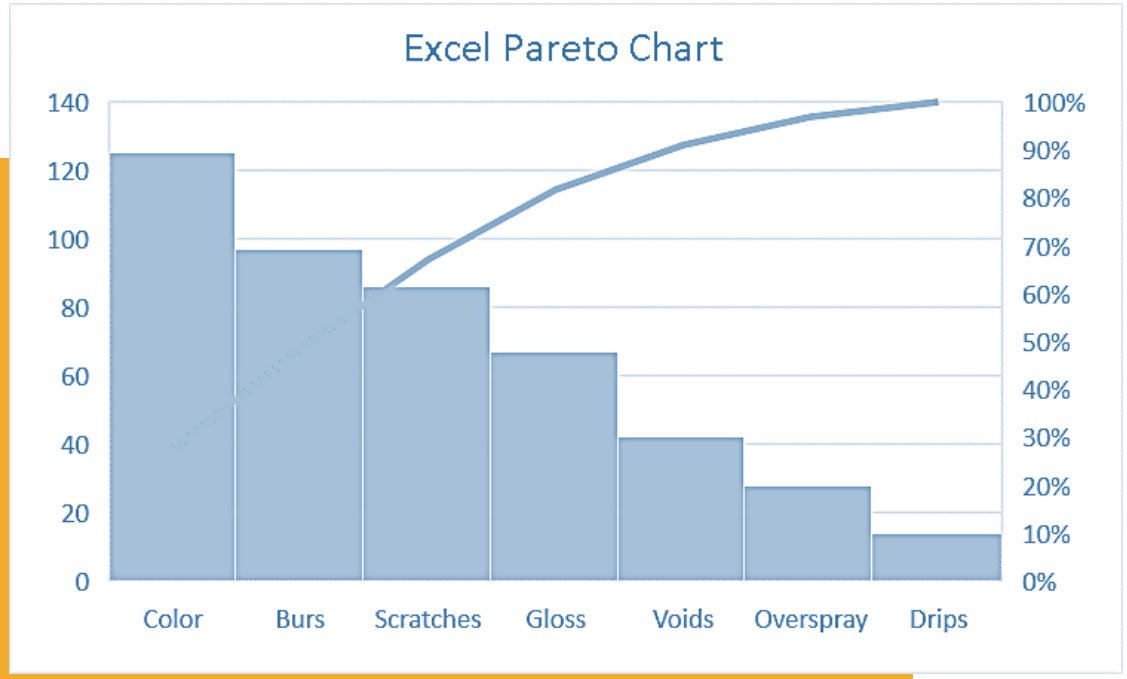
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THE PROBLEM


Evidence
Incident
Fact
Problem
Error
Reject
Look for systemic issues
Issue
Incidents
Rejects
Errors
Facts
Facts
Evidence
Problems
Issues
Facts
Problem
Fact
Group observations
(i.e., facts, errors)
into problem categories
Problem 1
Problem 2
Problem 3

PERFORMACE MEASURES

- Performance measures are the indicators used to see the difference between what is, and what should (or could) be.
- Established at each level of the organization.
- Often used to describe a problem condition.



PARETO

CHART

A Pareto Chart is a vertical bar graph in which values are plotted in descending order of frequency from left to right. This classifies problems and defects by type in the order of quantities and illustrates the cumulative percent total as a line graph.

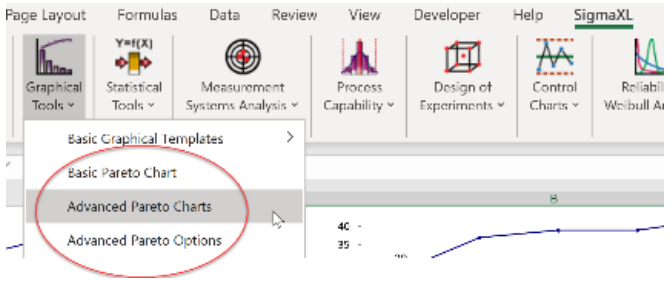
The Pareto principle is also call the 80/20 rule because roughly 80% of the problems come from 20% of the causes.

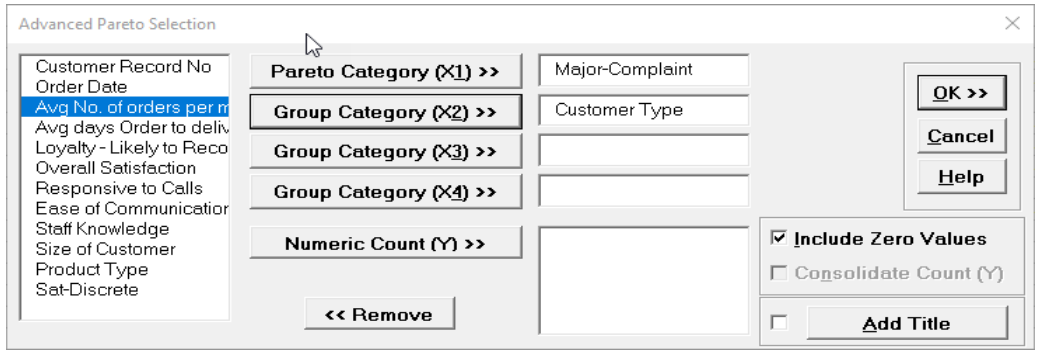
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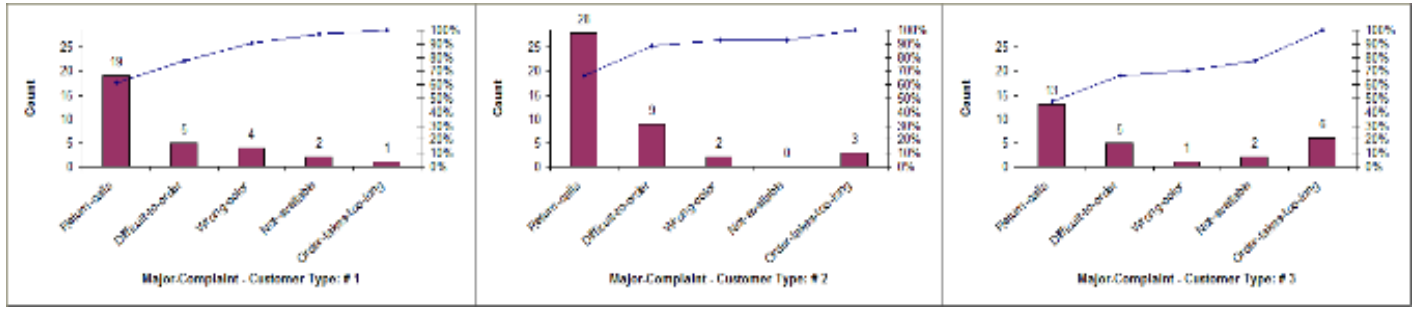
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SigmaXL Advanced Pareto Chart Example







PERFORMACE MEASURES



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THE PROBLEM STATEMENT

Must include:

1. What is the problem?
2. When/Where are we seeing the problem?
3. What requirement is affected?
4. Who does it affect?

Should not:

1. Be more than one problem
2. Suggest a solution
3. Make assumptions

THE PROBLEM STATEMENT

Poor:
The widget is too long (1)

Better:
The widget exceeds the requirement (1) of 38cm (3)

Best:
The last 10 production runs (2) show the widget measured an average of 41cm (1), which exceeds the customer (4) requirement of 38cm +/- 2cm.(3)

1. What is the problem?
2. When / Where are we seeing the problem?
3. What requirement is affected?
4. Who does it affect?

STEP 2

UNDERSTAND NEEDS & REQUIREMENTS

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UNDERSTAND NEEDS & REQUIREMENTS

- Determine customer needs, requirements and expectations.
- Product and process requirements must be understood prior to efforts to improve or change them.
- Understand technical requirements.
- Determine mandatory criteria.

STEP 3

USE A TEAM APPROACH

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USING A TEAM APPROACH

Collaborate with cross-functional team members from various levels that have a vested interest in solving the problem.

Philosophy

- Problem-solving efforts should be fact-based
- The person doing the job is the probably the most knowledgeable about it.
- People want to be involved and want to do their jobs well.
- More is accomplished together.
- Greater success comes with a structured approach.
- Are there employees with undiscovered talents.

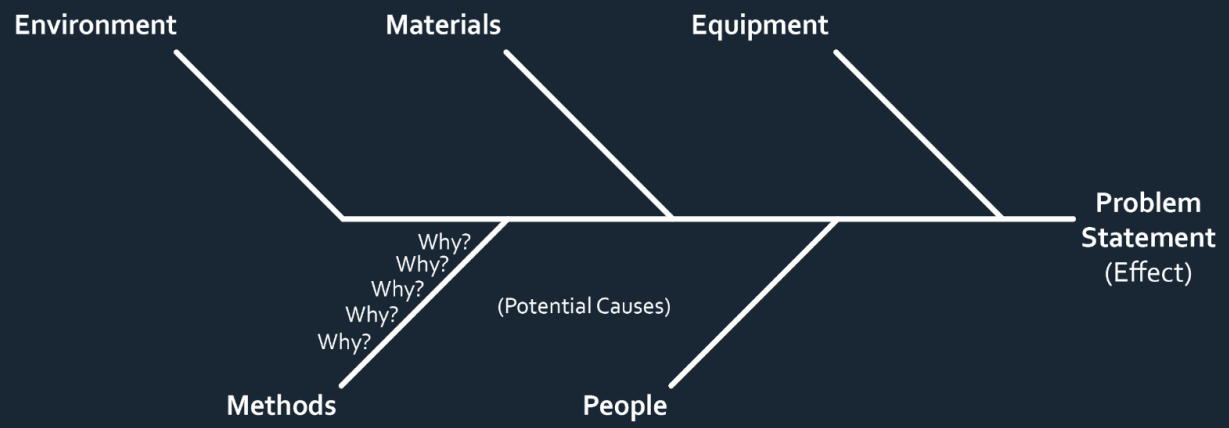
STEP 4

IDENTIFY POTENTIAL CAUSES

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CAUSE & EFFECT DIAGRAM

- Using a Cause & Effect Diagram, consider potential causes in each category.
- Ask "Why?"
- Use branches, stems, and twigs on the diagram to display each response.

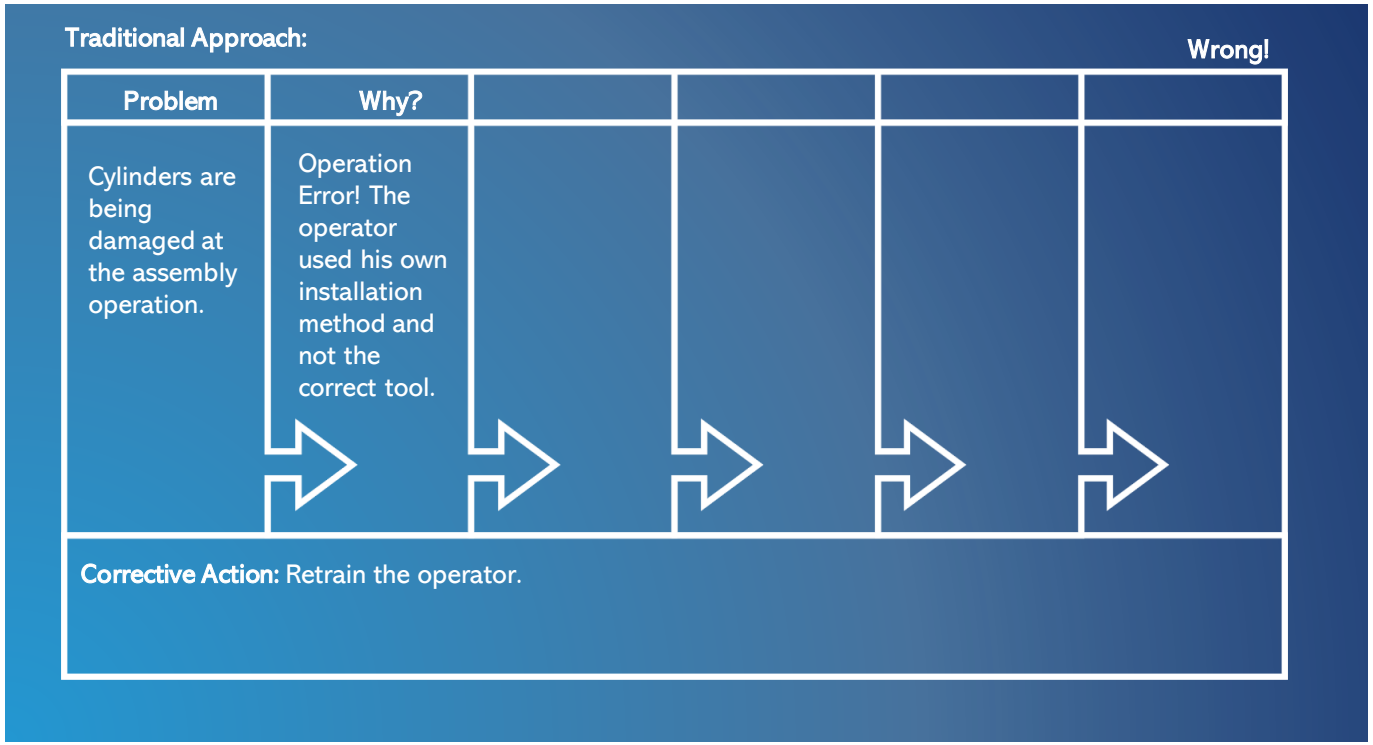


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WHERE DO I START

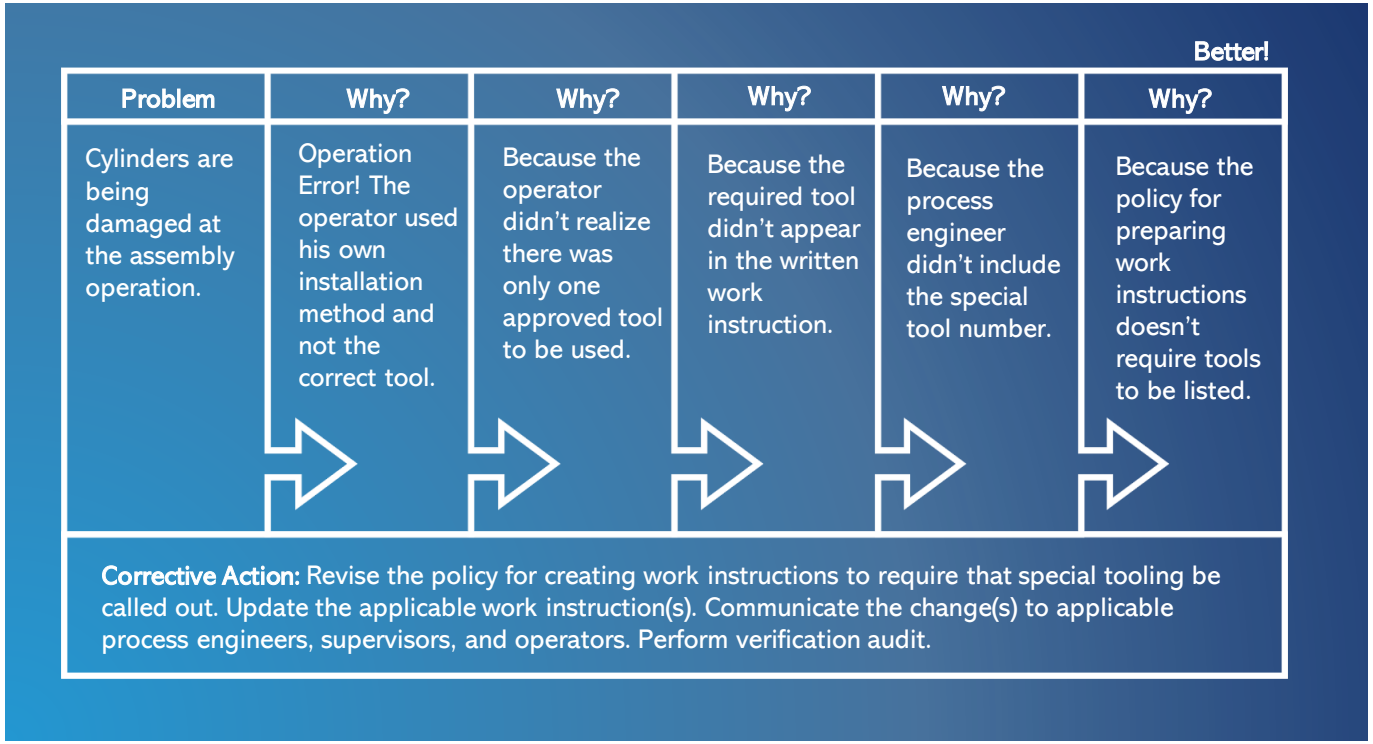
CLUSTERING METHOG + N/3 METHOD

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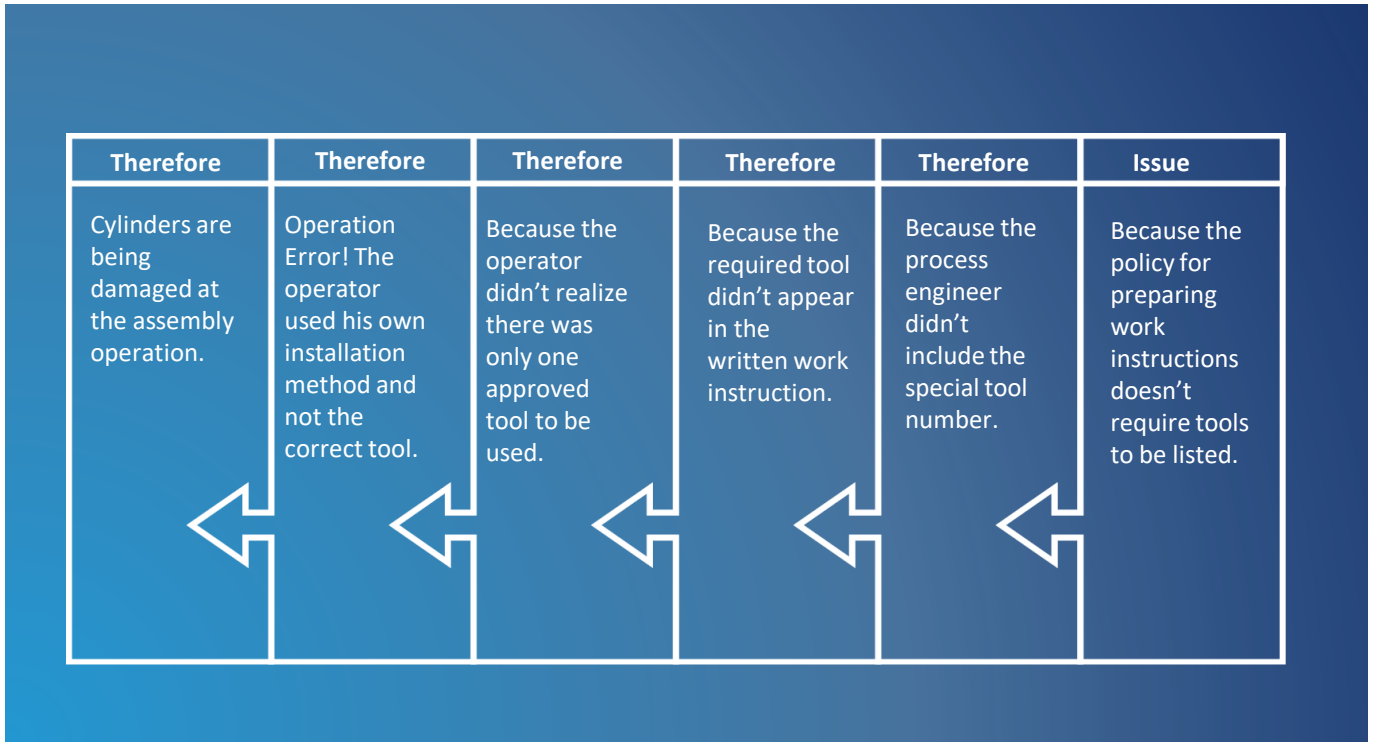
One of the most effective tools in determining root cause is to simply keep asking why something occurs/happened.

The traditional approach usually jumps to a quick conclusion which often results in repeat occurrences of the same or similar kind.



5 WHY ANALYSIS

On the other hand, continually asking 'why?' generally gets to the underlying root causes



THEREFORE TEST

After you reach the potential root cause using the "5 why's", check the rationale using the "therefore test" to verify the resulting cause/effect relationship. Does it make sense?

STEP 5

COLLECT & ANALYZE DATA

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QUALITY TOOLS

- Data Collection & Sampling
- Graphs
- Check Sheets
- Cause & Effect Diagrams
- Pareto Charts
- Histograms
- Control Charts
- Measurement Systems Analysis
- Failure Mode & Effects Analysis





MANAGEMENT BY FACT

Carrying out work based on facts, rather than intuition or past experiences

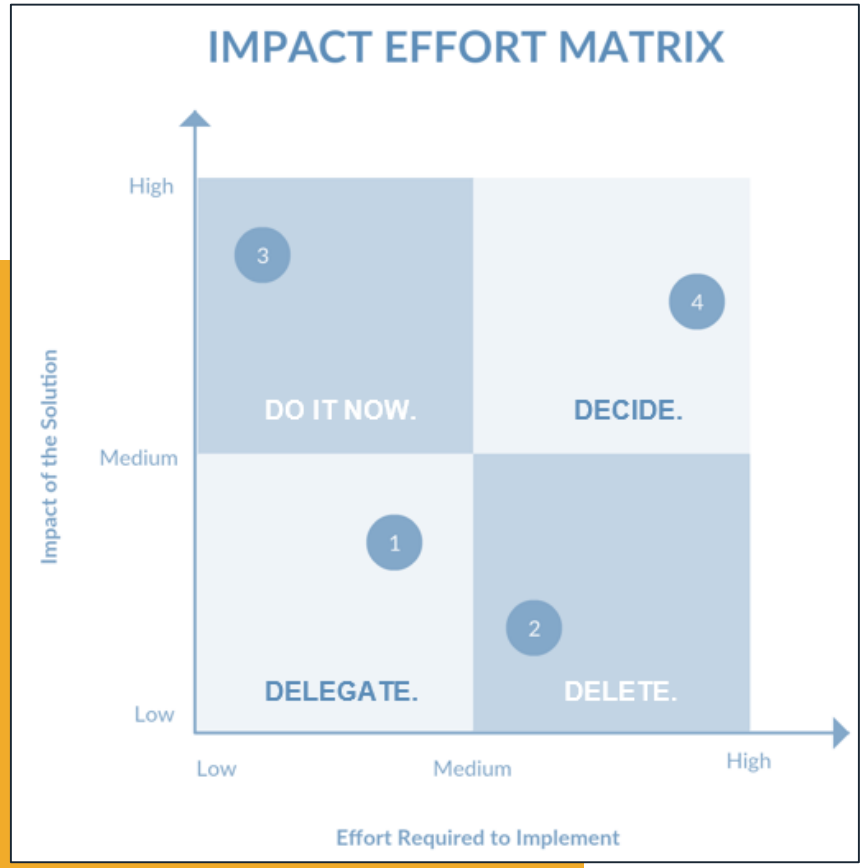
Steps to gathering facts:

1. Observe thoroughly to understand facts (must go and see).
2. Decide which data should be taken.
3. Clarify how you are going to use the collected data.
4. Collect accurate data.
5. Analyze data with basic quality tools.
6. Examine the results to get correct information.

STEP 6

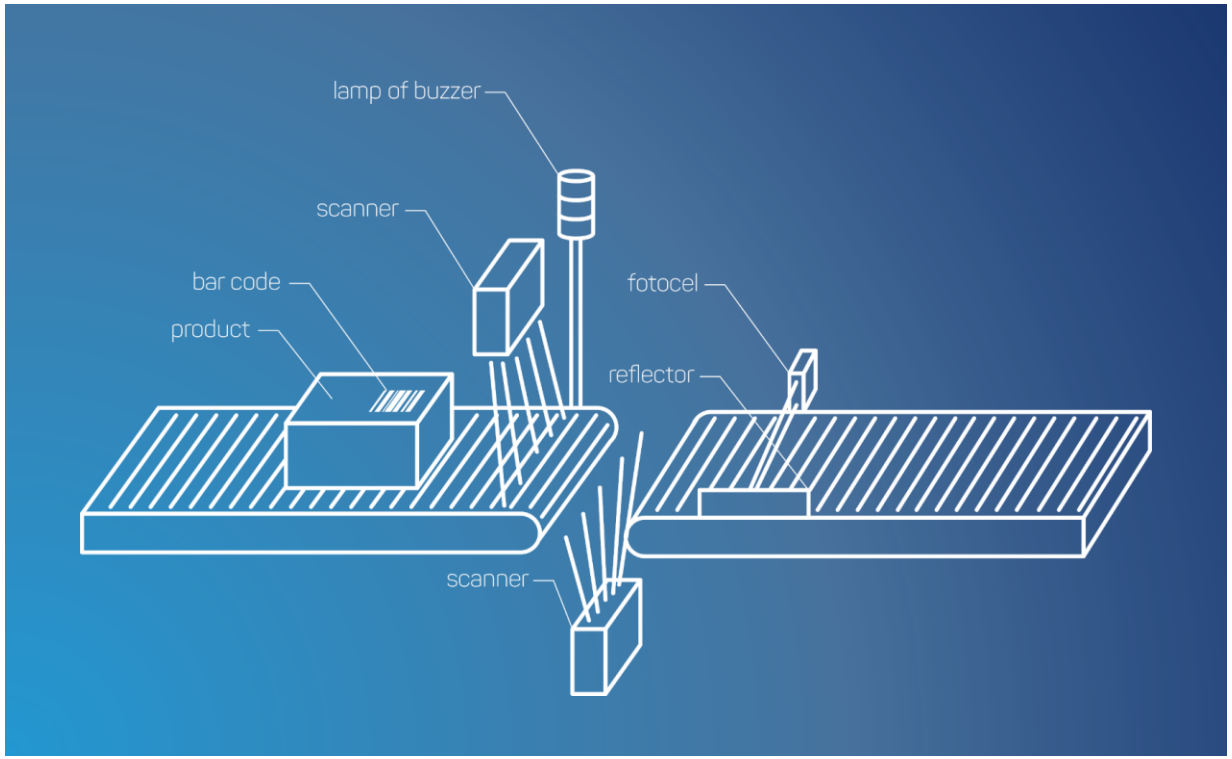
IDENTIFY ALTERNATIVE & SELECT SOLUTION

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IMPACT
EFFORT MATRIX

- Brainstorm alternative solutions.
- Ensure that solutions address root causes.
- Impact / Effort matrix
- Perform trials or pilot tests.
- Don't get caught in "paralysis by analysis."



POKA-YOKE

A Japanese term to describe a technique of preventing errors by designing the manufacturing process, equipment, and tools so that an operation cannot be performed incorrectly.

The Benefits:

Quality, cost, and delivery are all improved when errors are prevented. Detection and correction are costly alternatives.

POKA-YOKE

ERROR PROOFING

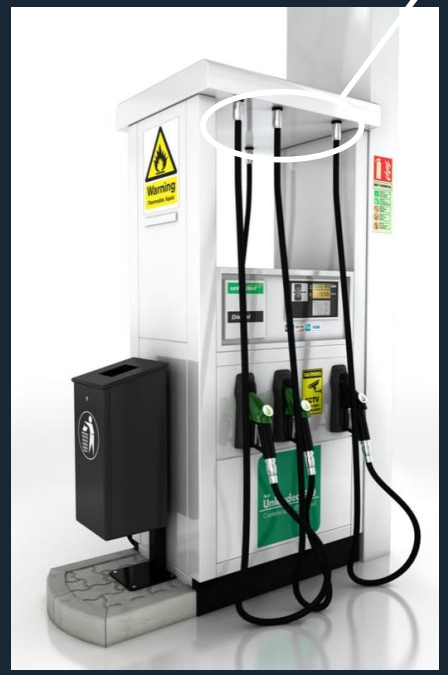
What error-proofing techniques can you detect in this process? There are at least 6

Safety valve at this fitting won't spill fuel in case of accidental break-away

Can't pump without paying

Must select desired grade to continue

Must activate pump when ready





Automatic shut-off when full



Can't misplace fuel cap

POKA-YOKE

ERROR PROOFING

Guidance:

When developing a solution to a problem, consider opportunities to error-proof the process with one or more of the following types of feedback being given to the worker:

- **Interlocking** sequences to ensure an operation is not omitted;
- **Alarms and Cut-offs** to signal problems;
- **Mistake-proof fixtures** and templates to ensure proper orientation;
- **Limiting mechanisms** to prevent too little or too much of something from occurring;



POKA-YOKE

ERROR PROOFING

- **Automatic dispensing** to ensure the correct selection of components; or amount of material
- **Automatic recording** (i.e., bar codes, software) to ensure accurate transfer of information;
- **Locating indexes** to outperform human precision;
- **Optical devices** that exceed human capabilities;
- **Visuals** (i.e., pictures or colors) in place of numbers;
- **Multiple signals** (i.e., sight and sound) to ensure recognition;
- **Remote controls** for features too hard or unsafe to access.



STEP 7

PREPARE A PROJECT PLAN

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PREPARE A PROJECT PLAN

A Project Plan should answer the following questions:

1. Who?
2. What?
3. When?
4. Where?
5. How?
6. How Much?

Make preparations to present it to the appropriate decision makers:

1. Project management tools
    1. Cost vs Benefits Analysis
    2. Milestone Charts

STEP 8

GET LEADERSHIP APPROVAL & SUPPORT

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GET GUIDANCE & SUPPORT FROM

LEADER,PROCESS OWNER, CUSTOMER, &
OTHER STAKEHOLDERS. AVOID FALSE STARTS!

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STEP 9

IMPLEMENT SOLUTION

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IMPLEMENT SOLUTION

- Brief all people involved about the plan so that they have ownership in its success.
- Use a detailed action plan to list the specific tasks required, who's responsible, due dates, expected results, and how effectiveness will be verified.
- Remember that even a great plan will fail if not executed properly.
- Ask the leadership team to help remove roadblocks as needed.

Project Management Tools

1. Milestone Charts (High Level)
2. Task Lists (Detail Level)

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FMEA (Risk Analysis)

Why Create an FMEA?

Failure Modes and Effects Analysis (FMEA) is a methodology to manage…

RISK!!!

The FMEA matrix

For a Process FMEA:

#	Process Function (Step)	Potential Failure Modes (process defects)	Potential Failure Effects (Y's)	SEV	Potential Causes of Failure (X's)	OCC	Current Process Controls	DET	RPN	Recommend Actions	Responsible Person & Target Date	Taken Actions	SEV	OCC	DET	RPN
1																
2																
3																
4																
5																
6																
7																
8																
9																

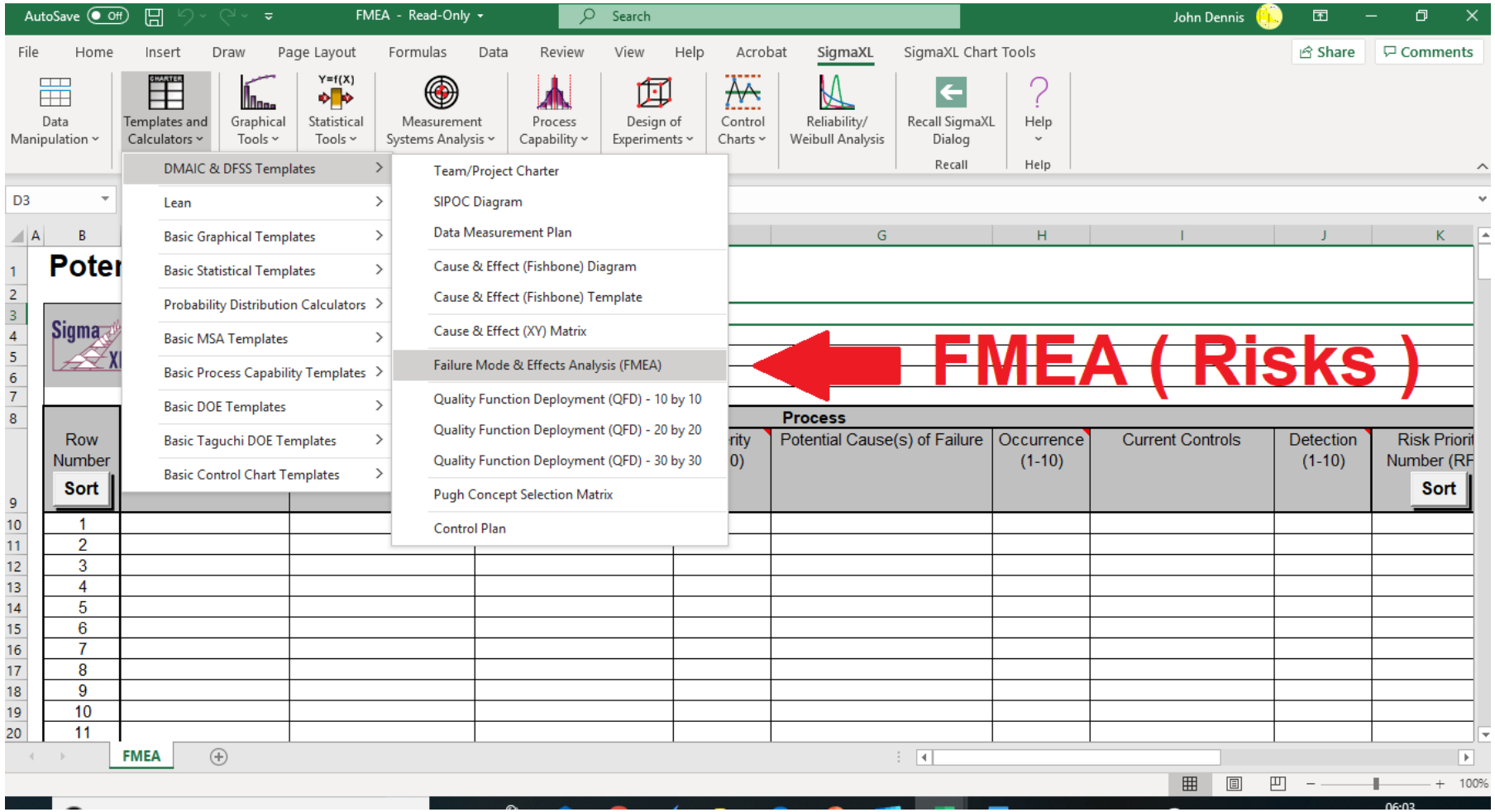
RPN = SEV x OCC x DET

RPN = Risk Prioritization Number
SEV = Severity of the Failure
OCC = Probability of Occurrence of the Failure
DET = Difficulty to detect the Failure

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Calculate RPN for your Business Risk if there was a new Lockdown in next 3 months for Covid19 that lasts more than 3 months ! Compare to RPN risk of a Financial Crash in Stock Market of more than 40% in next 3 months.



STEP 10

MEASURE, MONITOR & CONTROL

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MONITOR, MEASURE & CONTROL

- Remember that just because you have executed your plan does not mean that the problem is solved.
- You must verify your results and continually or periodically monitor results.
- If performance deteriorates, you must repeat the 10 steps.

Quality Tools

- Graphs
- Histograms
- Control Charts



DOCUMENTING ACTIVITIES/RESULTS

Useful forms of documenting problem solving efforts:

- **A3 Report** – Primarily used as an internal communication device amongst team members and management.
- **Corrective Action Report (CAR)** – Primarily used as an external device when required to communicate problem resolution to customers.
- **10-Step One Page Form** – 11x17

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Quiz 9:

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- What is the purpose of the MEASURE Phase in DMAIC?

To understand the Current State (As-Is) of the process that contains the Problem.

- Detailed Process Understanding is required in the Measure Phase ? Who are the People to involve to gain a better understanding of the process and problems ?
- **The people who work on the process. The workers at the GEMBA**

- Another name for an Ishikawa diagram is the _____ diagram.
- **FISH BONE**

- To ask your team `***Why does this happen ?'*** more than once in order
- to understand the Root Cause is called the _____ method.
- **5 WHYS**

- What is another name for the 80/20 Principle ?
- **PARETO PRINCIPLE**

LEAN SOLUTIONS ACADEMY



Lean Training

Green Belt

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Yellow Belt Review

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QUIZ 1:

1. What was the name of the first company to use the name ‘SIX SIGMA’ to describe its Quality Management System?
   - **MOTOROLA**

2. What is the First Principle of Lean production ? What is the most important thing that a Lean process must produce?
   - **VALUE** (for the customer of the process)

3. Which Japanese company is considered as being the first to use true ‘Lean Production “effectively and successfully”?
   - **TOYOTA**

4. A basic principle of Six Sigma is to always find the true original source of a defect or problem. This is called _____?
   - **ROOT CAUSE ANALYSIS**

5. A “Six Sigma Process” is often described one that produces no more than 3.4 DPMO What does DPMO stand for?
   - **DEFECTS PER MILLION OPPORTUNITES FOR DEFECTS**

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QUIZ 2:

1. What is the role of a Yellow Belt on a Lean Six Sigma project?
   - **A YELLOW BELT IS A TEAM MEMBER WHO ASSISTS A GREEN OR BLACK BELT, USING THEIR KNOWLEDGE OF THE PROCESS THAT THEY CURRENTLY ARE WORKING WITHIN.**

2. What is the role of a Green Belt in an organisation ?
   - **A GREEN BELT IS A PROJECT TEAM LEADER FOR SMALL AND MEDIUM SIZED PROCESS IMPROVEMENT PROJECTS.**

3. What is the role of a Black Belt in an organisation ?
   - **A BLACK BELT IS A PROJECT TEAM LEADER FOR LARGE PROBLEM SOLVING / IMPROVEMENT PROJECTS or OVERSEES THE WORK OF GREEN BELTS FOR MULTIPLE PROJECTS. A BLACK BELT IS A FULL TIME PROBLEM SOLVER FOR THE ORGANISATION.**

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QUIZ 3 :

1. Which stage of the 5S method is used to ensure that the workers have the good habits and discipline to continue the other 4S tasks?
   - **SUSTAIN**

2. In 5S the action of removing unnecessary tools, equipment and materials from the workspace is called _____.
   - **SORT**

3. Cleaning the workplace of dirt, dust and litter is called what in 5S ?
   - **SHINE**

4. Give one example of a 5S method used for **SET IN ORDER / STRAIGHTEN**
   - **SHADOW BOARDS**
   - **RACKS**
   - **COLOURED LABELS**
   - **FLOOR MARKING etc**

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QUIZ 4 :

1. What Tool is used to understand what is Critical to Quality (CTQ) by Forming 3 categories: *threshold, performance,* and *excitement*?
   - **KANO ANALYSIS**

2. Splitting Customers into groups according to different needs or behaviours is called _____.
   - **SEGMENTING**

3. CTQs are also sometimes called CTCs or CTSs. What does CTS stand for?
   - **CRITICAL TO SATISFACTION**

4. Give one example of a method used to understand the **Voice of the Customer**?
   - **SURVEYS**
   - **FEEDBACK**
   - **FOCUS GROUPS**
   - **REPEAT SALE METRICS, etc**

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QUIZ 5 :

1. What relationships are depicted by a SIPOC?
   - **Suppliers through customers**

2. Why is VOC so important at the beginning of a project?
   - **To be sure we understand the problem from the customers standpoint**

3. A process map is used to accomplish what?
   - **Identify all steps and decisions of a process in diagrammatic form**

4. What is special cause variation?
   - **Special cause variation is when any one data point is outside the control limits**

5. Kaoru Ishikawa (Fishbone Exercise) and other quality professionals focused on _____ term quality improvements over _____ term cost cutting and profit targets.
   - **Long**
   - **Short**

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GREEN BELT PROJECT

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Project Charter

PROJECT INFORMATION			
Project Title:	Achieve our 95% Inventory Accuracy Target	**Project Initiation Date:**	09/29/2022

Problem Statement: We have inventory inaccuracy in the factory resulting in achieving in an average 92% accuracy rate over 6 months (Apr 2022 - Sept 2022) after 4,378 individual part cycle counts. This inaccuracy has led to missed orders and waste looking for material.

Project Goals: After determining and implementing solutions, achieve 95% inventory accuracy for 3 months after the next 3 month AB inventory cycle moves through.

In Scope (Inclusions):	**Out of Scope (Exclusions):**
Inventory in the A & B inventory classification code.	Inventory classified as a C item.

Project Champion:	Dennis Patrick
Process Owner(s):	All that do inventory transactions and engineering changes to creat BOM's.
Project Manager:	Doug Saunders
Core Team Members:	Kyle Sinke, John Pham, Tracy Helmer, Managers
Target Completion Date:	March 31, 2023

PROJECT OBJECTIVES		
Objective	**Baseline**	**Target**
Objective #1 Achieve 95% inventory accuracy on A & B Items. Currently achieving 92%	92%	95%
Objective #2 Create Standard Work for inventory transaction.	No Standard Work in place.	Standard Work and training.
Objective #3		

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SIPOC

Suppliers (resource provider)	Inputs (process)	Process (high level process flow)	Outputs (from the process)	Customers (receiver an output from the process)	
Coffeemaker purchased - on countertop	>5 cup capacity coffee maker	**Making coffee**	heating to keep coffee warm for 1 hour after brewing	All of us enjoy the same brand of coffee with varying condiments	
city water supply into faucet	water supply	Add water	enough coffee to serve all of us within 15 minutes of start time.	1 cup of coffee	wife
purchase from XYZ company	1 filter	Add filter & ground coffee	one filter to prevent overflow	1 teaspoon of french vanilla creamer	
Use ABC brand beans	4 tablespoons of coffee grinds		correct amount of grinds		
Electric company	120V GFCI outlet	Plug-in and turn on		1 cup of coffee	
Upper left drawer next to refrigerator	measuring spoons		Source to heat water to temperature	Honey on the table	husband
			Pump to move water up through filter.	Dash of cinnamon	
Mugs purchased - in upper left cabinet	coffee mugs	Pour into mug	Hot coffee filled near the top of the mug.		
refrigerator and pantry	condiments and containers for sugar, creamer, honey, cinnamon.	Add condiments		1 small cup of coffee for each	
ABC brand for sugar & creamer.			coffee served in spouses favorite mug	1 teaspoon sugar	
XYZ brand for honey and cinnamon		Stir	coffee served in husbands mug	1 tablespoon french vanilla creamer	
pantry	stirrers, lids	Serve	coffee served in personalized kids mugs	Let sit for 5 minutes before serving	2 teenagers

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Process Improvement

+

Culture Improvement

+

Leadership Improvement

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STRATEGIC OBJECTIVES & HOSHIN KANRI

Hoshin = Policy, Principle, Direction

Kanri = Supervision, Administration, Management

Classic Book: Akao, Y. (Ed.) (1991). *Hoshin Kanri: Policy Deployment for Successful TQM*. Productivity Press, Cambridge, MA.

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"*Hoshin Kanri* is a systematic annual process led by senior executives—and preceded by Strategic Management activities—for developing, deploying, and accomplishing policies (objectives + strategies) through coordinated organization-wide activities and the rigorous application of the PDCA cycle."

Paper: "*The Application of Policy Deployment in Indian Companies*" by Liedtke

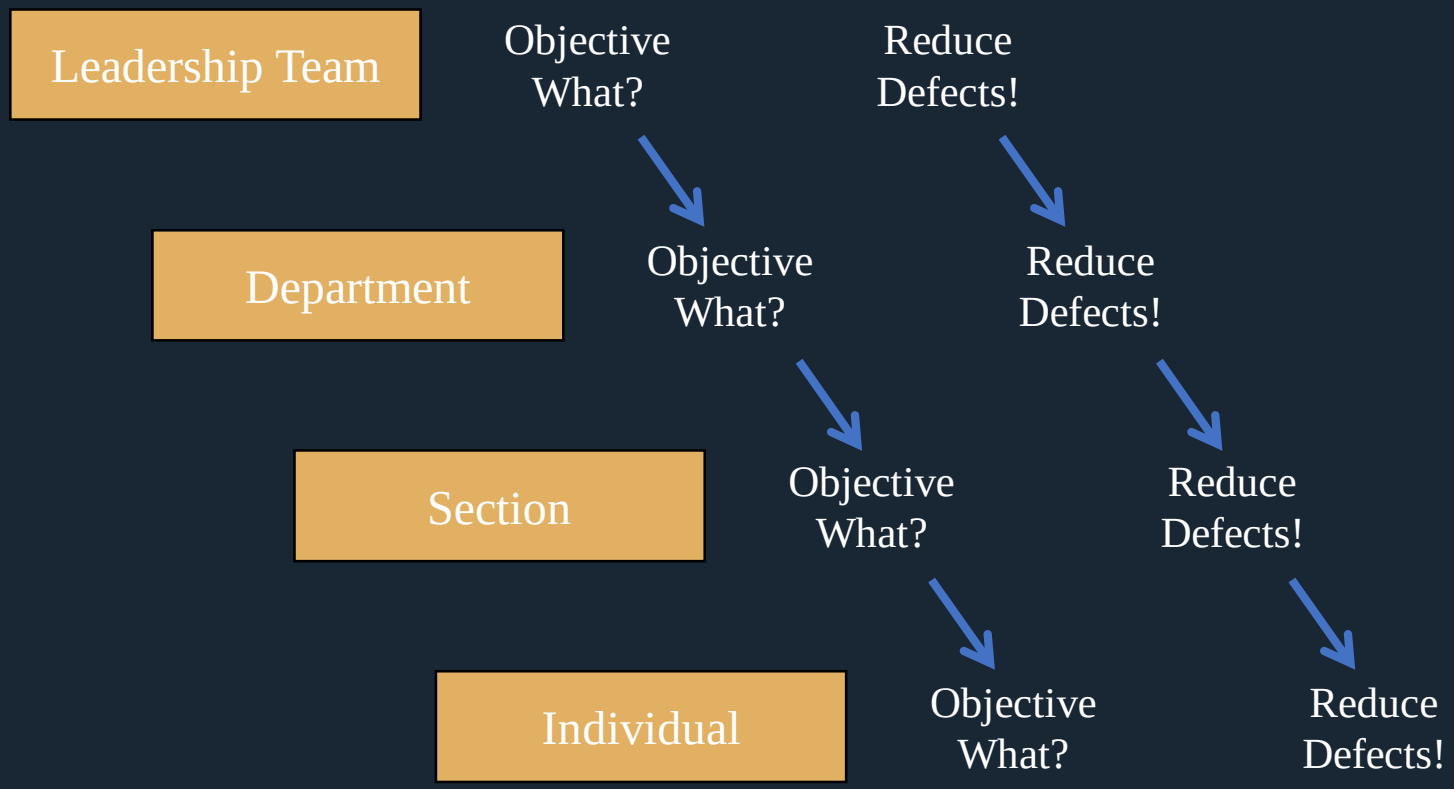
Go to . . . www.strategicimprovementsystems.com and click on "RESEARCH"

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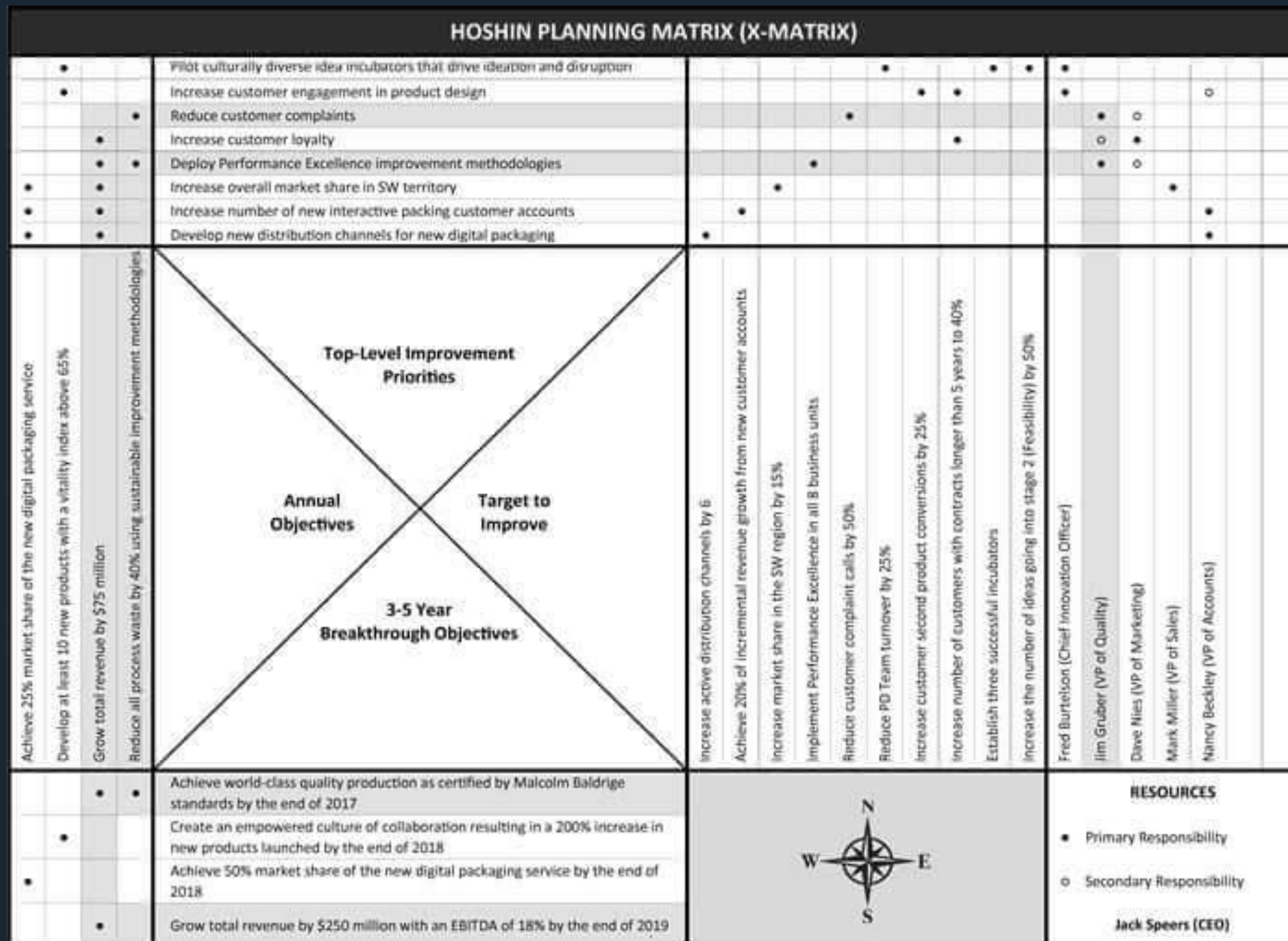
The 7-Step Hoshin Planning Cycle



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LEAN LEADERSHIP & LEADER STANDARD WORK

What is Culture?

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Different Business = Different Leadership System

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WHAT DOES

A GOOD LEADER DO?



WE HAVE
A PROBLEM...

- 50% of people who leave their jobs do so to get away from bad leaders
- 70% of employees are not engaged at work
- A study of over 2,000 managers found that 51% are not engaged and 14% are actively disengaged.

Gallup Study: Amy Adkins

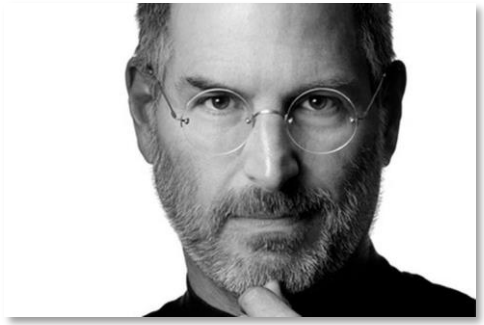
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Defining Lean Leadership

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WHAT IS
LEADERSHIP?

Leadership is the art of motivating a group of people to act towards achieving a common goal.





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LEADERSHIP
VS MANAGEMENT

Leadership is not management. Leadership should compliment management, not replace it.

Management	Leadership
Planning and Budgeting	Direction Setting
Organizing and Staffing	Aligning constituencies
Controlling and problem –solving	Motivating and Inspiring

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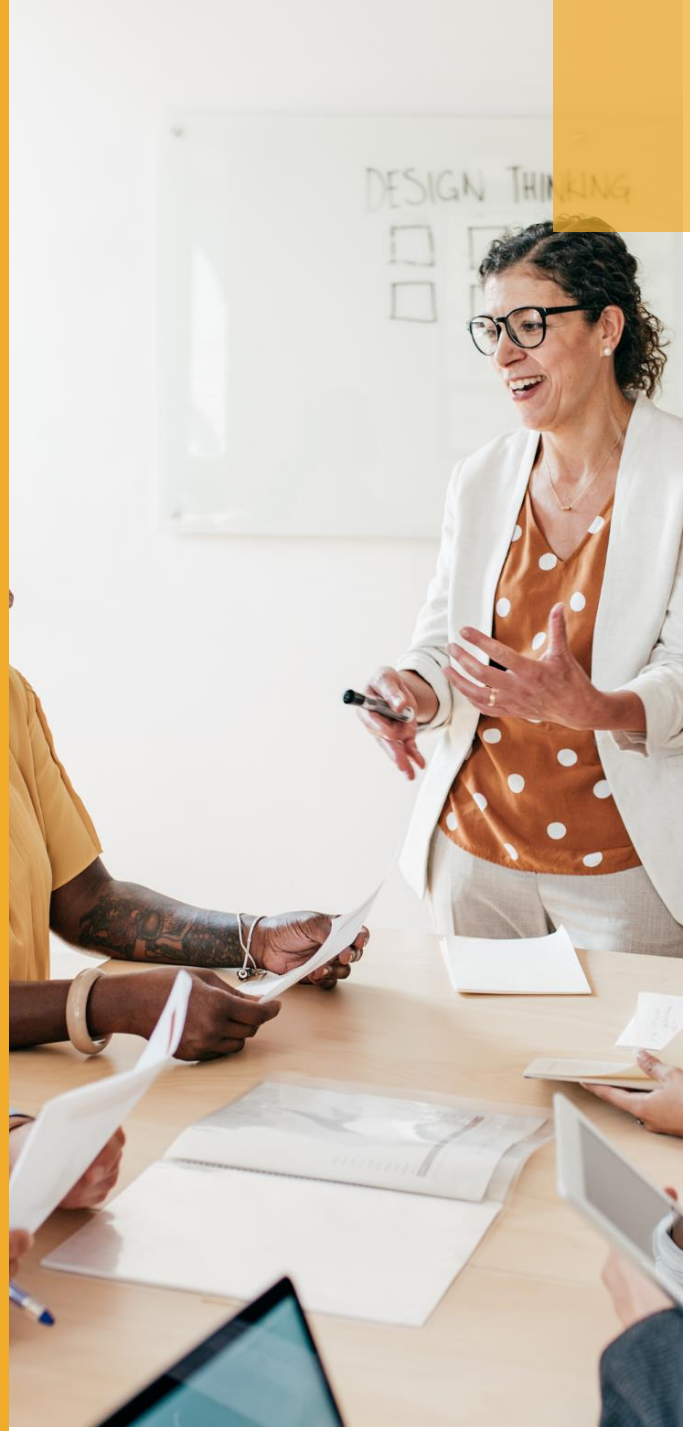


WHAT IS

LEAN LEADERSHIP?

Lean Leaders embrace and champion continuous improvement throughout their organization.

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5 LEAN
LEADERSHIP ACTIONS

1. Leaders must be Teachers
2. Build Tension, Not stress
3. Eliminate Fear and Comfort
4. Lead through visible participation, not proclamation
5. Build Lean into Personal Practices

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THE HEART OF A SERVANT

What is Servant Leadership?

Hard-to-Learn Characteristics

- Calling, Empathy, Healing, Stewardship

Learnable Skills

- Listening, Awareness, Persuasion, Foresight, Growth, Team Building

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7 CHARACTERISTICS OF

SUCCESSFUL COMPANY CULTURE

1. A purpose-driven company culture
2. Effective communication patterns
3. A culture of feedback
4. Embracing diversity
5. Teamwork
6. Engagement and loyalty
7. Growth and development

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7 CHARACTERISTICS OF
SUCCESSFUL COMPANY CULTURE

1. A purpose-driven company culture

- Shift resources to achieve goals
- Inspiration driver for engagement
- Drive performance

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7 CHARACTERISTICS OF

SUCCESSFUL COMPANY CULTURE

2. Effective communication patterns

- Clarity
- Courtesy
- Proactivity

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7 CHARACTERISTICS OF

SUCCESSFUL COMPANY CULTURE

3. A culture of feedback

- Receptive to give and receive
- Internal and external
- Any aspect of organizational life

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7 CHARACTERISTICS OF

SUCCESSFUL COMPANY CULTURE

4. Embracing diversity

- Tolerance and acceptance of others
- Aware about difference
- Evaluate impact of differences

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7 CHARACTERISTICS OF

SUCCESSFUL COMPANY CULTURE

5. Teamwork

- Mutual understanding
- Focus on team accomplishment
- Fast, better and more efficient

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7 CHARACTERISTICS OF

SUCCESSFUL COMPANY CULTURE

6. Engagement and loyalty

- Psychological meaningfulness
- Psychological safety
- Availability

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7 CHARACTERISTICS OF

SUCCESSFUL COMPANY CULTURE

7. Growth and development

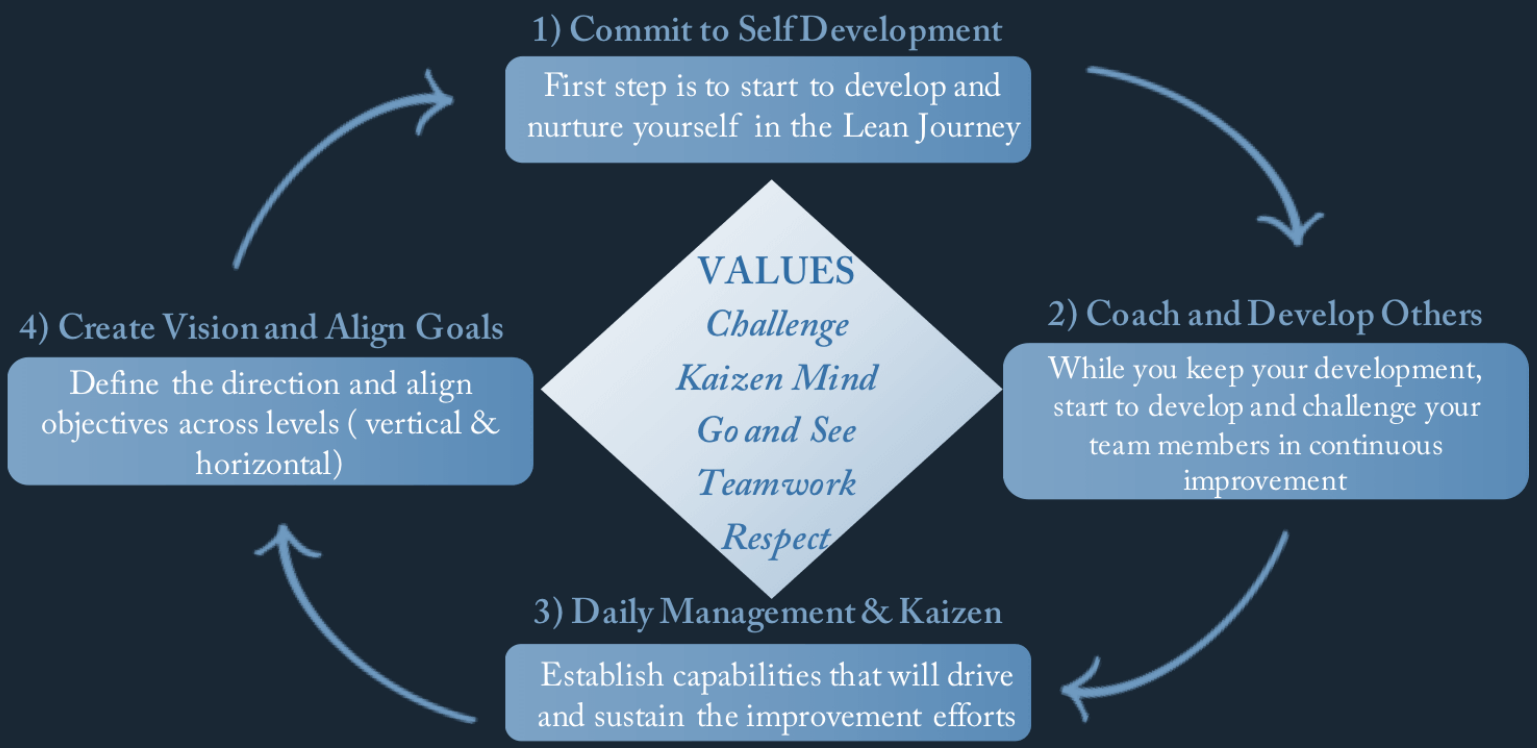
- Position-based growth
- Professional growth
- Financial growth

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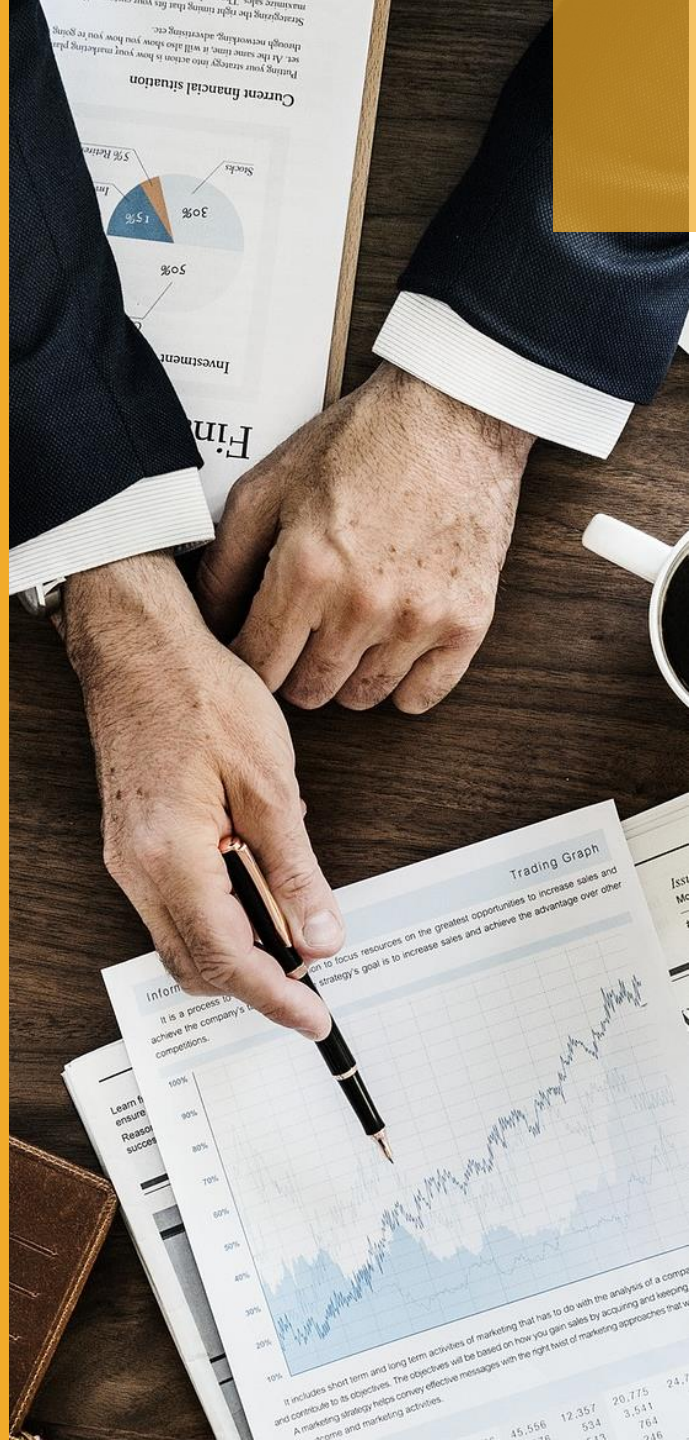
LEADERSHIP
REQUIREMENTS

- The majority of people, if given leadership, respect, opportunities for satisfaction and worthwhile goals, will attempt to excel.
- As leaders, we need to have a set of beliefs, expectations, and direction, that focuses everyone in the organization on critical objectives in an effective manner.

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WHAT IS

LEADER STANDARD WORK

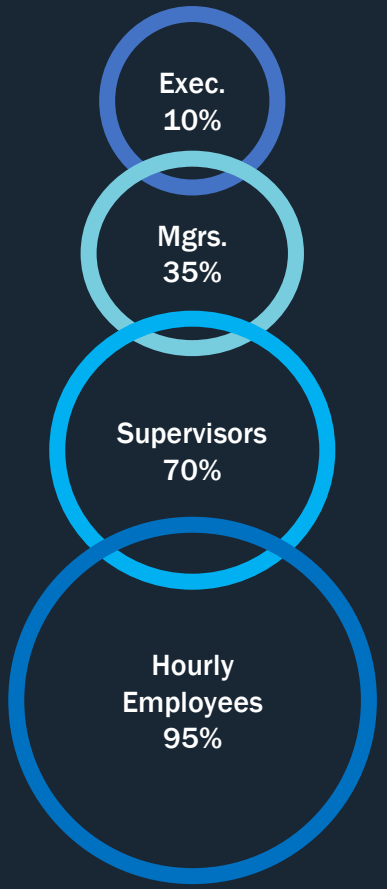
A set of daily and weekly actions, tools, and behaviors, that leaders apply to build and sustain a continuous improvement culture.

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WHO USES
LEAN STANDARD WORK?

All leaders! However, it varies based on the roles and responsibilities.

ROLE	% of Work (time that should be standardized	
Executives	10-15%	Standard work is LESS structured • % of time standard • Specific sequence • Specific time of day • More time for discretionary tasks
Support Department Managers	25%	
Value Stream Managers	50%	
Value Stream support staff	50%	Standard work is MORE structured • % of time standard • Specific sequence • Specific time of day • Less time for discretionary tasks
Team leaders	80%	
Operators (Associates)	95% +	



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WHY FOLLOW
LEADER STANDARD WORK?

You are creating a culture that...

- Solves problems quickly, creatively, and permanently
- Collaborate instinctively
- Make continual gains in performance
- Develops the next generation of leaders
- Deliver Superior Financial Results

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LEADER STANDARD WORK MATRIX

Tasks Category	Team Leader	Supervisor	Operations Team or Plant Manager*
Tier 1	Lead	Attend 1 per day (rotate through areas responsible for)	
Tier 2	Attend	Lead	
Tier 3		Attend	Lead
Plant Board			Attend
Standard Work	▪ Daily Audit ▪ Update as necessary	▪ Verify visual system up to date ▪ Audit 1 per week per area ▪ Verify standard work revision is current	1 per week
Process Performance	Observe for abnormal - follow escalation Monitor: ▪ Hour by Hour boards ▪ PM completion ▪ 5S ▪ Product quality (incoming and outgoing) Frequently throughout the day	Observe for abnormal - follow escalation ▪ Audit logs ▪ Monitor 5S/PM ▪ Monitor hour by hour boards ▪ Daily KPI team board audit Minimum: start/End of shift	During Gemba: ▪ Review corrective actions / plans for top issues ▪ Discuss team board problem solving process ▪ Review training matrix and ensure plans in place ▪ Pay attention to lean waste and review plans
Gemba Walk	w/ Supervisor	▪ 1 daily with team leaders ▪ 1 per week per area with Ops Mgr	1 per week per area
Continuous Improvement	Kaizen on the line: ▪solve a problem ▪ complete item from team board	▪ Follow up on member ideas ▪ CI coaching ▪ Support/lead mfg initiatives	▪ Lead strategic initiatives ▪ Lead operations CI project
Training	▪ train new member ▪ maintain training matrix ▪ learn a job on the line	▪ Ensure proper training and document upkeep	▪ Support /provide training
Safety	▪ Daily 2-5 minute safety discussion ▪ Safety Audit	▪ Daily 2-5 minute safety discussion ▪ Safety Audit	▪ Daily 2-5 minute safety discussion ▪ Safety Audit
LSW Review		Review Team Leader	Review Supervisor
HR	Notify team of OT	▪ Staffing ▪ Assess member performance ▪ Promotion/disciplinary action	▪ Assist supervisor as required ▪ Hr activities for direct reports as required

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LEADER STANDARD WORK



Daily Tasks

- ☐ Tier 1 Meeting- Lead ☐ Attend ☐
- ☐ Tier 2 Meeting- Lead ☐ Attend ☐
- ☐ Tier 3 Meeting- Lead ☐ Attend ☐
- ☐ Gemba Walk Lead ☐ Attend ☐
- ☐
- ☐
- ☐

Multiple Times a Day Tasks

- ☐ Hour by Hour Boards
- ☐ 5S Audit
- ☐
- ☐
- ☐
- ☐
- ☐

Notes:

Continuous Improvement:

Opportunities:

Problems:

Actions:

Tasks Assignments:

Self:

- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐

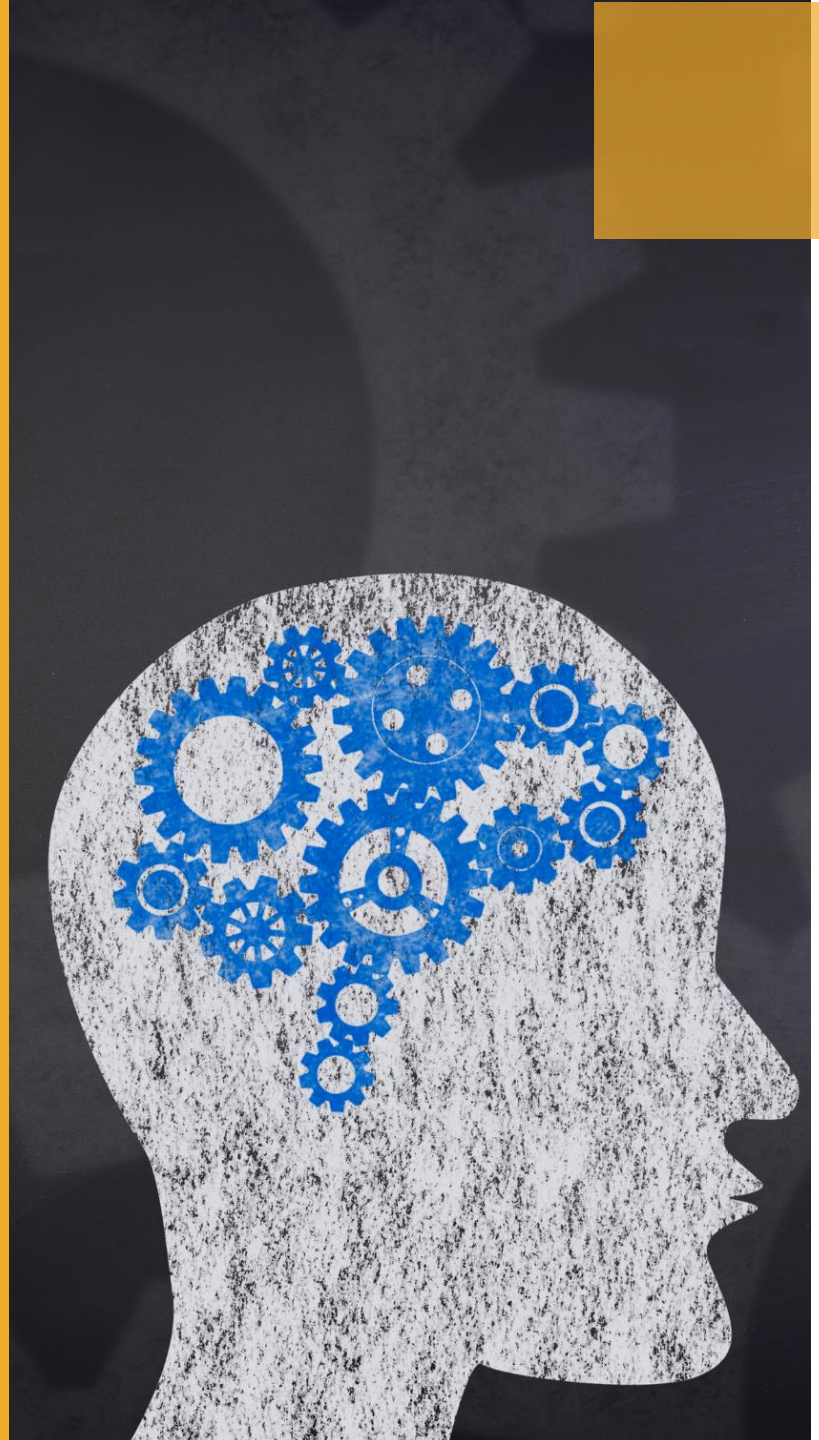
Tasks Assignments:

Others:

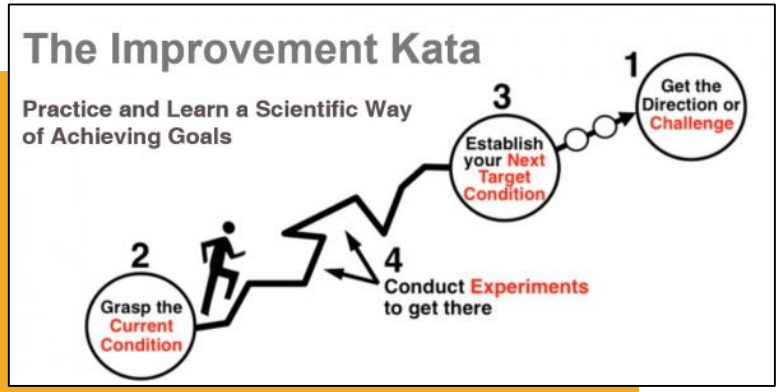
- ☐
- ☐
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IMPROVEMENT
KATA THINKING



LEARNING
OBJECTIVES

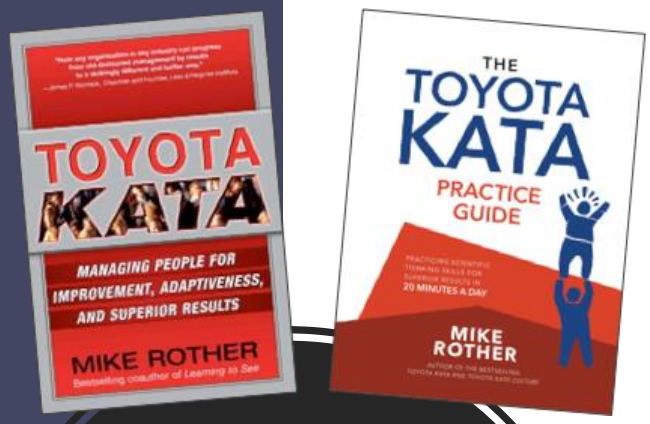
- Apply the Improvement Kata methodologies, models, and tools
- Recognize the value of the Coaching Kata methodology
- Gain a continuous improvement view of how the Toyota Improvement Kata and Coaching Kata can be used

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LESSON 1

An Introduction to Kata

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The Improvement Kata Pattern

EXCERPT FROM *TOYOTA KATA*

There are perhaps only three things we can and need to know with certainty: where we are, where we want to be, and by what *means* we should maneuver the unclear territory between here and there. And the rest is supposed to be somewhat unclear, because we cannot see into the future! The way from where we are to where we want to be next is a gray zone full of unforeseeable obstacles, problems, and issues that we can only discover along the way. The best we can do is to know the approach, the means, we can utilize for dealing with the unclear path to a new desired condition, not what the content and steps of our actions—the solutions—will be.

—*Toyota Kata* (2009), page 8

By Mike Rother

patrickadams

QUICK QUESTION

If you're running a race and you pass the person in second place, what place are you in?

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QUICK QUESTION



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QUICK QUESTION



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WHAT IS
TOYOTA KATA ABOUT?

- A way of working, and of working together.
- Scientific thinking as an ingredient that makes some teams and organizations particularly effective. A 21st Century skill.
- Thinking - and culture? - that you can develop through practice.

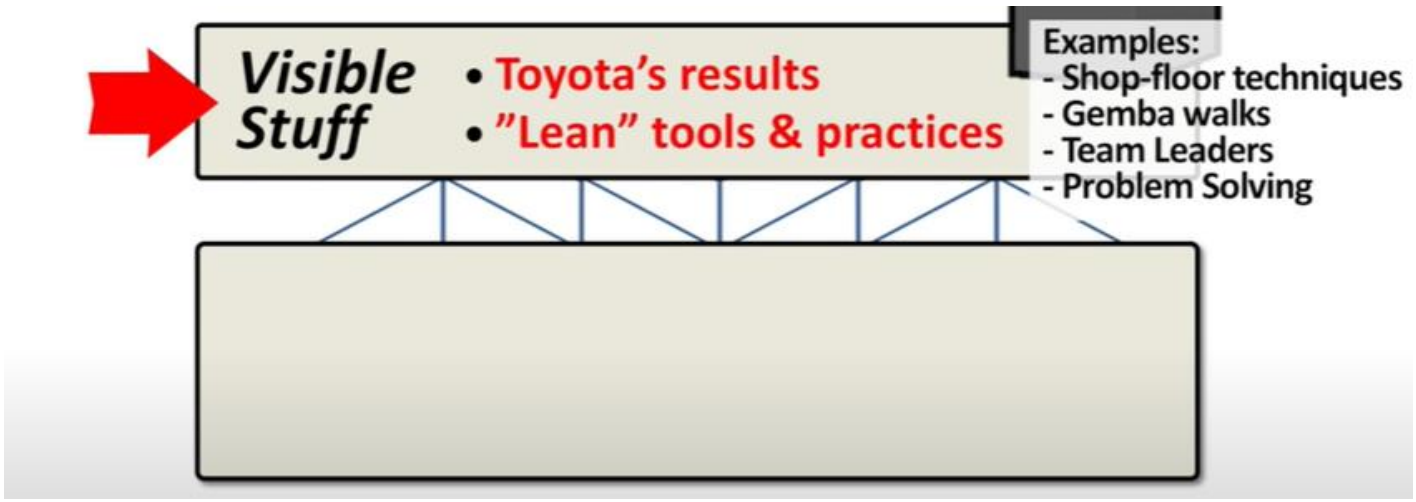
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HERE'S WHAT

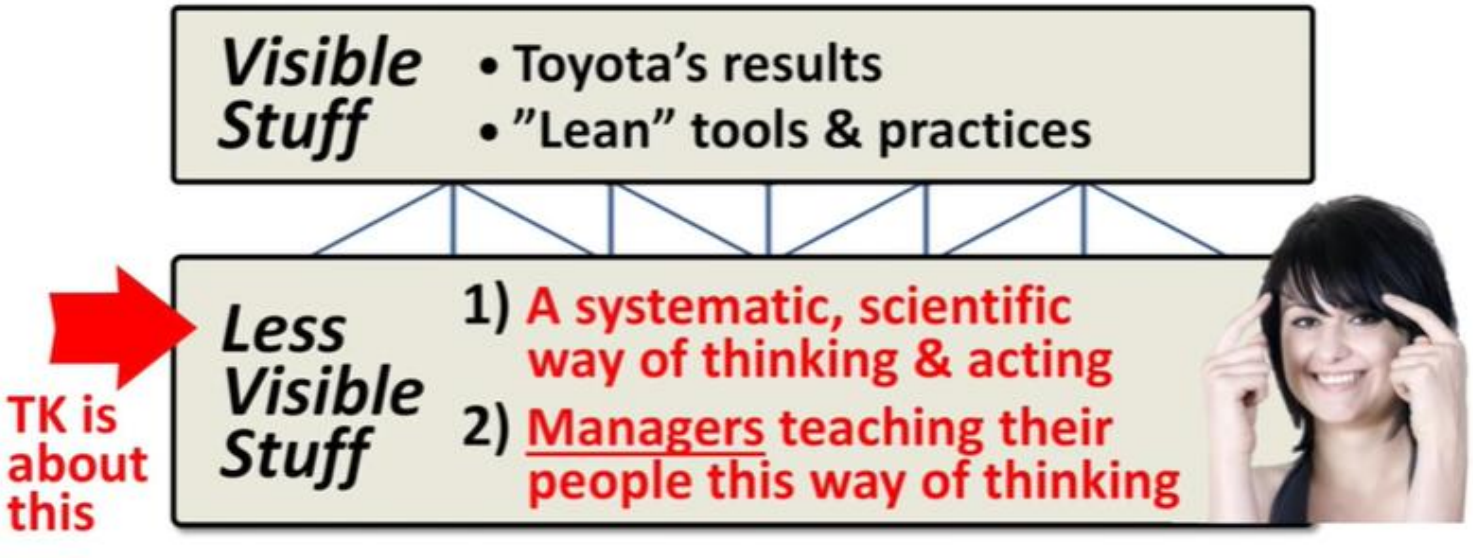
WE FOUND



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HERE'S WHAT

WE FOUND



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WHAT IS THE PURPOSE OF TOYOTA KATA?

- Engage staff in practicing daily continuous improvement
- Provide staff with a routine to enhance coaching skills and develop habits
- Equip people with a pattern and a mindset that is discovery oriented (rooted in scientific thinking)
- Develop behaviors within the organization that leverage the philosophy of continuous improvement to achieve operational excellence

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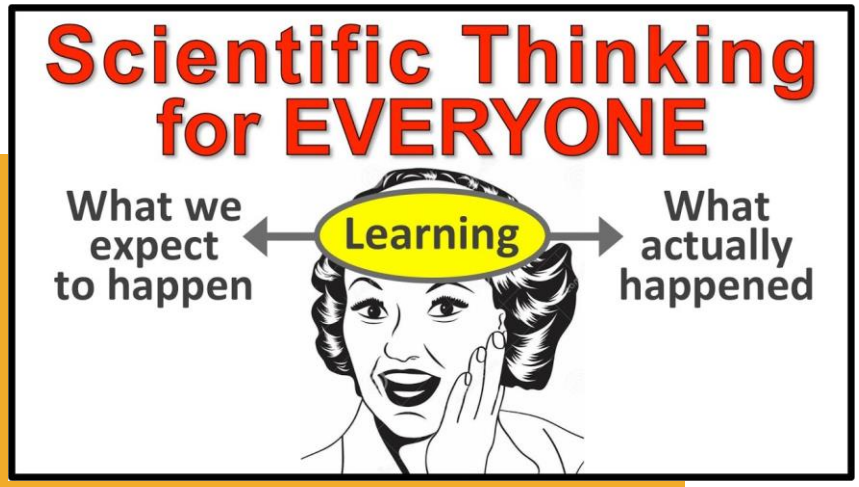


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SCIENTIFIC METHOD



LEAN SOLUTIONS COMMUNITY



SCIENTIFIC
THINKING

Scientific thinking is a routine of intentional coordination between what we think will happen (theory), what actually happens (evidence), and adjusting based on what we learn from the difference.

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2.

STARTER KATA

Structured routines for beginners
to practice fundamentals

3.

COACHING

Corrective feedback
to ensure the Learner practices the right patterns



1.

FREQUENT PRACTICE

A little every day

4.

MASTERY

Growing self
"I'm getting better at this"

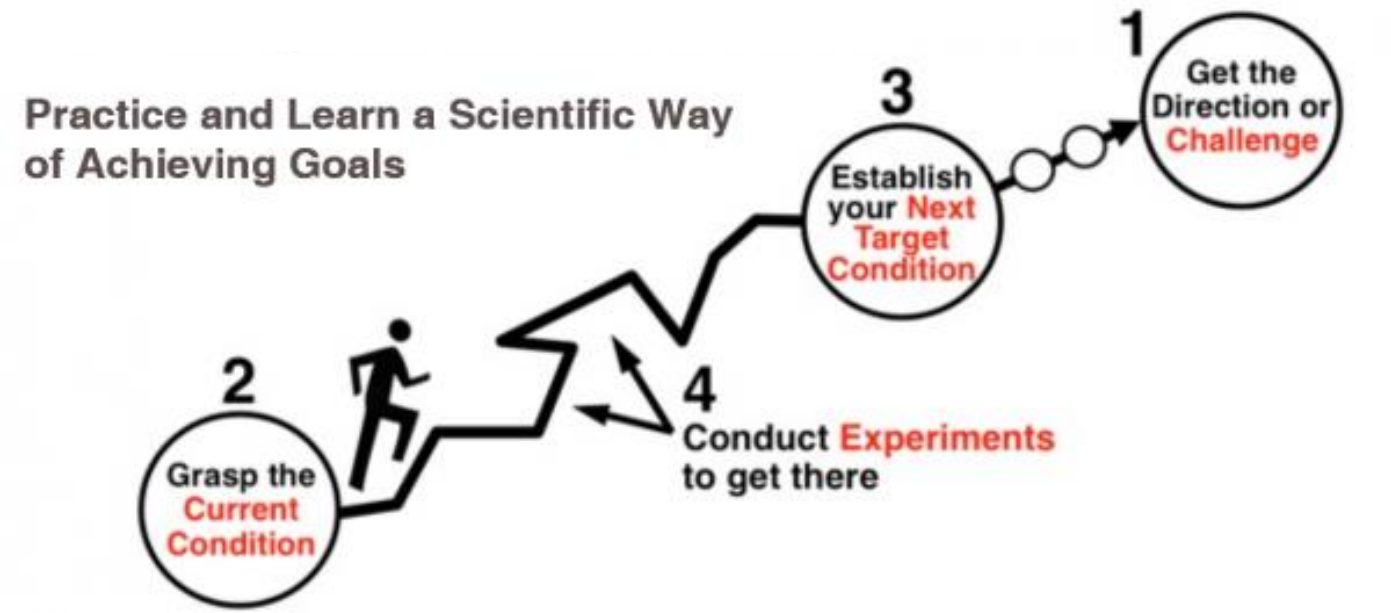
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THIS IS WHAT
YOU WANT TO FEEL

- Awkward
- Slow
- Unnatural
- Stiff
- Uncomfortable
- It Feels Wrong
- Difficult
- Really Had to Think

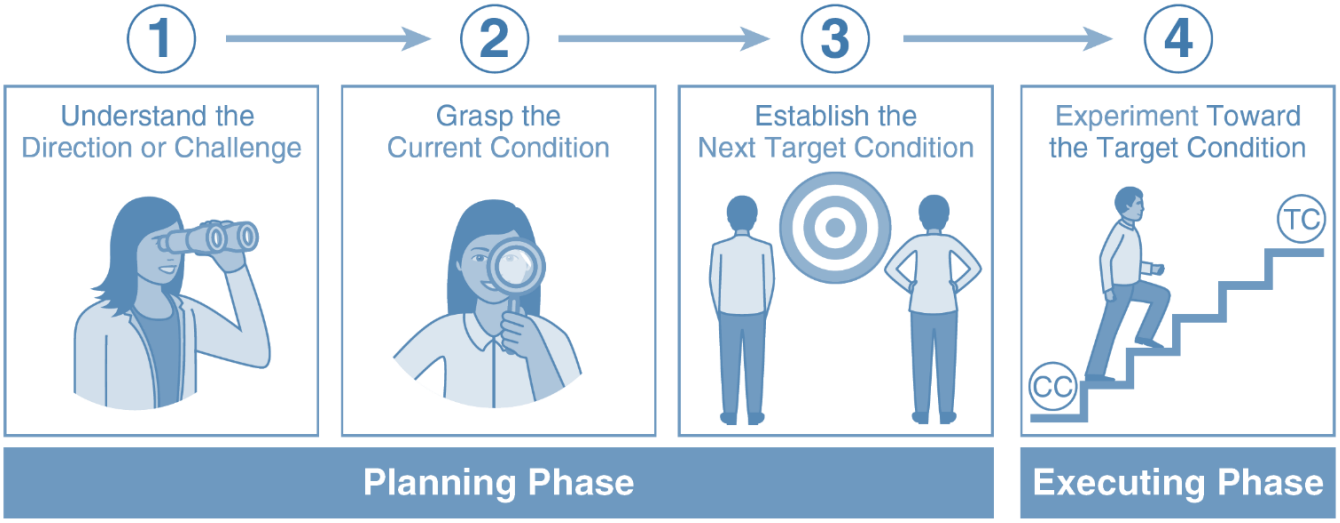
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THE IMPROVEMENT KATA PATTERN



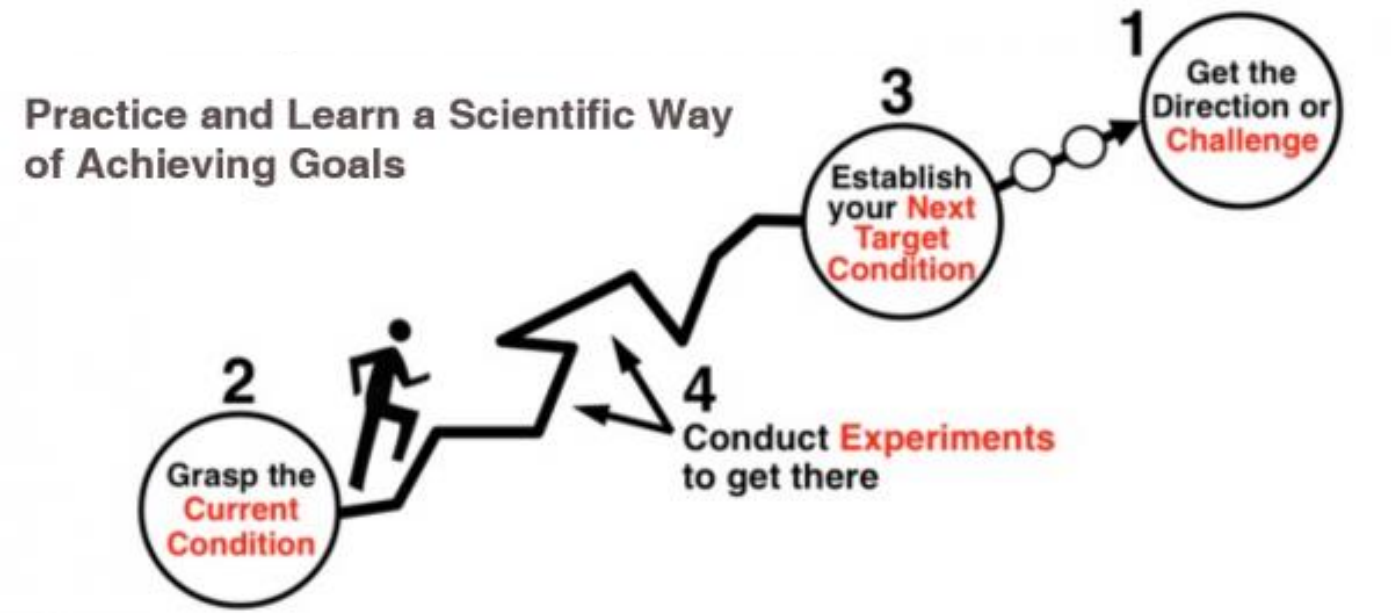
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THE IMPROVEMENT KATA PATTERN



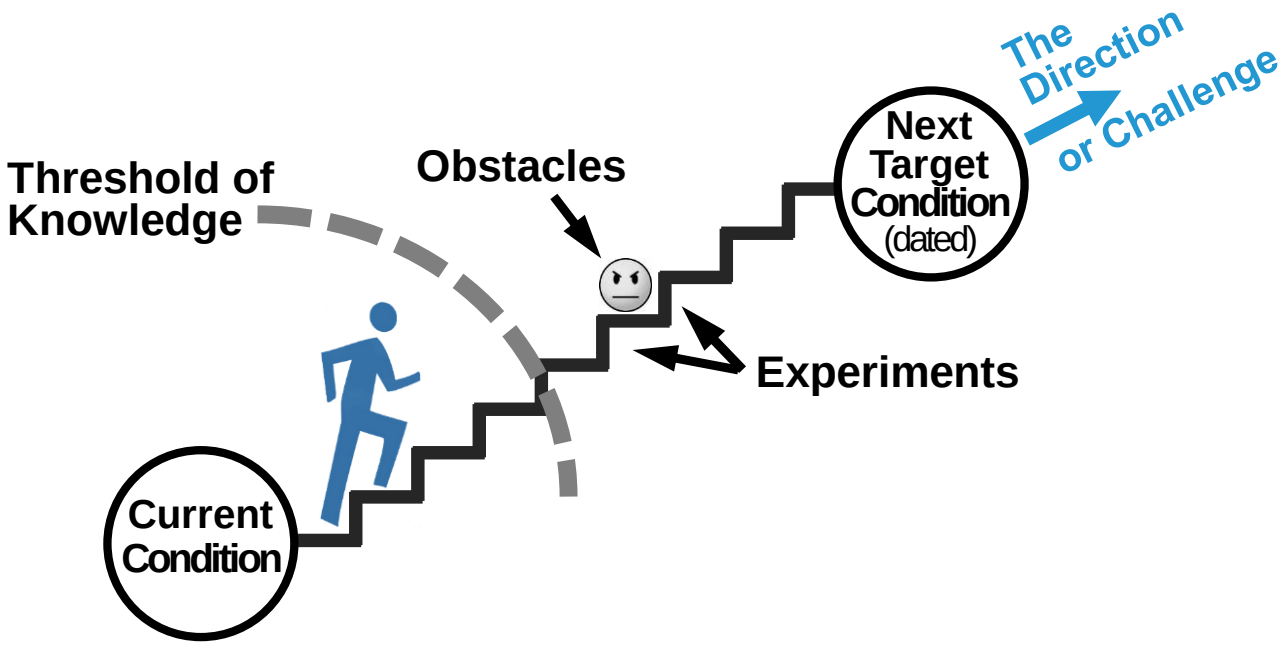
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THE IMPROVEMENT KATA PATTERN



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THE IMPROVEMENT KATA PATTERN





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UNDERSTANDING

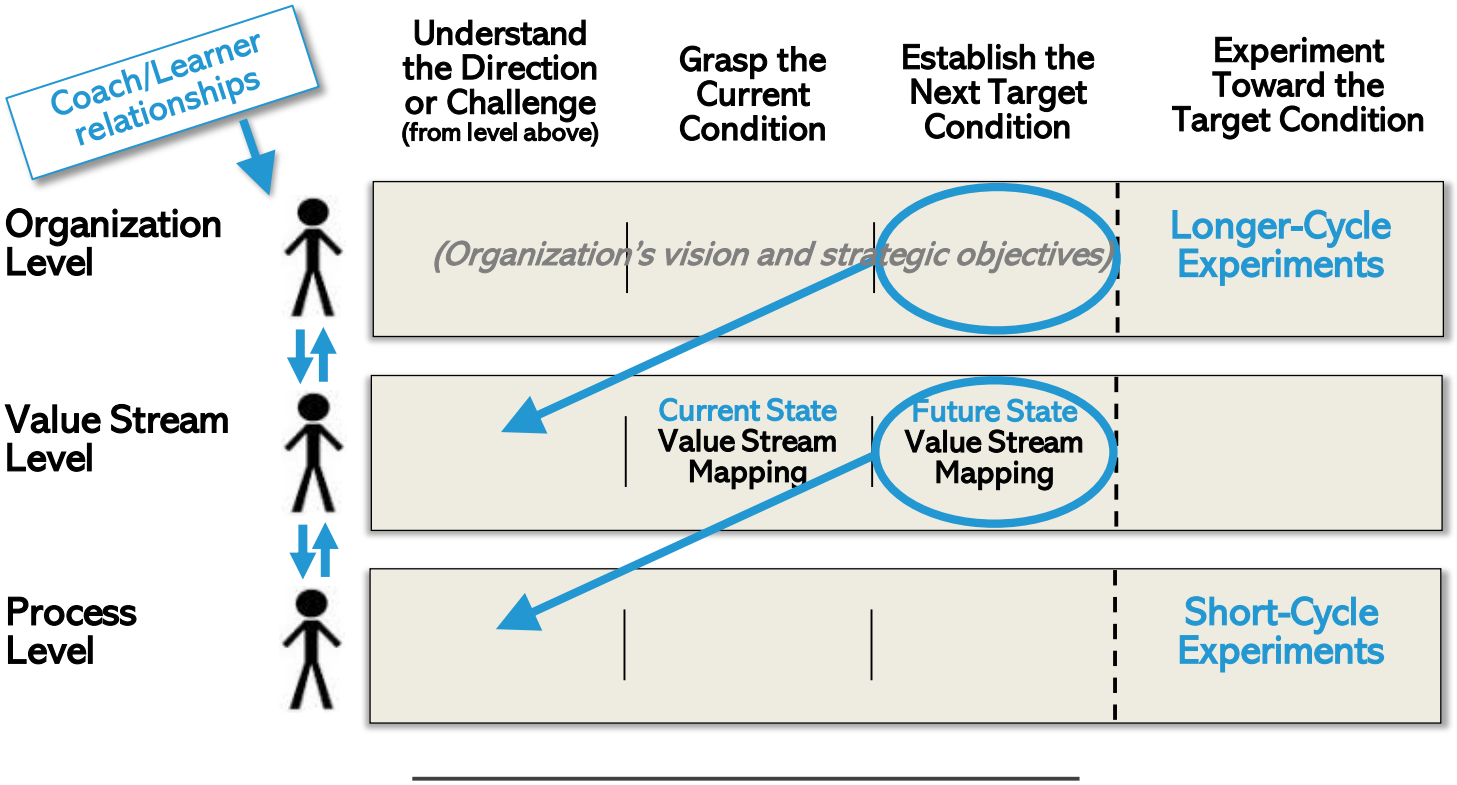
THE CHALLENGE

- Don't Need to Know How You Will Arrive at The Finish Line
- Gives us a Sense of Direction



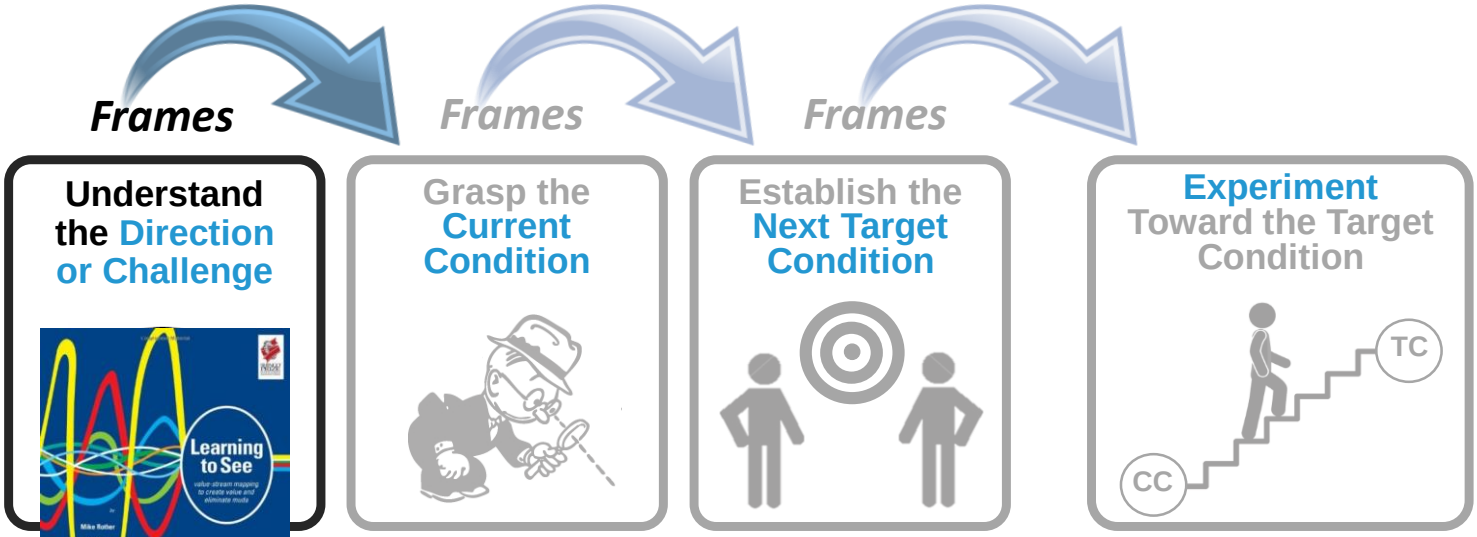


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VSM Here

In what direction should process teams improve, using the Improvement Kata pattern?

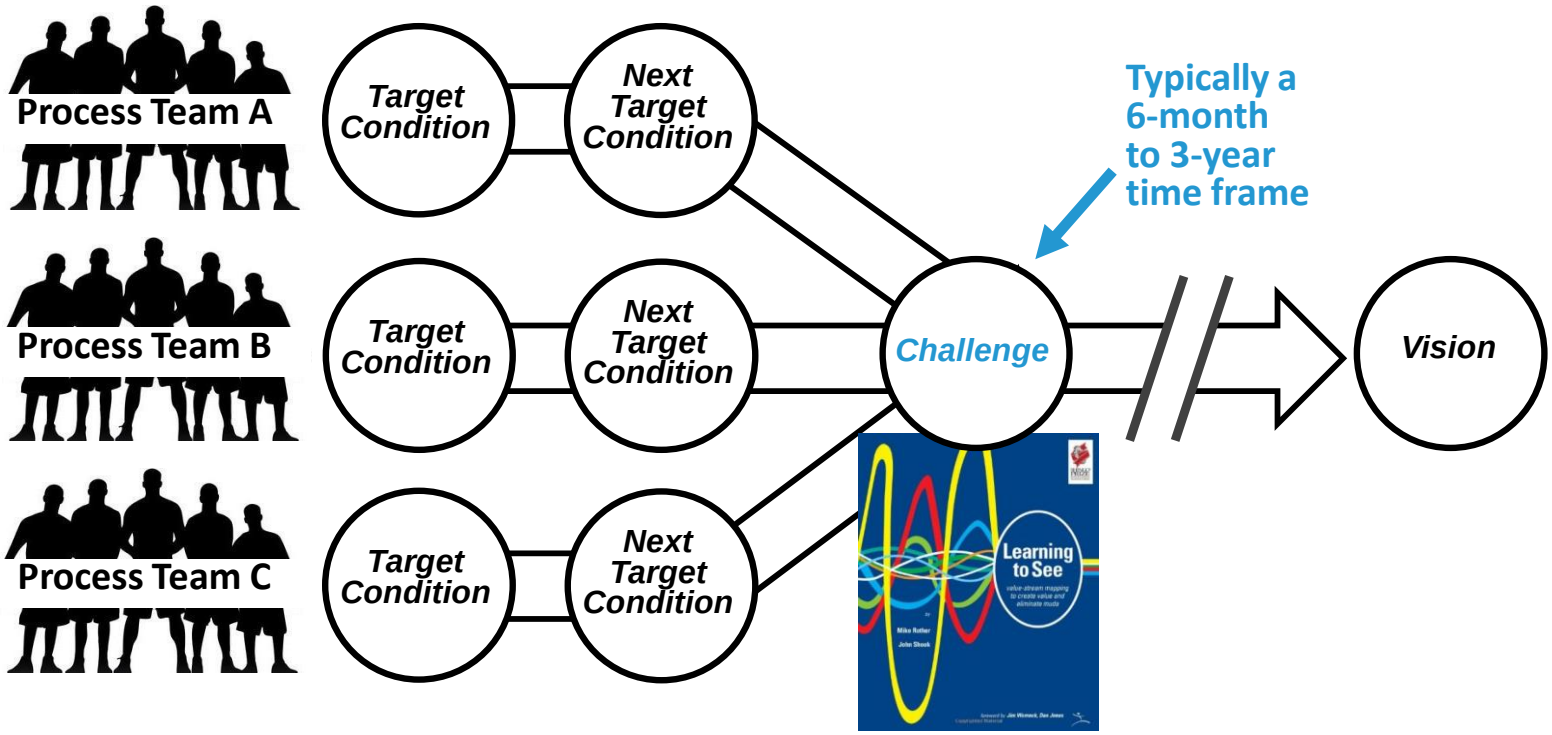


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LESSON 2

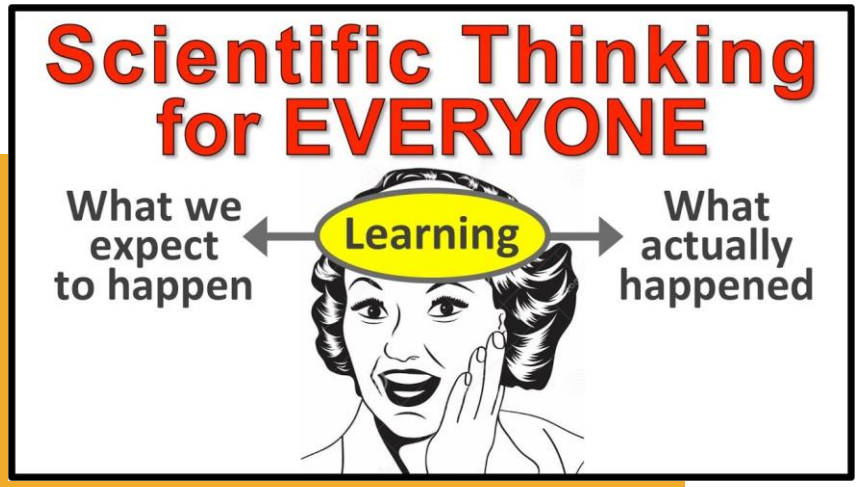
Where Are You Going?

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THE LEARNERS

STORYBOARD



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Focus Process: Lab	Challenge: Done in 45

Target Condition Achieve by: _____	Current Condition	Experimenting Record
		Obstacles Parking Lot

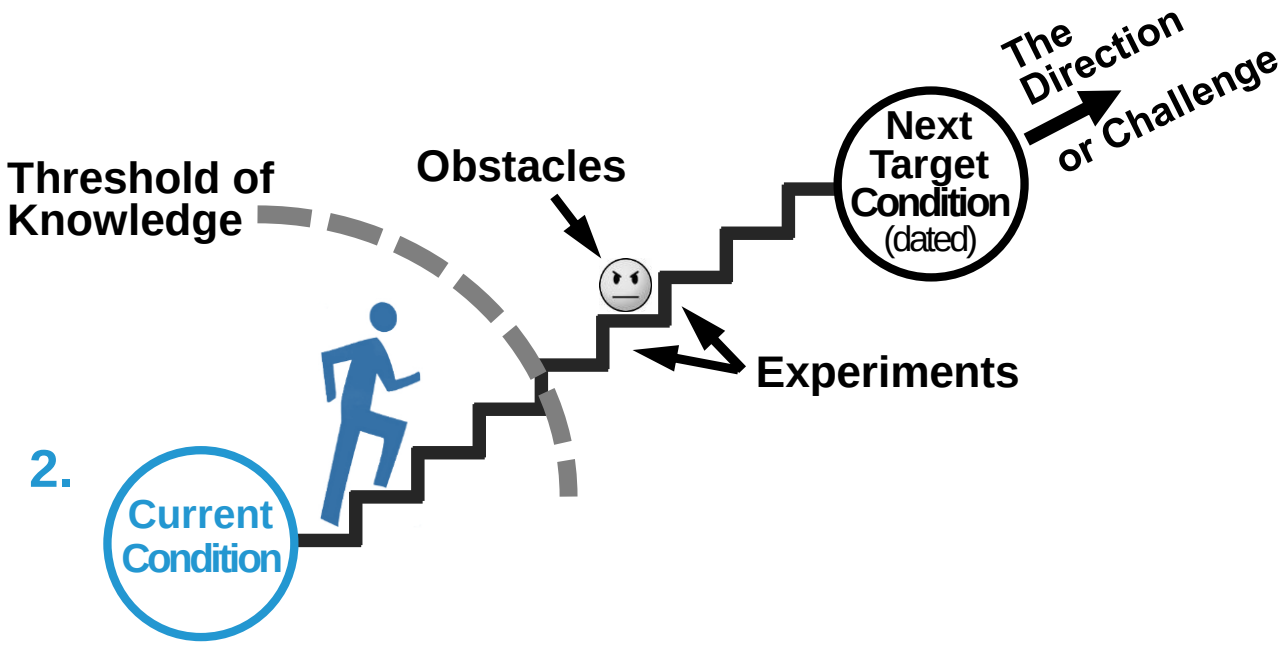
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LESSON 2

Grasp the Current Condition

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THE IMPROVEMENT KATA PATTERN





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PROCESS ANALYSIS

1 GRAPH PROCESS OUTCOME PERFORMANCE
How is the process performing over time?

2 CALCULATE THE CUSTOMER DEMAND RATE AND PLANNED CYCLE TIME
How frequently should the process do what it does?

3 STUDY THE PROCESS'S OPERATING PATTERNS
- ☐ Draw a block diagram of the process steps and sequence.
- ☐ Time exit cycles and draw run charts, to make variation visible.
- ☐ Record your observations about the current operating patterns.

4 CHECK EQUIPMENT CAPACITY
Are there any equipment constraints? What are they?
(This step is only for processes that include automated equipment.)

5 CALCULATE THE CORE WORK CONTENT
How many operators would be necessary if the process had no variation?



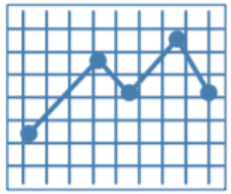
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PROCESS ANALYSIS

1

GRAPH PROCESS OUTCOME PERFORMANCE

How is the process performing over time?





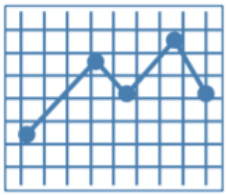
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PROCESS ANALYSIS

2

CALCULATE THE CUSTOMER DEMAND RATE AND PLANNED CYCLE TIME

How frequently should the process do what it does?





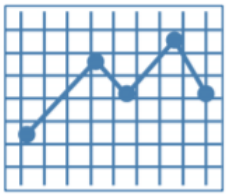
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PROCESS ANALYSIS

STUDY THE PROCESS'S OPERATING PATTERNS

3

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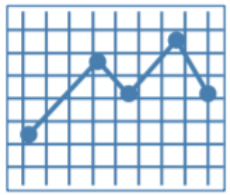


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PROCESS ANALYSIS

4 **CHECK EQUIPMENT CAPACITY**

Are there any equipment constraints? What are they?
(This step is only for processes that include automated equipment.)





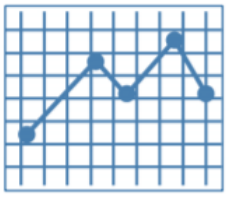
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PROCESS ANALYSIS

5

CALCULATE THE CORE WORK CONTENT

How many operators would be necessary
if the process had no variation?





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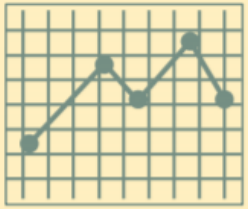
Focus Process: Lab

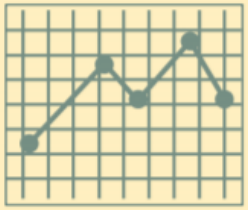
Challenge: Done in 45

Target Condition
Achieve by: _____

Current Condition





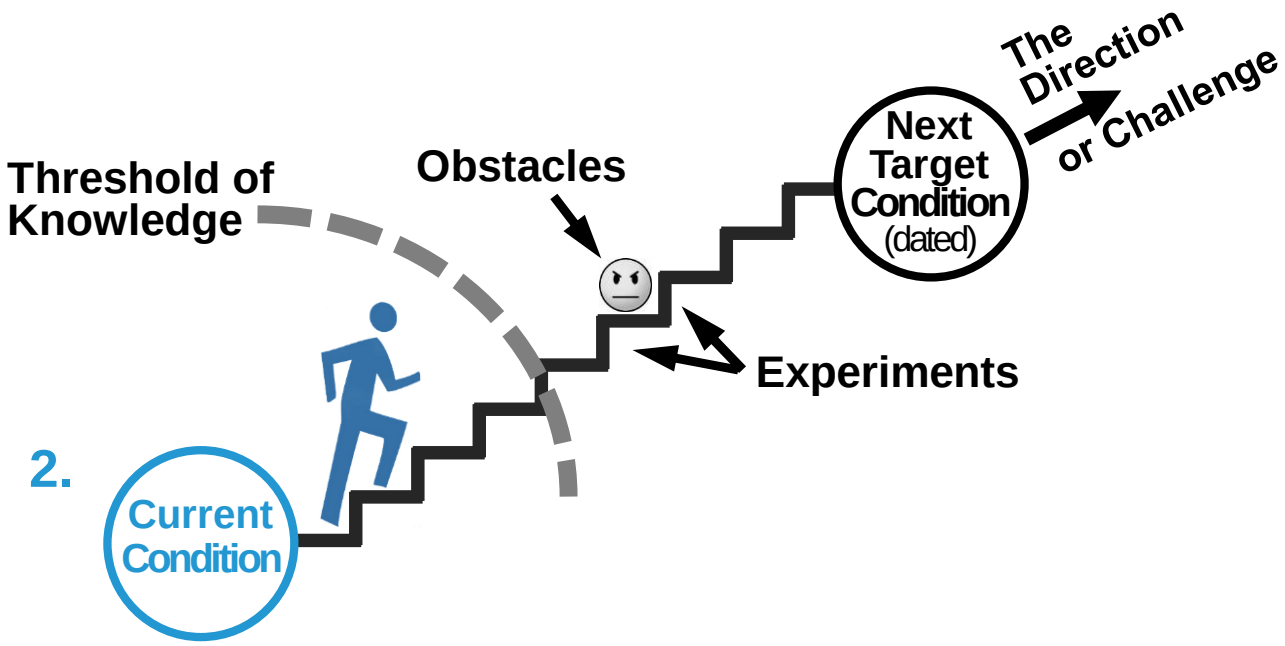


Experimenting Record

Obstacles Parking Lot

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THE IMPROVEMENT KATA PATTERN





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QUIZ 6:

1. What is necessary for world class 'operational excellence'?
   - **Process Improvement + Culture Improvement + Leadership Improvement**

2. What is the first step in strategic planning (Hoshin Kanri) for an organization?
   - **Establish and agree on the Mission, Vision, and Goals**

3. What are the four parts of Dr. Jeff Likers Leadership Development Model?
   - **First, Commit to Self-development. Second, Coach and Develop others. Third, Daily Management and Kaizen. Fourth, Create Vision and Align Goals.**

4. What are the four steps to Toyota Kata?
   - **1. Get the Direction 2. Grasp the Current Condition 3. Establish your Next Target Condition 4. Conduct Experiments to Get There**

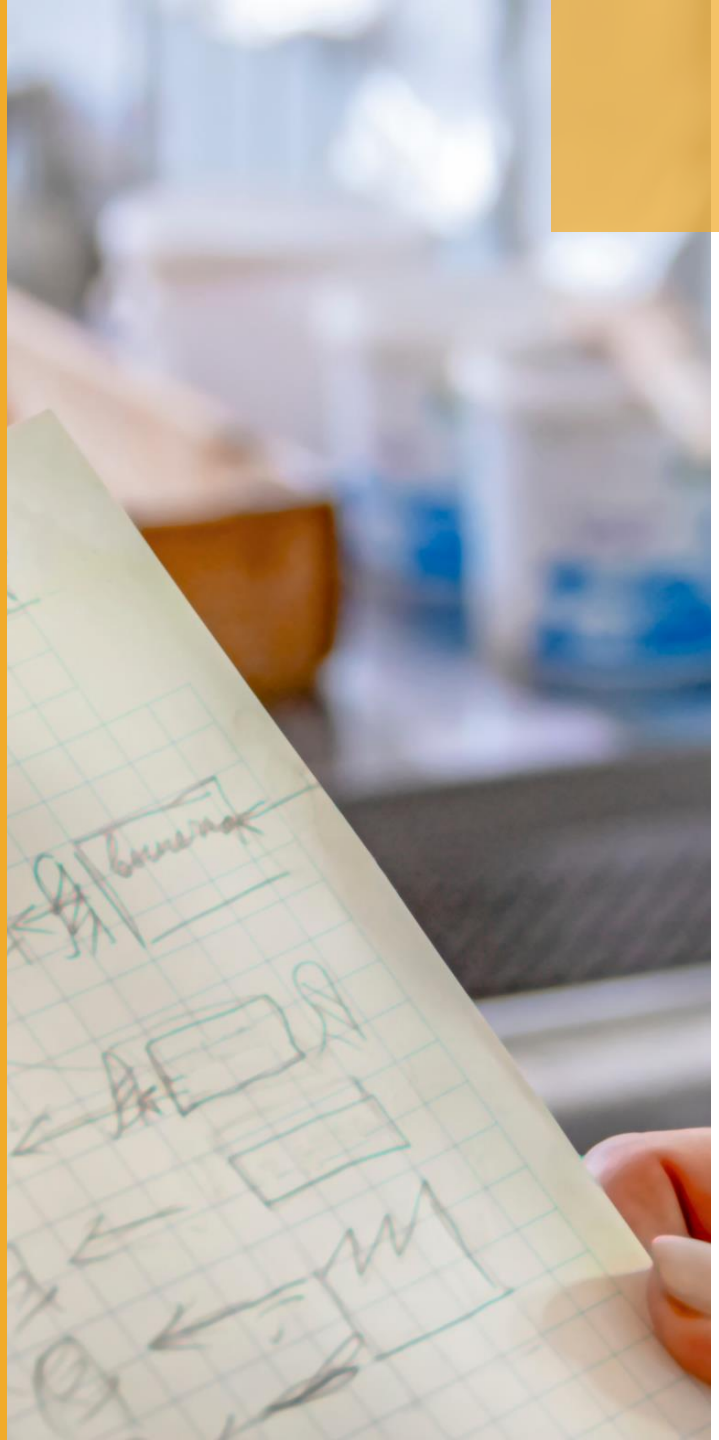
5. A Kanban is used as a signal for movement of raw materials. In which direction does a Kanban usually move?
   - **It moves to the supplier of the materials, parts, or finished goods**

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VALUE STREAM MAPPING

DEEPER DIVE!



INTRODUCTION

Definition: All the actions (both value added and non-value added) currently required to bring a product from raw material to customer.

- Shows the “Big Picture”.
- Documents the path from customer to supplier and back.

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WHY IS THIS
AN ESSENTIAL TOOL?

- Helps you “see” the flow
- Identify the waste and its source
- Provides a common language
- Decisions about the flow become apparent
- Linkage between information flow and material flow

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REDUCE
LEAD TIME

- Lead time is measured from the point where flow is initiated or triggered in a process until the product or service reaches the customer
- The aim is to reduce this timeframe by only producing in response to a pull from the customer (or the next process as customer) and eliminating the things that waste time and resources.
- LT reduction is often accomplished by eliminating queue times between processes



"All we're trying to do is shorten the time line..."

Taiichi Ohno

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CURRENT STATE VS MAP STEPS

- **Step 1:** Identify customer requirements and calculate takt time
  - Our customer is sometimes internal or external
  - Our customer is also the shareholder

- **Step 2:** (DATA BLOCKS) Identify Main Processes In Order
  - Each one will be different and unique to the area you are working with.
  - A data block is created when a person or area passes a product or service to the next step.

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CURRENT STATE VS MAP STEPS

- **Step 3:** Add arrows for the Flow of Information.
  - Straight arrows
  - Right Angles (NO diagonals)
  - Information flow arrows
- **Step 4:** Walk the Value Stream: Add inventory / delay queues. Note movement and inventory
  - What will be considered the WIP? What is considered inventory?
  - Inventory triangles should be noted between process blocks.
  - Stay customer centric here. A customer doesn't care if you have a price on a line item if they are waiting for a package…

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CURRENT STATE VS MAP STEPS

- **Step 5:** Walk the Value Stream - Populate the Data Boxes with Metrics
  - Identify Key Performance Indicators for the Value Stream.
  - For today => See Data Box
- **Step 6:** Summarize Value Stream Metrics - Calculate Lead Time Ladder
  - Lead time complete = lead time PLUS Inventory

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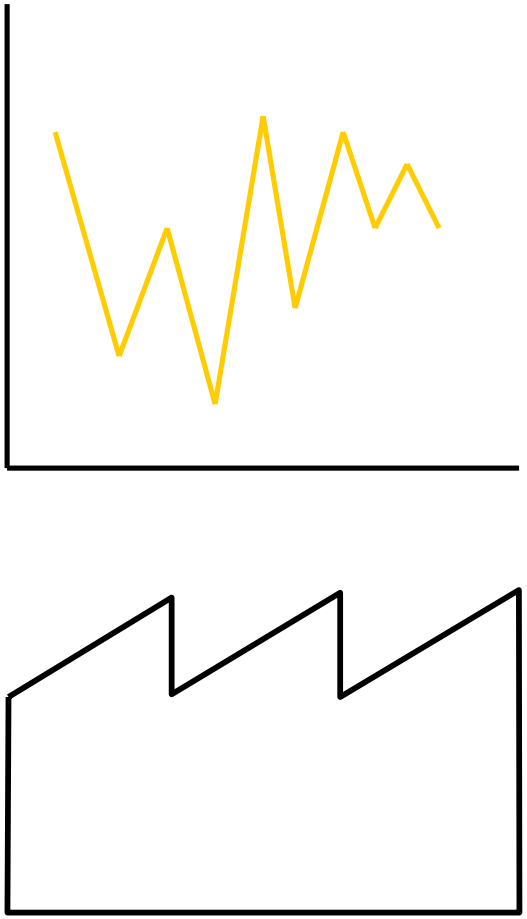
DATA INTEGRITY

There are four scenarios for data collection.

- Data exists
- Data can be gathered through observation of work
- Data can be collected through simulation of activities
- If you cannot observe or simulate the activity you may have to make an educated "estimate"

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CREATING THE CURRENT STATE VALUE STREAM MAP



Always Start With the Customer

- What capability /service do you provide?
- What are the boundaries of your map?
- What is the demand profile?

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TAKT TIME



Takt Time – The available production time divided by customer demand.

The first step in Standard Work development is understanding the customer requirements.

- Defining the "right goods or services", is done in the design and development process.
- The steps to transform the raw material or data to the customer defined value are captured as the work elements.
- To provide goods and services "in the right quantity, at the right time", customer demand (takt time) must be understood.

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TAKT TIME EXAMPLE

Takt Time = Demand Rate

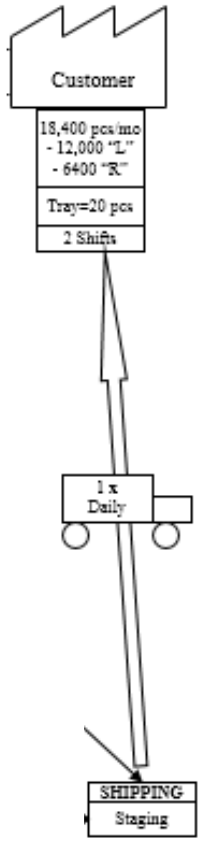
- Synchronizes pace of processing to match pace of customer need.

$$\text{Takt Time} = \frac{\text{Effective working time per time period}}{\text{Customer requirement during the time period}}$$

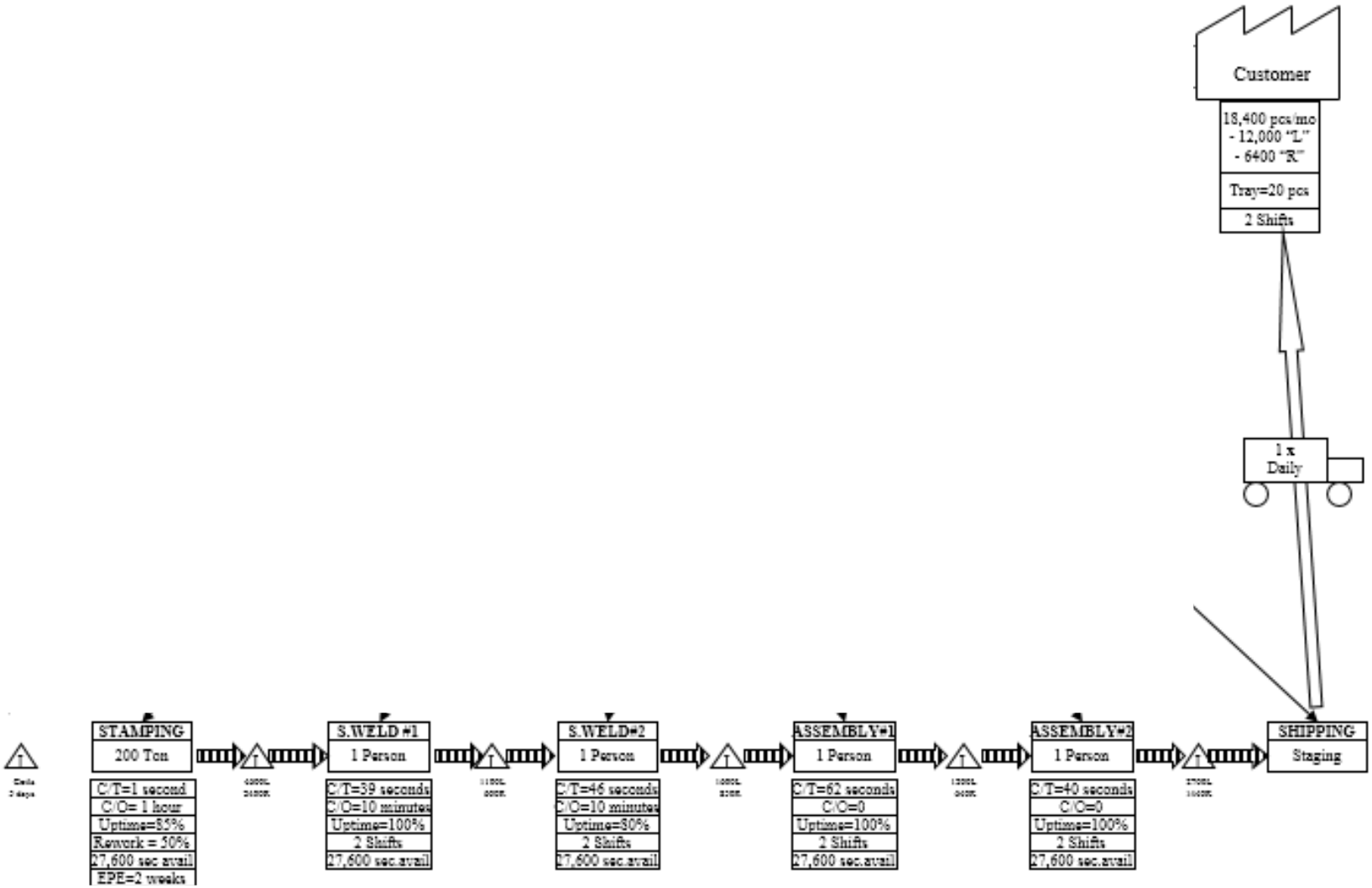
$$= \frac{460 \text{ minutes / day}}{46 \text{ quotes}} = 10 \text{ minutes per quote}$$

Ideally, one quote every 10 minutes must be processed

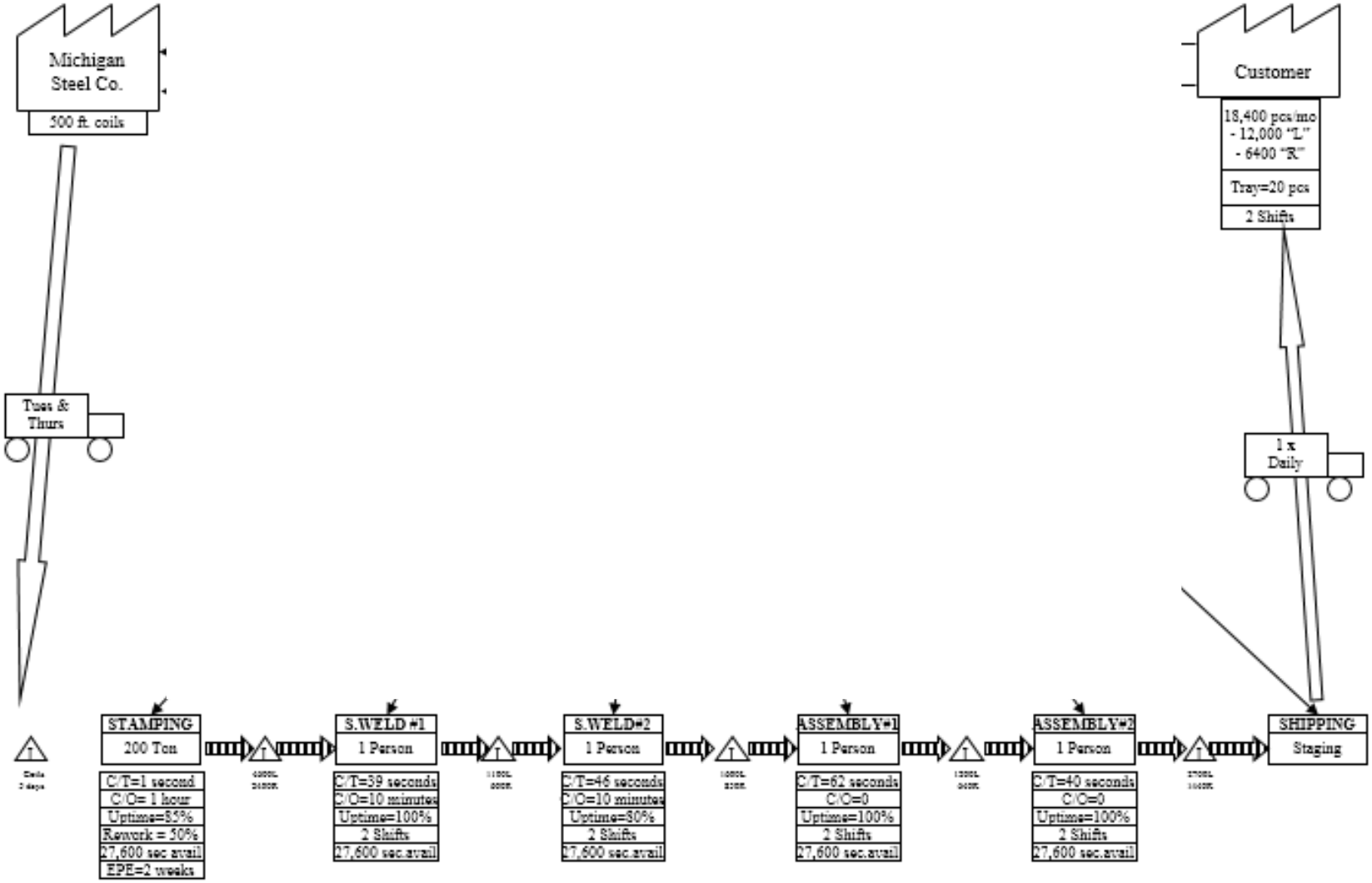
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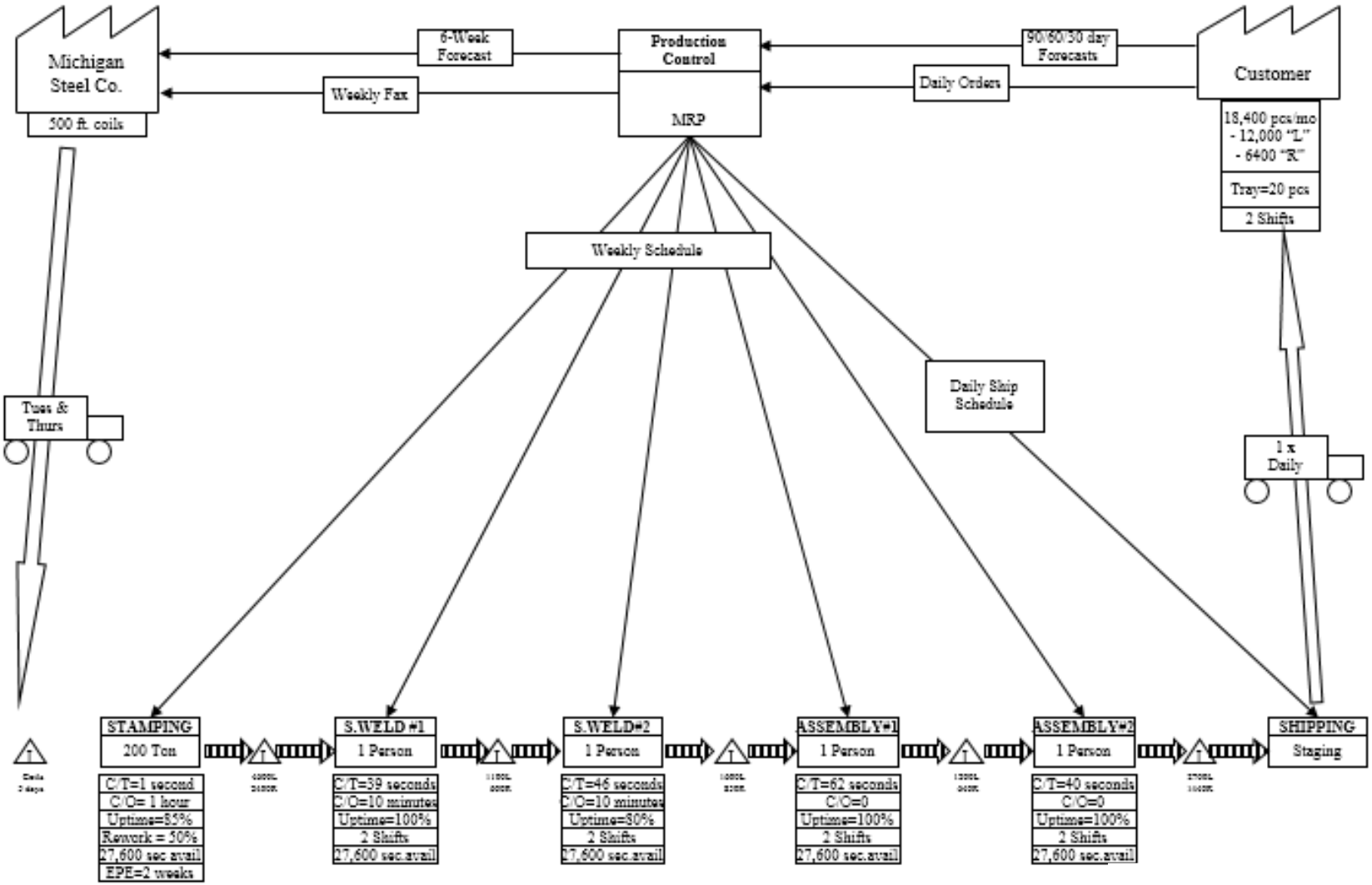


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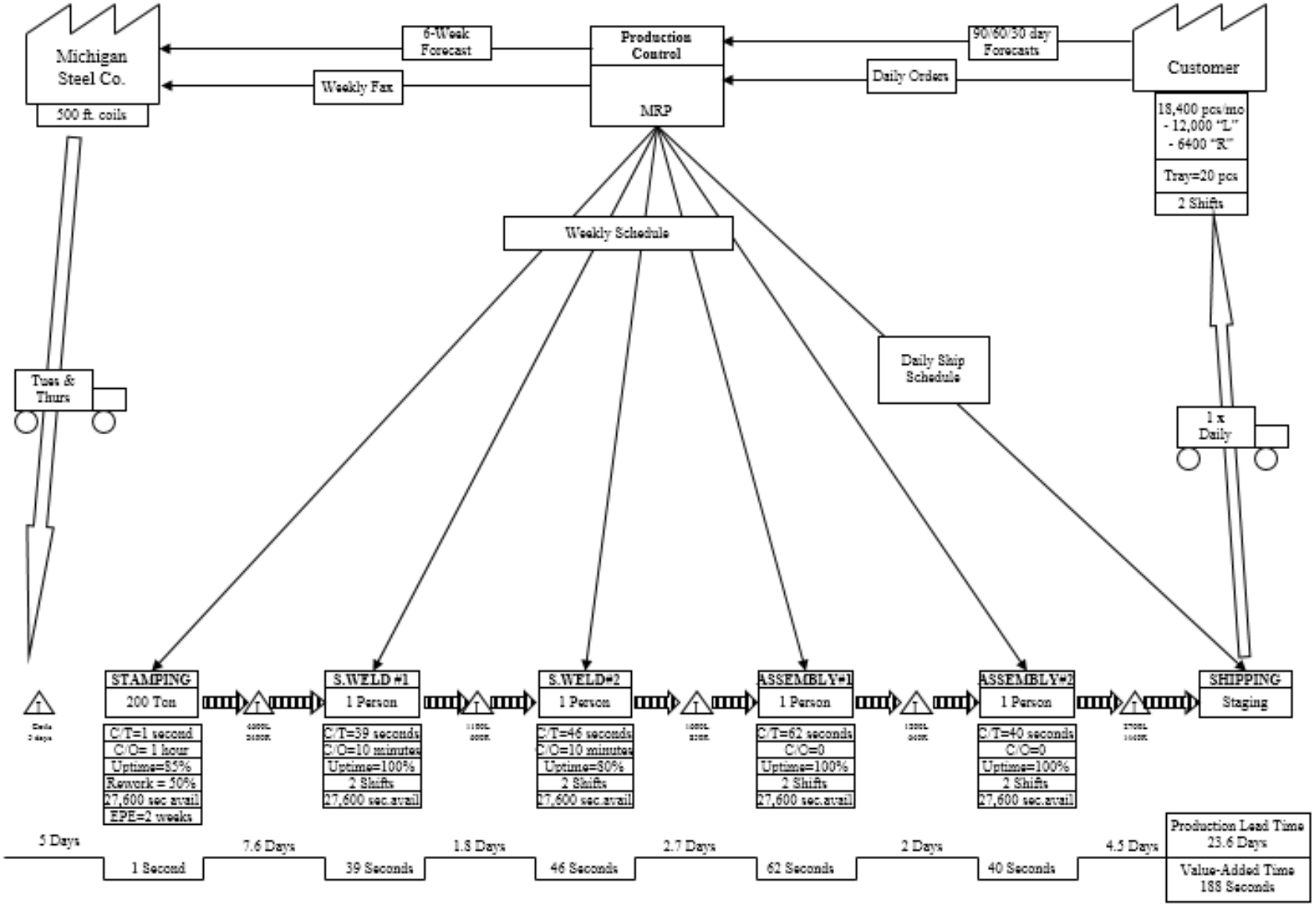


LEAN
SOLUTIONS


Michigan Steel Co.
500 ft. coils
Tues & Thurs
Customer
18,400 pcs/mo
- 12,000 "L"
- 6400 "R"
Tray=20 pcs
2 Shifts
1 x Daily
STAMPING
200 Ton
C/T=1 second
C/O= 1 hour
Uptime=85%
Rework = 50%
27,600 sec avail
EPE=2 weeks
S.WELD #1
1 Person
C/T=39 seconds
C/O=10 minutes
Uptime=100%
2 Shifts
27,600 sec avail
S.WELD#2
1 Person
C/T=46 seconds
C/O=10 minutes
Uptime=80%
2 Shifts
27,600 sec avail
ASSEMBLY#1
1 Person
C/T=62 seconds
C/O=0
Uptime=100%
2 Shifts
27,600 sec avail
ASSEMBLY#2
1 Person
C/T=40 seconds
C/O=0
Uptime=100%
2 Shifts
27,600 sec avail
SHIPPING
Staging

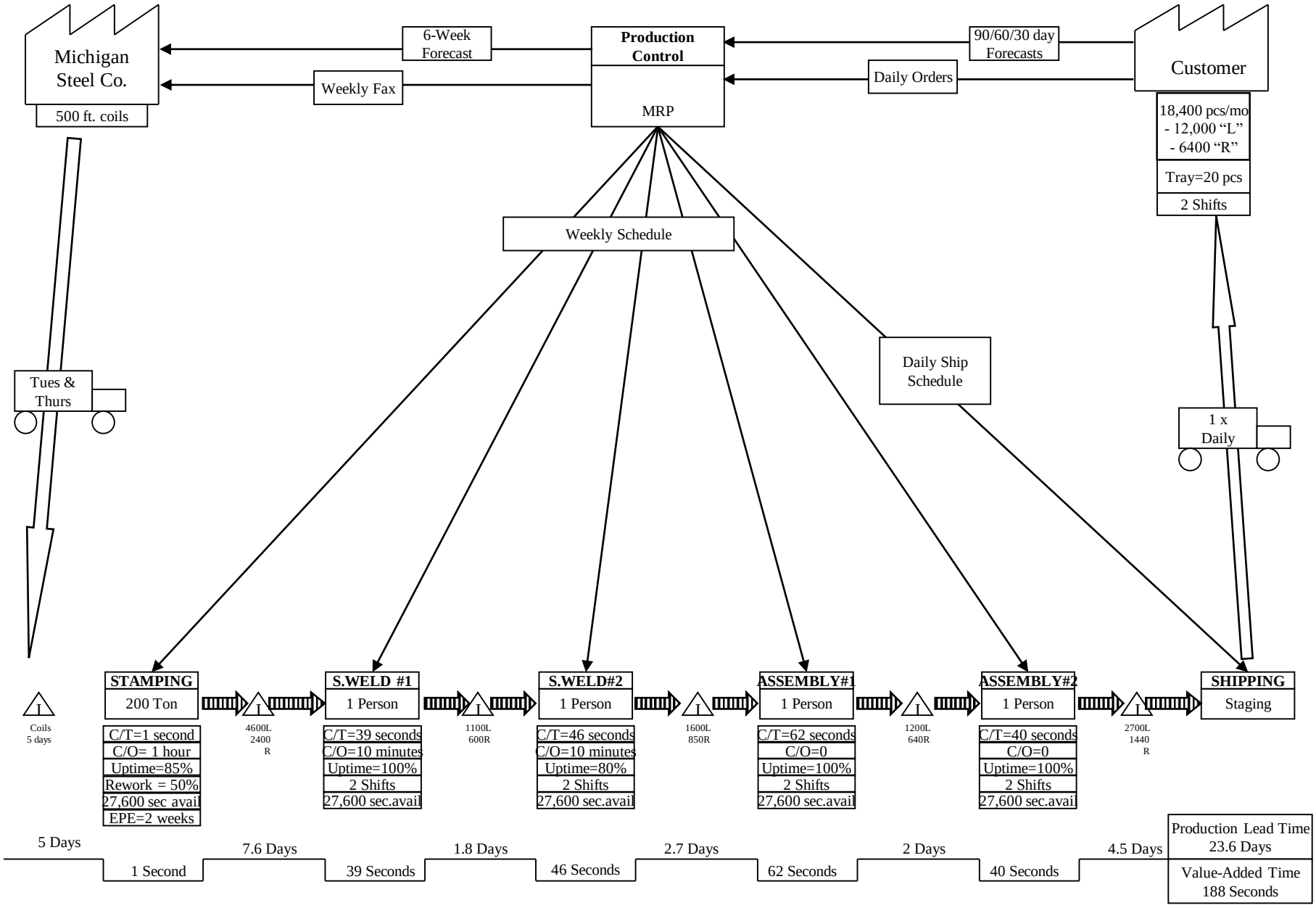


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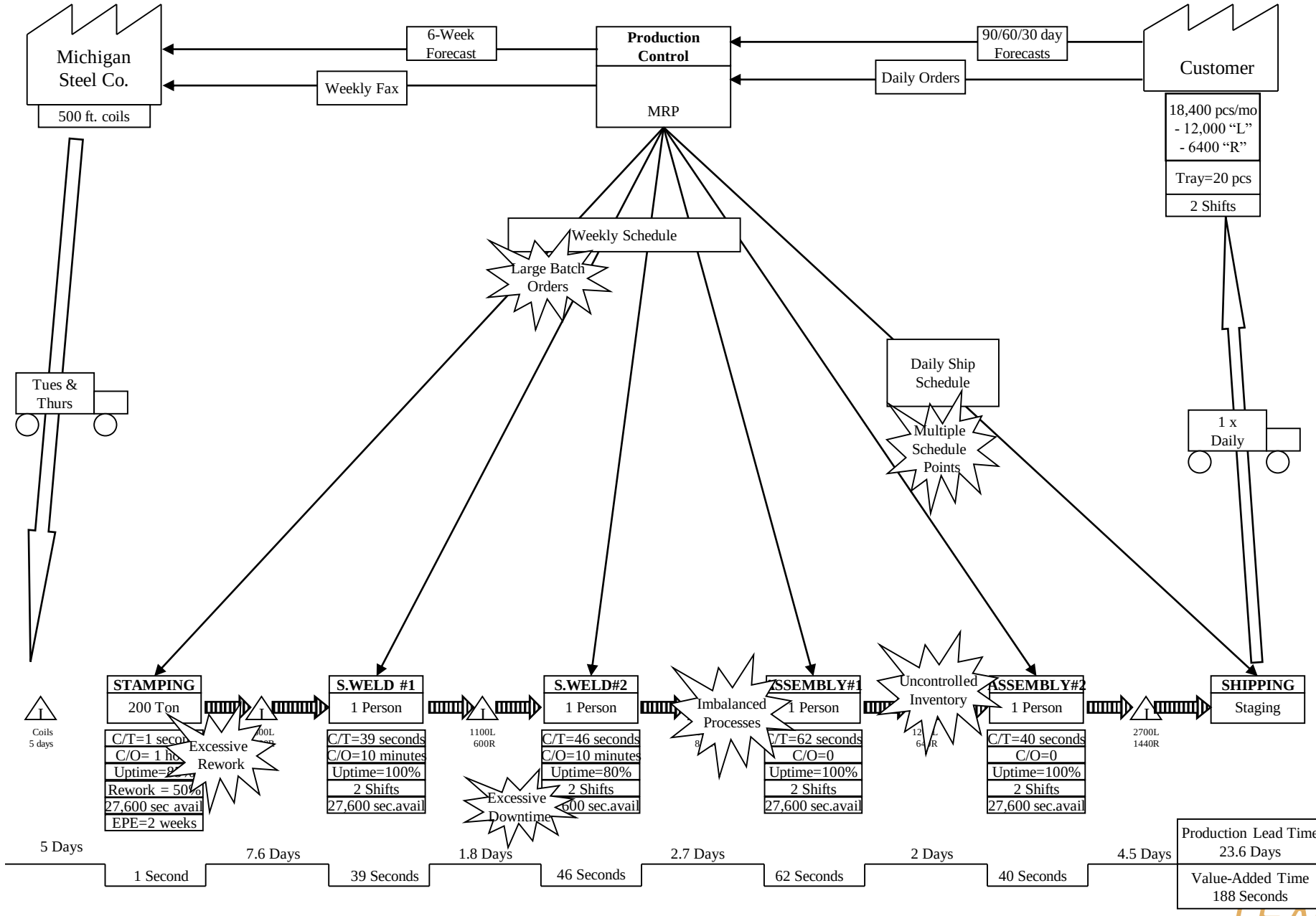
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CURRENT STATE MAP



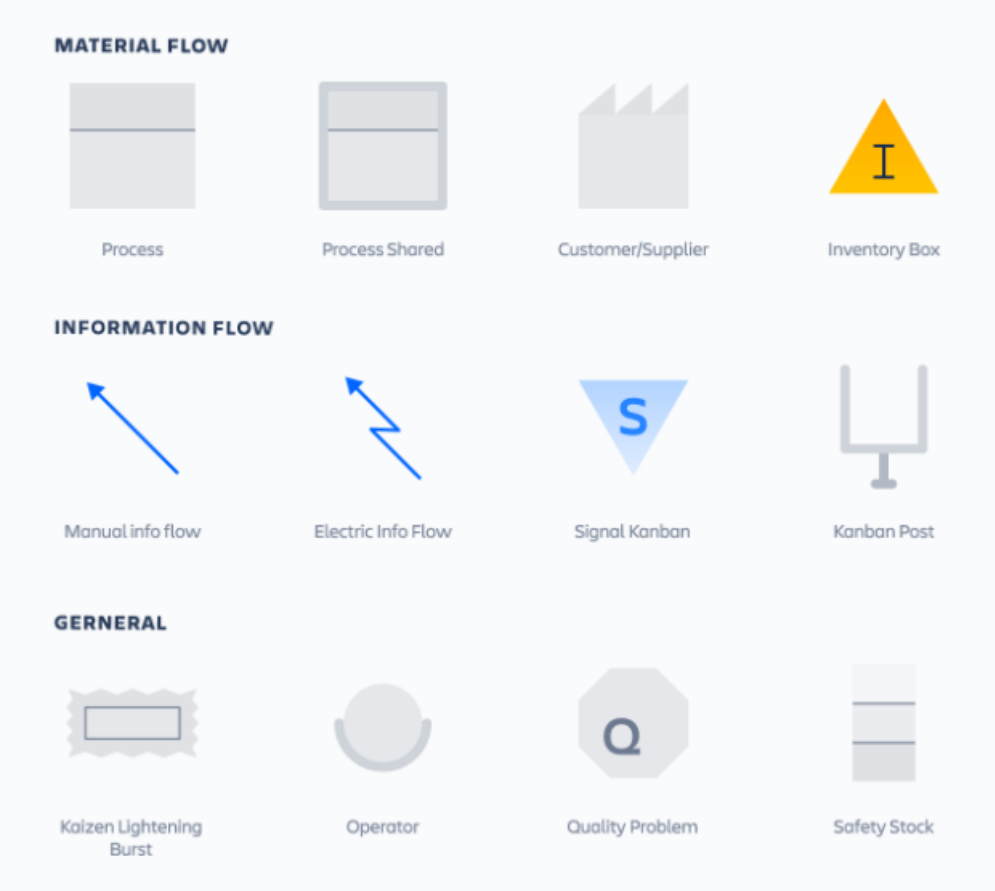
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CURRENT STATE MAP



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VALUE STREAM SYMBOLS

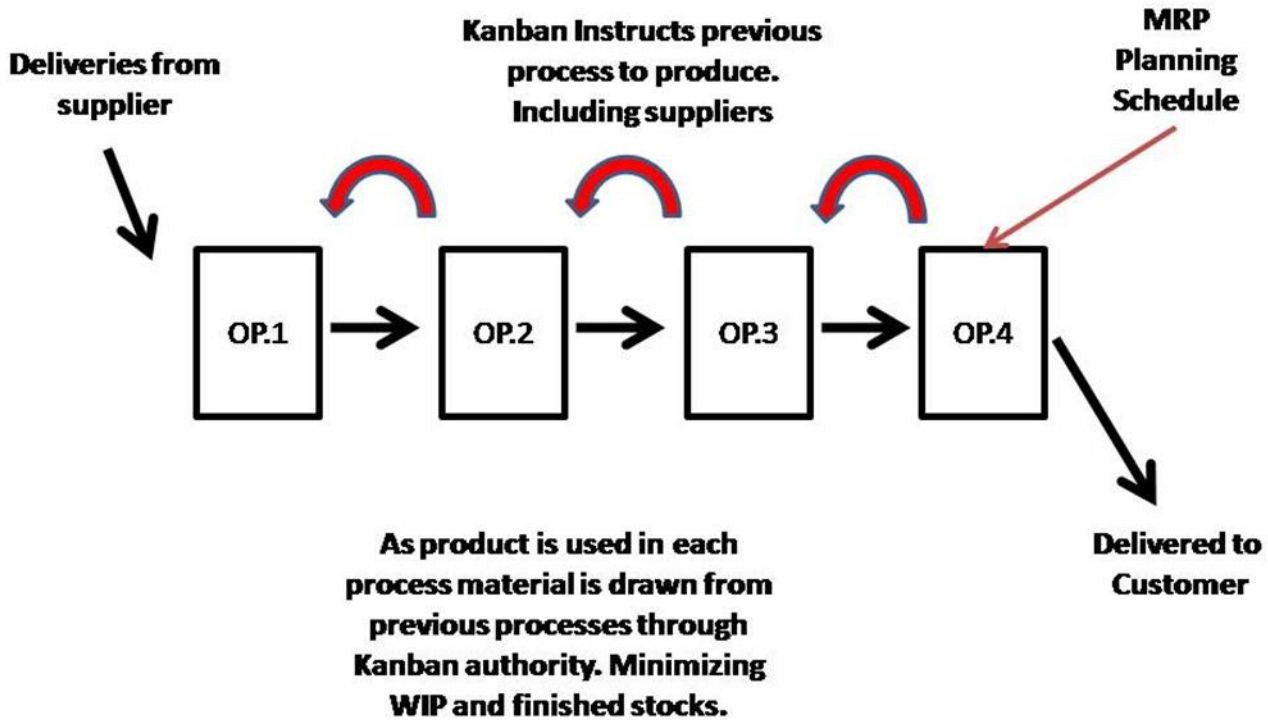


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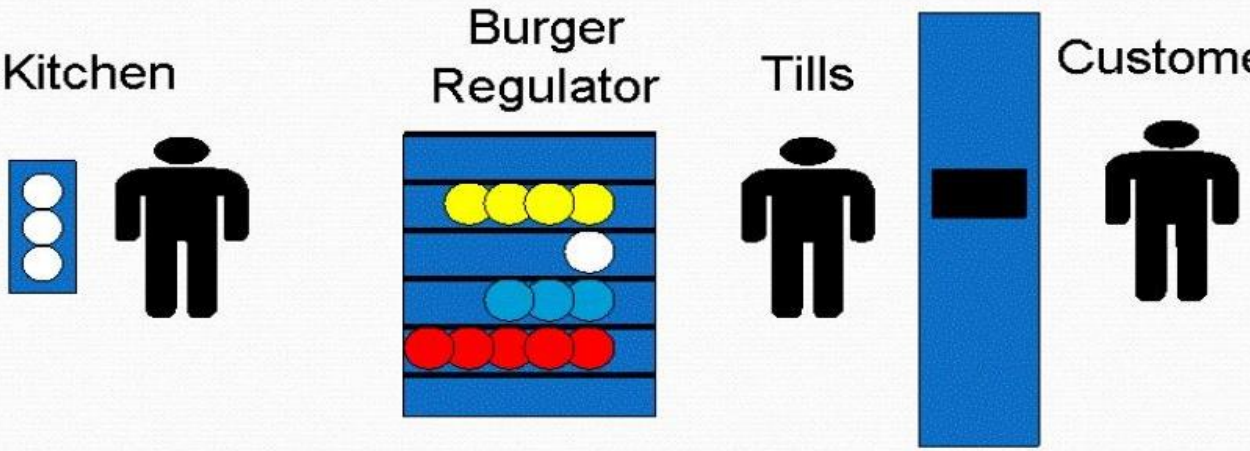
KANBAN CARDS & SYSTEMS

LEAN SOLUTIONS

Pull Production



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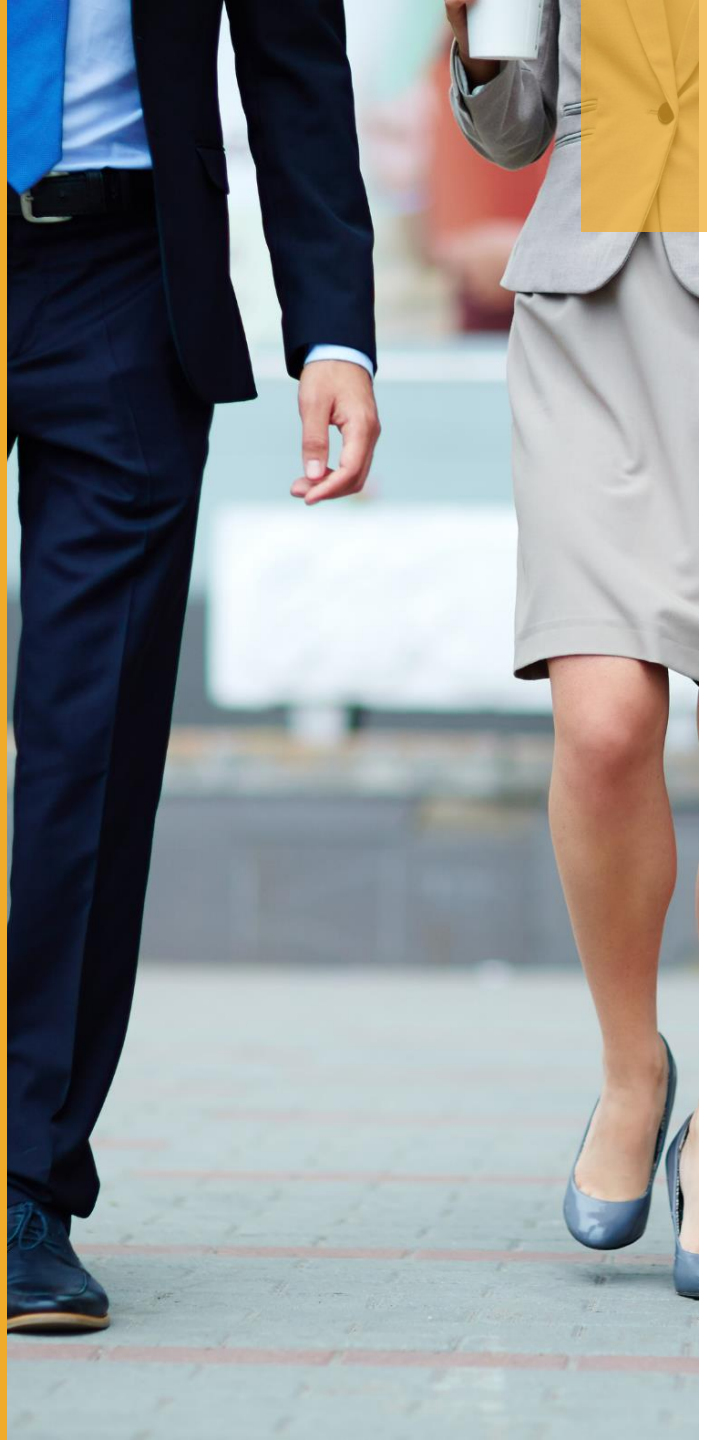
As each burger is consumed . . .
They are removed from the regulator . . .
And then replenished by the kitchen . . .
Not made to a forecast and pushed at the customer

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GEMBA WALKS

LEAN SOLUTIONS



WHAT IS A GEMBA WALK?

The Gemba walk is an essential part of the Lean management philosophy.

- Its purpose is to allow managers and leaders to observe the actual work process, engage with employees, gain knowledge about the work process and explore opportunities for continuous improvement.
- A Gemba Walk is also an opportunity for managers and leaders to coach and receive coaching.

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GEMBA WALKS
ARE NOT DONE ALONE

Gemba walks are meant to be coaching opportunities.

Step 1: Use your LSW to establish a day/time and stick to your schedule. Make it routine!

Traditional Management Style: "Do It My Way"



Lean Leadership Style: "Follow Me, and We'll Figure This Out Together"



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DEFINE
THE PURPOSE

Define ‘purpose’ for walk – why doing it?

Define scope for walk – where headed?

Coach appropriate behaviors to participants:

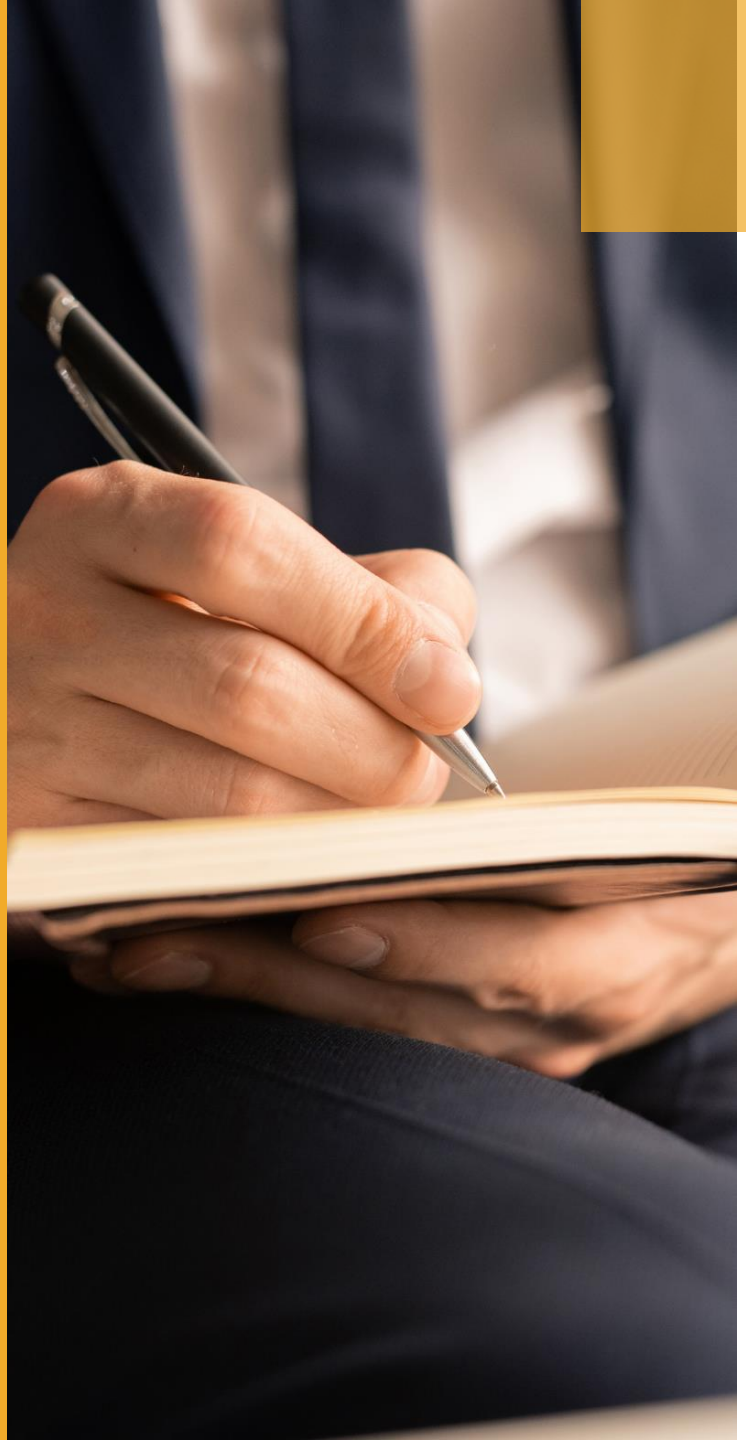
- One conversation at a time.
- Show respect. Listen more than you talk.
- Make no on the spot judgements, seek to understand.

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TYPES OF
GEMBA WALKS

- Safety
- 5S
- Waste – Waste Walk
- Process Focus – Never Focus on Individuals
- Walk the Value Stream of a Product





WHAT TO DO

ON A GEMBA WALK

- If with another leader, ask to SEE their leader standard work
- Review Hr x Hr and Tier Boards
- Review corrective actions / plans for top issues
- Discuss team board problem solving process
- Review training matrix and ensure plans are in place
- Pay attention to lean waste and review plans

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TIPS & POINTS

TO REMEMBER

Step 1: Create a Theme

Before a walk begins, managers should pick a theme to guide the entire Gemba walk. This narrows the focus of the Gemba walk and yields better results, as attention is not spread amongst different themes and objectives. Once a theme has been chosen it's easier to tailor your Gemba walk questions to the theme you chose, and ask quality questions.

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TIPS & POINTS

TO REMEMBER

Step 2: Prepare the Team

Inform the team by explaining what a Gemba walk is and what to expect from a routine Gemba walk. Share this in your Tier Meetings. Consider sharing your checklist, too.

This lowers a team's anxiety as the Gemba walk will not be perceived as an evaluation, but rather, a collaboration between participants. Getting buy-in from the team beforehand will also raise questions that could have been missed.

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TIPS & POINTS

TO REMEMBER

Step 3: Focus on the Process

Stick to the evaluation of the process and how things are done. Here, a checklist can help. By writing questions that force you to assess the process, not the person, you can avoid the most common Gemba walk mistakes: **blaming.**

Remember: **You are there to identify opportunities of improvement in the process and barriers on the shop floor hindering productivity.**

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TIPS & POINTS

TO REMEMBER

Step 4: Keep the Value Stream Front & Center

Make sure your checklist traces the whole value stream. By sketching these questions out beforehand, you can ensure you don't miss any crucial stations or processes.

Focusing the bulk of your Gemba walk on the value chain is more effective in identifying bottlenecks and potential pockets of waste. Removing such bottlenecks will improve overall performance across the value chain.

TIPS & POINTS

TO REMEMBER

Step 5: Record Your Observations

Record everything. Record every data point you encounter on your Gemba walk. Don't make assumptions or recommendations before journaling everything you find on the Gemba walk. Here, checklists are helpful. You can record your observations as answers to the questions you know you need answered. You can also just take notes or record and document your findings via video.

Regardless of method: **record, record, record!**

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TIPS & POINTS

TO REMEMBER

Step 6: Get a Second Vantage Point

Once the Gemba walk has concluded and all relevant information has been recorded, seek a second opinion. Better yet, have another team member write their own checklist. **Having a fresh set of eyes review your findings could yield important insights.**

Comparing checklists can help you locate any gaps in your own thinking. This second perspective could be someone far removed from the operations or an experienced operator who did not take part in the Gemba walk. Feedback reveals overlooked information.

TIPS & POINTS

TO REMEMBER

Step 7: Solicit Feedback

Present your findings to the team regardless of outcome. Whether your findings were insignificant and no changes need to be made to the operations or vice versa. This brings the collaboration between stakeholders full circle and negates any feelings of being watched by the team during the Gemba walk.

If changes need to be made, include them in your presentation tying back to your findings. This brings buy-in from all stakeholders and increases probability of success once the change to operations occurs.

Conclusion

Gemba walks are a crucial observational method for assessing a manufacturing operation. Checklists are an easy, quick tool for adding structure to your observations, and for getting more out of the gemba walks you schedule. Use a checklist and stick to your plan.

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QUESTIONS
TO ASK

Simple 3 Question Summary:

1. What is Working?
2. What Is NOT Working?
3. Given That, What Will You Do Differently Going Forward?

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GEMBA CHECKLIST



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QUIZ 7:

1. How do you calculate Takt Time?
   - **Available Time divided by Customer Demand**

2. A Kanban is used as a signal for movement of raw materials. In which direction does a Kanban usually move?
   - **It moves to the supplier of the materials, parts, or finished goods**

3. What three questions can you ask on a gemba walk?
   - **What is working? What is not working? What can we do differently going forward?**

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QUESTIONS?

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LEAN SOLUTIONS ACADEMY



Lean Six Sigma Training

Green Belt

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PROJECT CHECK-IN'S

- What is your Problem Statement? What are your objectives?
- Give an Update on your Project
- Do you have any roadblocks? Do you need help with anything?
- What are your next steps?

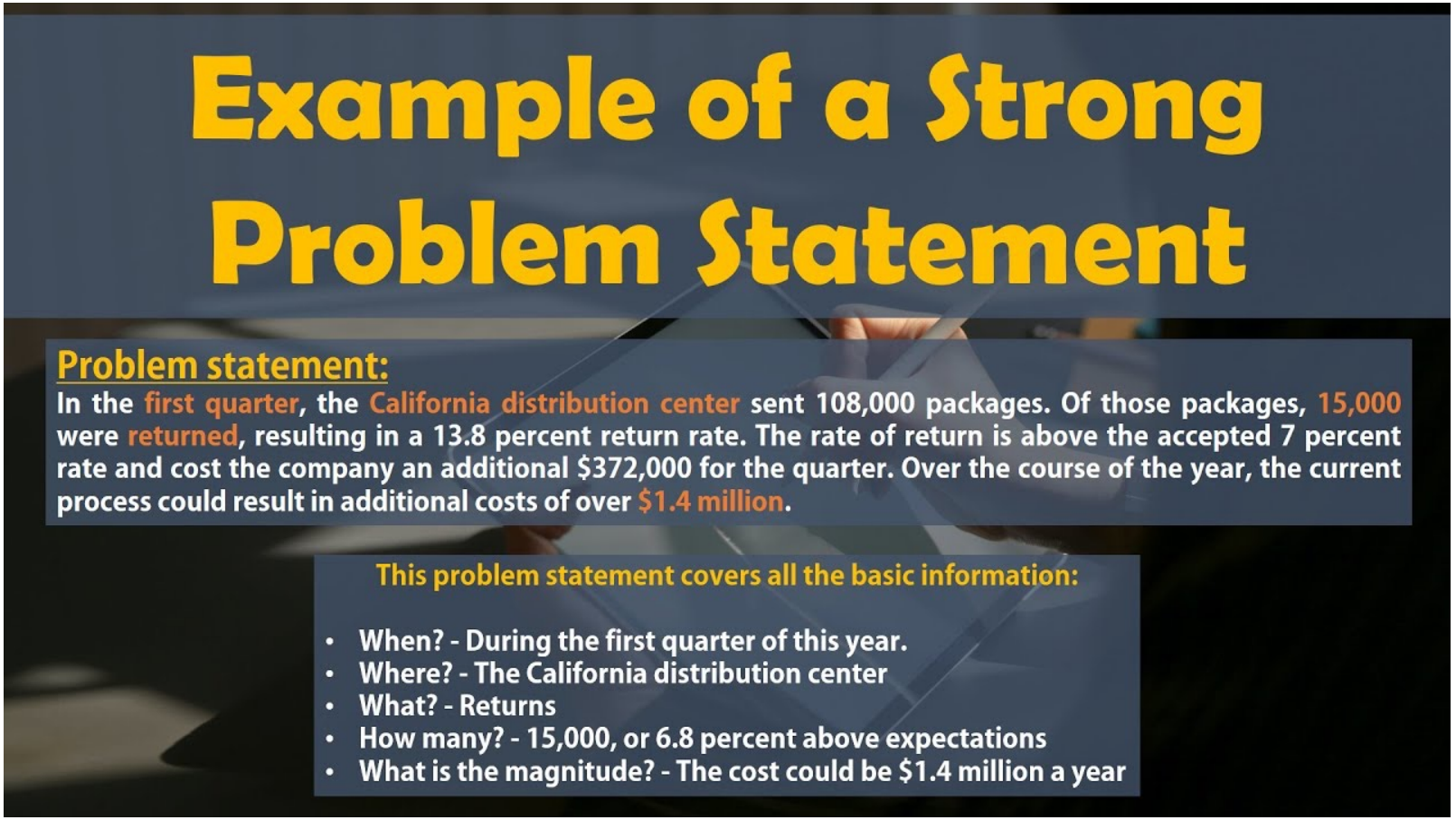
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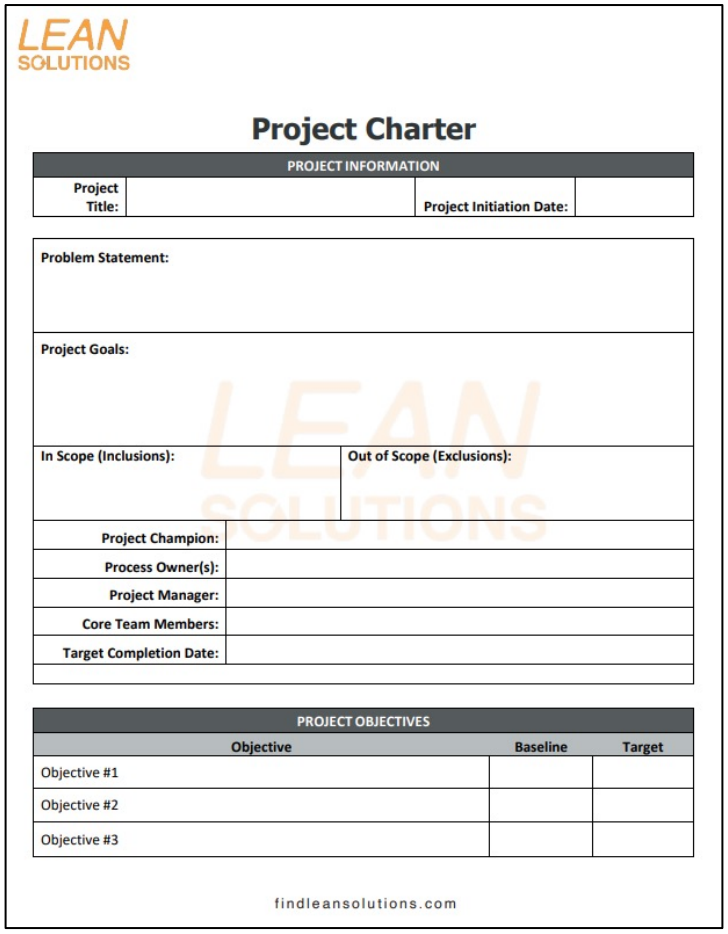
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Define Phase

Problem Statement



Project Charter



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Project Charter

PROJECT INFORMATION			
Project Title:		Project Initiation Date:	

Problem Statement:	
Project Goals:	
In Scope (Inclusions):	Out of Scope (Exclusions):

Project Champion:	
Process Owner(s):	
Project Manager:	
Core Team Members:	
Target Completion Date:	

PROJECT OBJECTIVES		
Objective	Baseline	Target
Objective #1		
Objective #2		
Objective #3		

findleansolutions.com

SIPOC

Process/Project Name:

Date:

SIPOC WORKSHEET

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Prepared By:

Notes:

SUPPLIERS	INPUTS	PROCESSES	OUTPUTS	CUSTOMERS
Who supplies the process inputs?	What inputs are required?	What are the major steps in the process?	What are the process outputs?	Who receives the outputs?

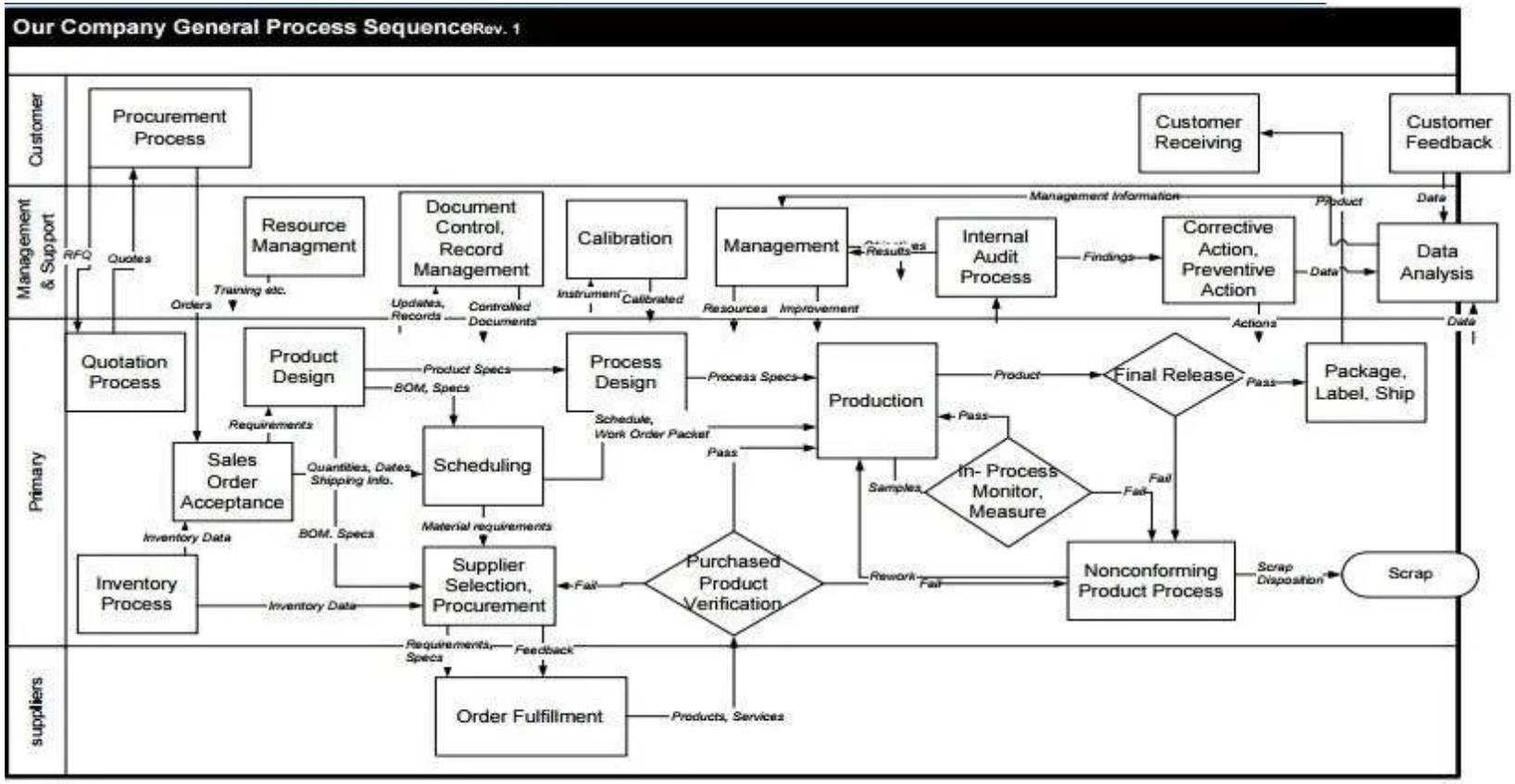
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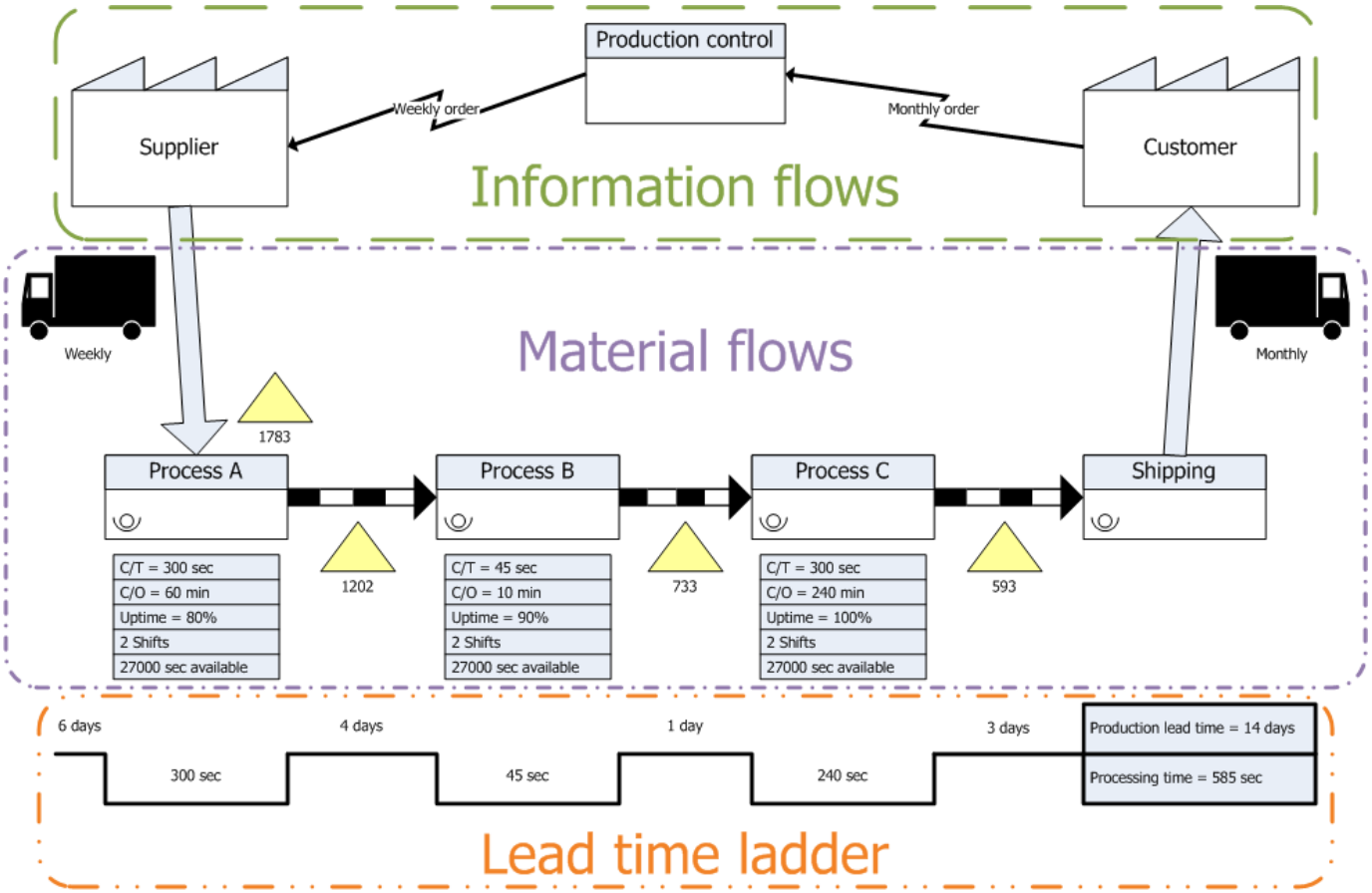
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Measure Phase

Process Map


Our Company General Process Sequence Rev. 1
Customer
Management & Support
Primary
suppliers
Procurement Process
Customer Receiving
Customer Feedback
Resource Managment
Document Control, Record Management
Calibration
Management
Internal Audit Process
Corrective Action, Preventive Action
Data Analysis
Management Information
RFQ
Quotes
Orders
Training etc.
Updates, Records
Controlled Documents
Instrument
Calibrated
Resources
Improvement
Results
Findings
Product
Data
Actions
Quotation Process
Product Design
Process Design
Production
Final Release
Package, Label, Ship
Product Specs
BOM, Specs
Process Specs
Requirements
Schedule, Work Order Packet
Pass
Fail
Sales Order Acceptance
Quantities, Dates, Shipping Info.
Scheduling
In- Process Monitor, Measure
Samples
Inventory Data
BOM, Specs
Material requirements
Inventory Process
Supplier Selection, Procurement
Purchased Product Verification
Nonconforming Product Process
Rework
Scrap Disposition
Scrap
Requirements, Specs
Feedback
Order Fulfillment
Products, Services

Value Stream Map



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Check Sheets

Motor Assembly Check Sheet

Name of Data Recorder: Lester B. Rapp

Location: Rochester, New York

Data Collection Dates: 1/17 - 1/23

Defect Types/ Event Occurrence	Dates							TOTAL
	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	
Supplied parts rusted		9	5	4	2			20
Misaligned weld			3			2		5
Improper test procedure								0
Wrong part issued		1		2				3
Film on parts								0
Voids in casting				4	2			6
Incorrect dimensions						2		2
Adhesive failure								0
Masking insufficient					1			1
Spray failure			5					5
TOTAL		10	13	10	5	4		

Check Sheet

Date:

Verification Stage **Section:**

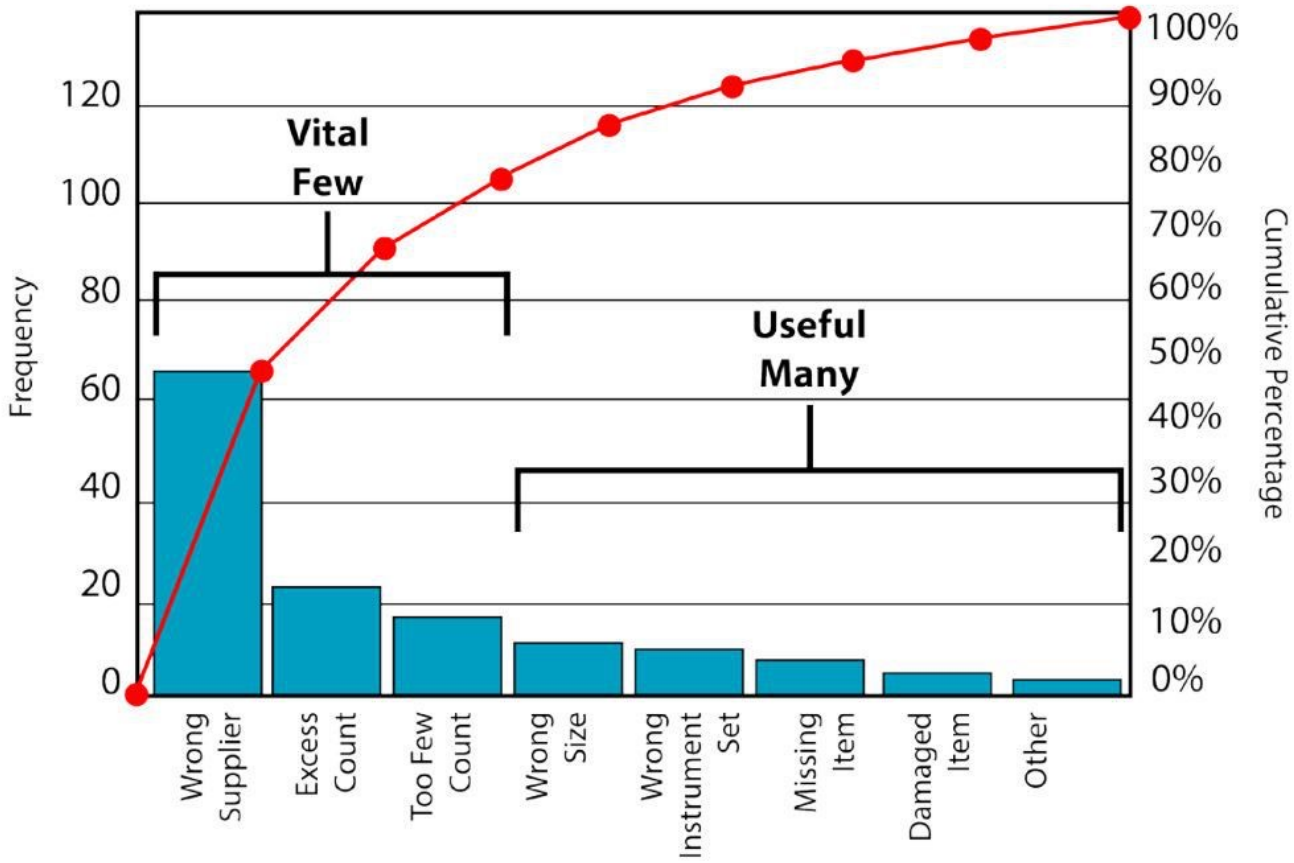
Product: **Machine:**

Total inspected: **Inspector:**

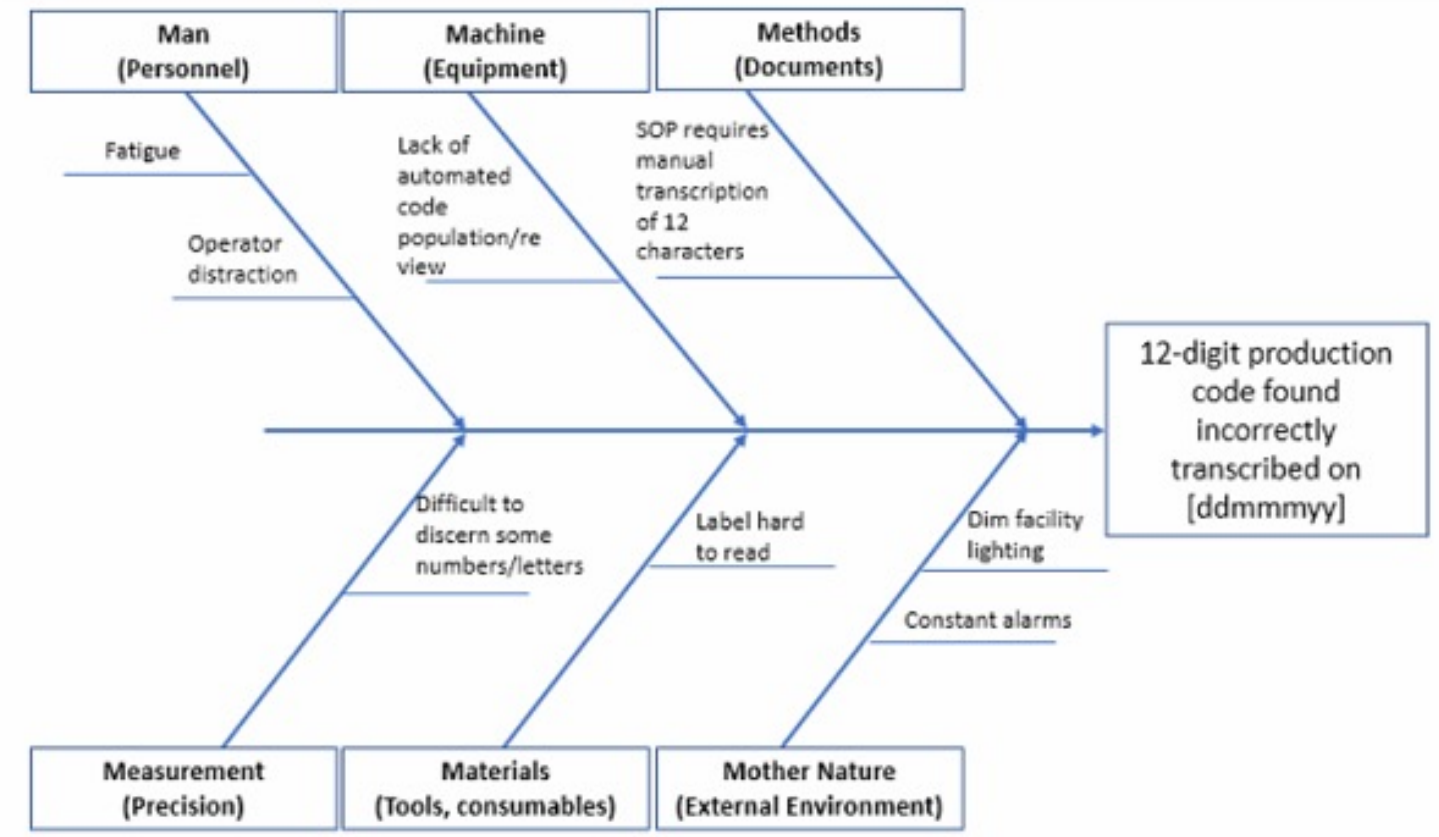
Batch: **Shift:**

Specification (weight)	Variation	Verifications	Frequency
	< -0.03	X	
	-0.03	X	
	-0.02	X X X	
	-0.01	X X X X X X X X	
5.20	0	X X X X X X X X X X X X	
	0.01	X X X X X X X	
	0.02	X X X	
	0.03	X X	
	> 0.03	X	
		TOTAL	

Pareto Chart



Cause & Effect Diagram



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FMEA

1. Failure Modes

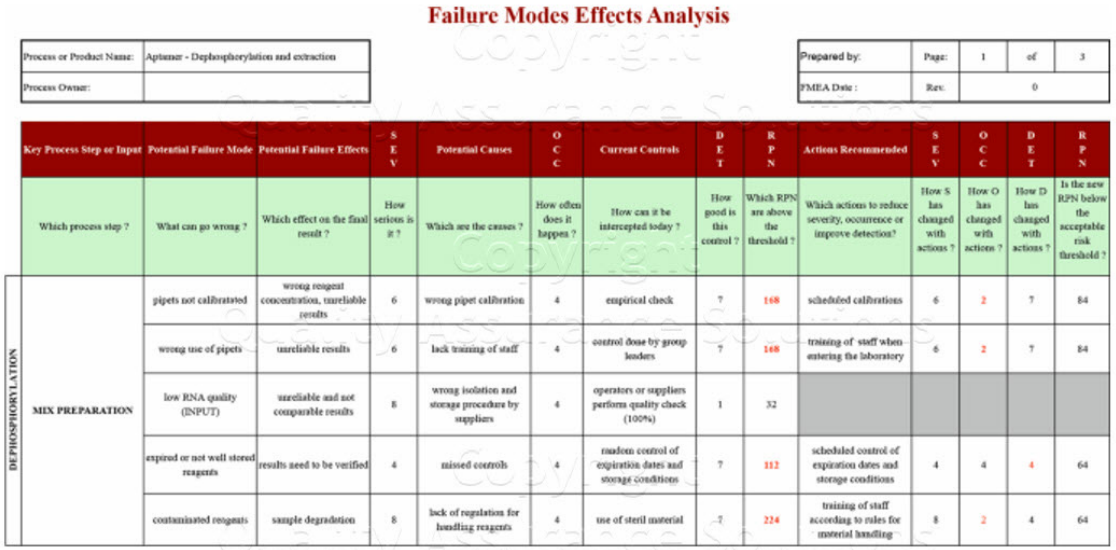
Identify all the probable failure modes

2. Review History

Base the analysis on experience, review, previous history, and brainstorming

3. Score

For each failure mode assign a value of 1-10 scale for severity, probability of occurrence, and probability of detection.



Failure Modes Effects Analysis

Process or Product Name:	Aptamer - Dephosphorylation and extraction								Prepared by:		Page:	1	of	3
Process Owner:									FMEA Date :		Rev:		0	
Key Process Step or Input	Potential Failure Mode	Potential Failure Effects	SEV	Potential Causes	OCC	Current Controls	DET	RPN	Actions Recommended	SEV	OCC	DET	RPN
Which process step ?	What can go wrong ?	Which effect on the final result ?	How serious is it ?	Which are the causes ?	How often does it happen ?	How can it be intercepted today ?	How good is this control ?	Which RPN are above the threshold ?	Which actions to reduce severity, occurrence or improve detection?	How S has changed with actions ?	How O has changed with actions ?	How D has changed with actions ?	Is the new RPN below the acceptable risk threshold ?
DEPHOSPHORYLATION	pipets not calibrated	wrong reagent concentration, unreliable results	6	wrong pipet calibration	4	empirical check	7	168	scheduled calibrations	6	2	7	84
	wrong use of pipets	unreliable results	6	lack training of staff	4	control done by group leaders	7	168	training of staff when entering the laboratory	6	2	7	84
	MIX PREPARATION low RNA quality (INPUT)	unreliable and not comparable results	8	wrong isolation and storage procedure by suppliers	4	operators or suppliers perform quality check (100%)	1	32					
	expired or not well stored reagents	results need to be verified	4	missed controls	4	random control of expiration dates and storage conditions	7	112	scheduled control of expiration dates and storage conditions	4	4	4	64
	contaminated reagents	sample degradation	8	lack of regulation for handling reagents	4	use of steril material	7	224	training of staff according to rules for material handling	8	2	4	64

4. Calculate RPN

Multiply the Scores of Item 3 together.

5. Rank

Address the items with highest RPN first.

6. Recalculate RPN

After address issues, recalculate the RPN and re-rank.

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Measure Phase

A Few New Tools…

Monitoring with SPC

Statistical Process Control (SPC):

- SPC is used for monitoring of a process to make sure it is ‘ in control’

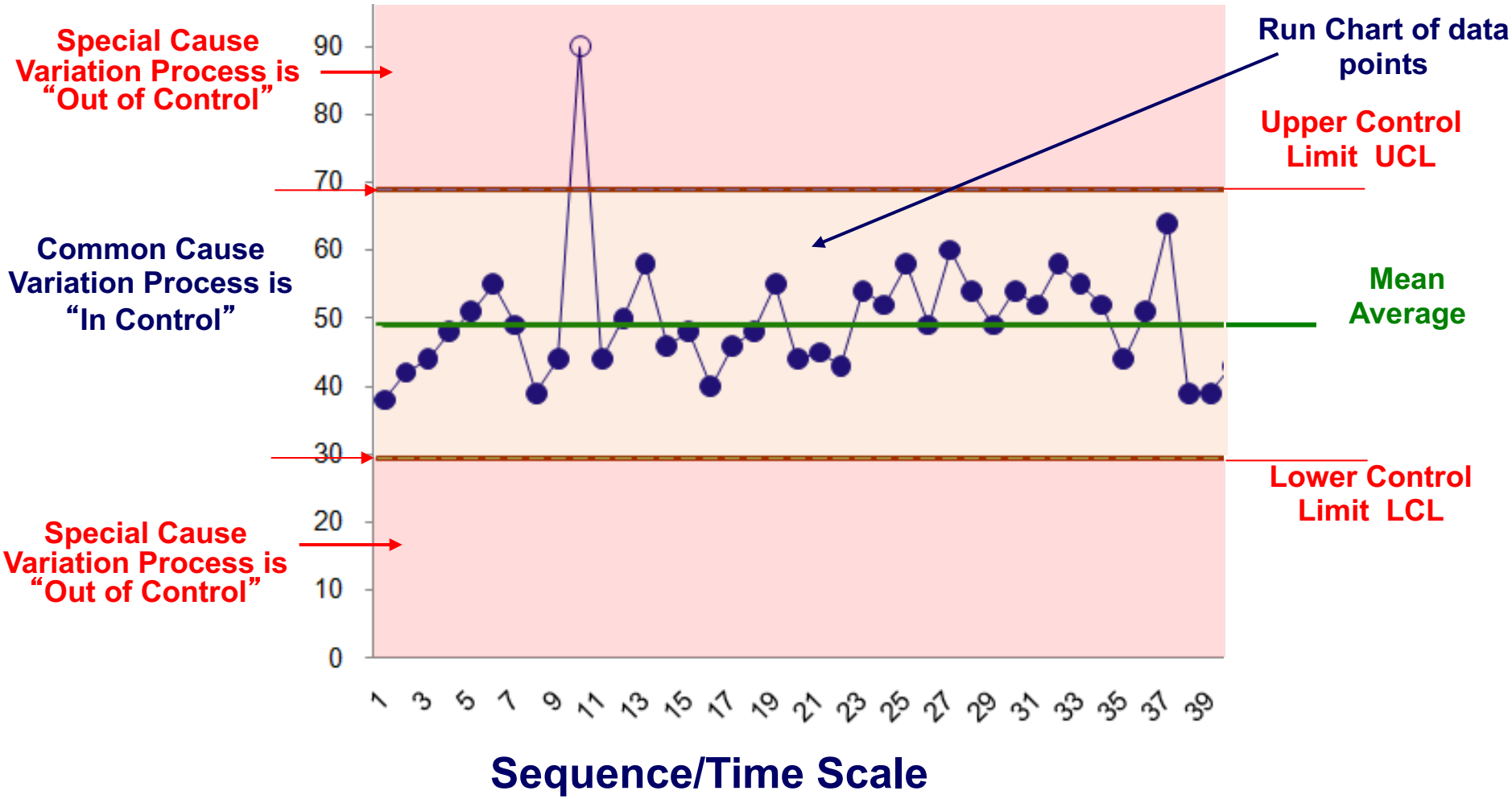
- The most common method of SPC is a

  Control Chart

- SPC was first introduced in the 1930 by **Walter Shewhart** and then popularized in the 1960 and 1970 by **Joseph Juran** and was the basis of the Motorola ‘**Six Sigma**’ Quality program.

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A Control Chart



2 types of Variation shown on Control Chart

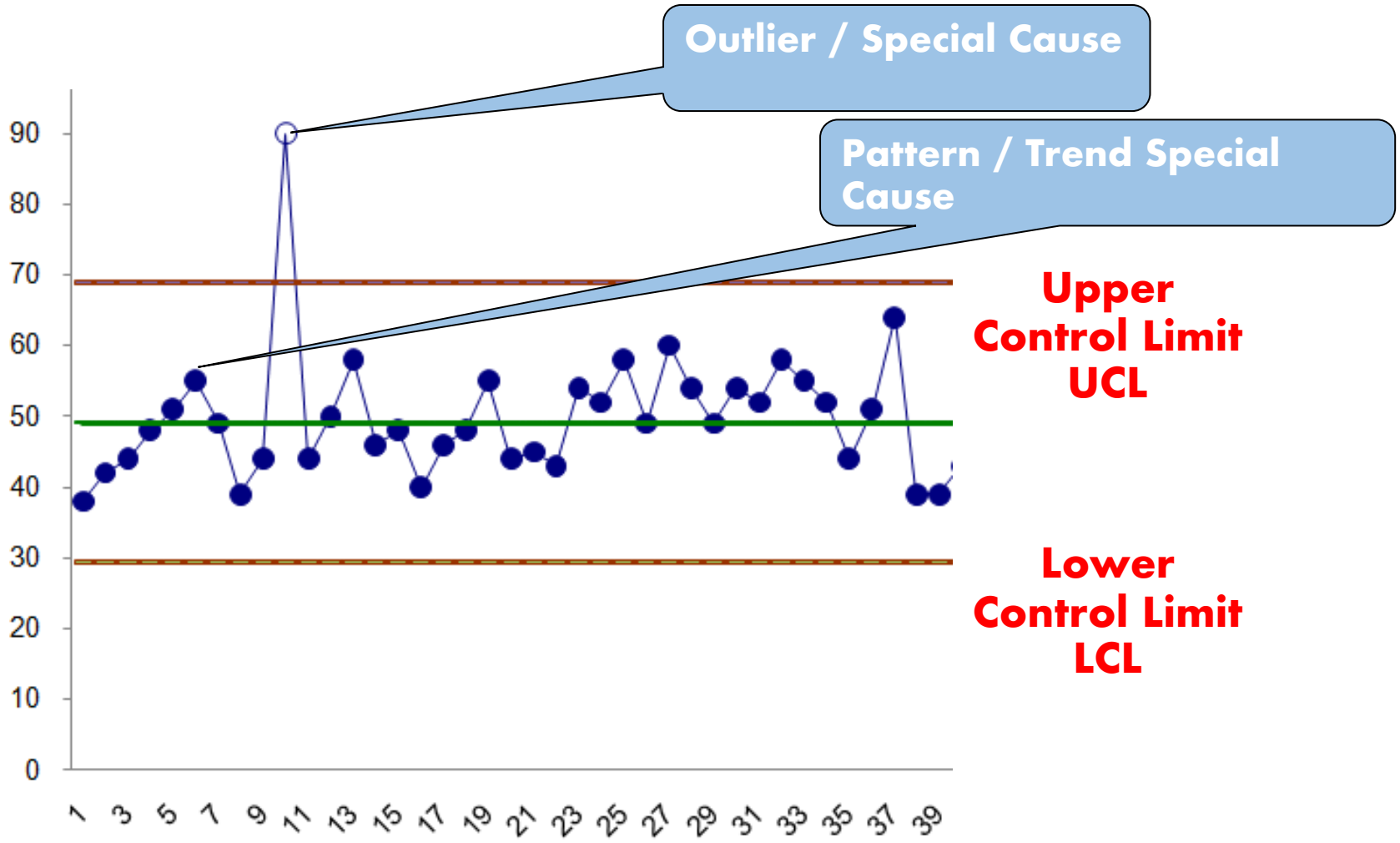
1. Common Cause Variation

Expected, natural and inherent in every process. Due to random small changes in the process inputs. Small changes in temperature, vibration, wait time or worker energy level are examples. 'Chronic' variation

2. Special Cause Variation / Assignable Cause Variation

Unexpected, not part of the process. Often due to external influences out of our control such as accidents, mechanical or electrical failures. 'Sporadic' variation. Can be either an **'Outlier'** or an unusual **'Pattern or Trend'** in the data. See the 'Western Electric' tests for Special Causes.

Control and Out of Control



Control Charts

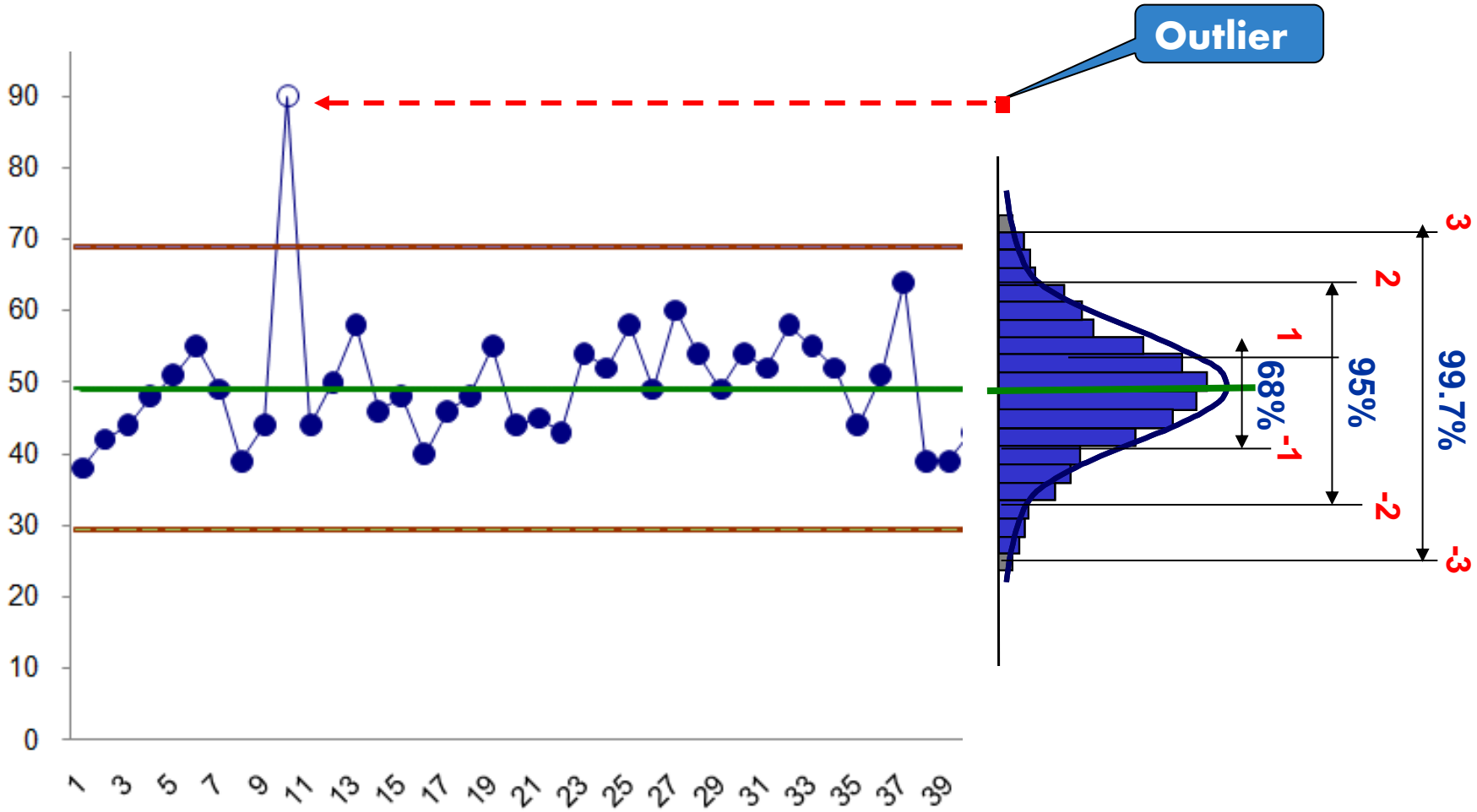
- **Control Charts indicate when a process is "out of control" or exhibiting Special Cause variation.**

- **Control Charts incorporate upper and lower Control Limits.**
  - **The limits are typically +/- 3 σ from the Center Line.**
  - **These limits represent 99.73% of natural variability for Normal Distributions.**

- **Use of Control Charts can be applied to all processes.**
  - **Services, manufacturing and retail are just a few industries with SPC applications.**

- **Control Limits are used to define the limits that the business is setting for the process.**
  - **Ideally Control Limits should be narrower than customer specs.**

Control and Out of Control



Considerations when selecting a control chart

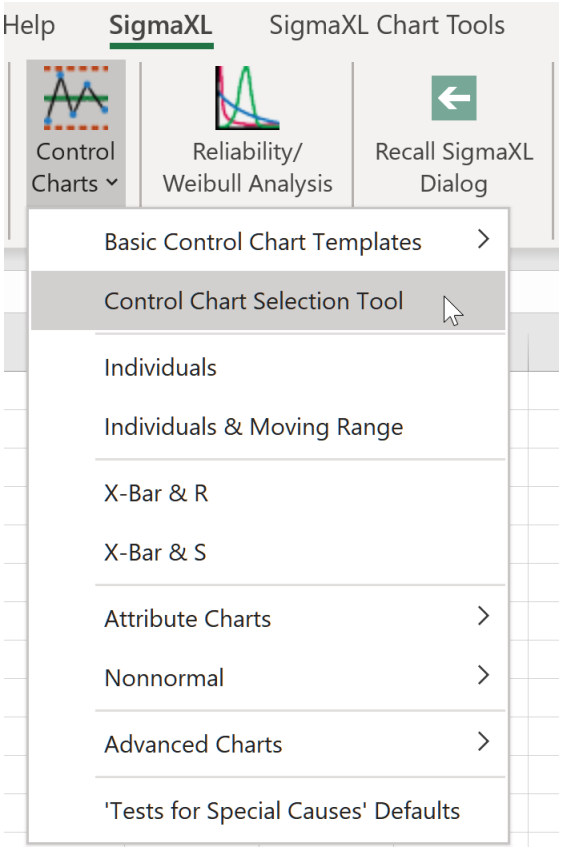
There are over 10 different types of Control Chart !

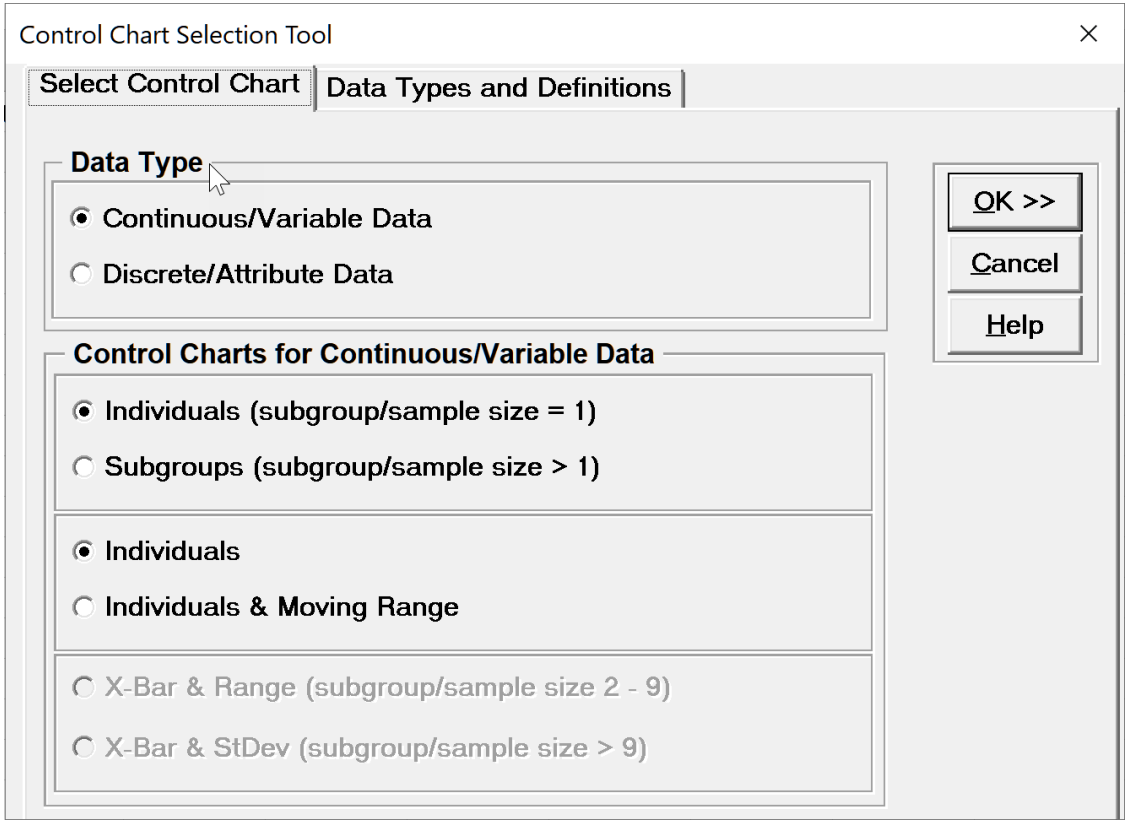
Many factors influence the choice of which control chart to use.
These include:

1. The type of data being charted (Variable or Attribute)
2. The required sensitivity (size of the change to be detected) of the chart
3. The subgroup size / sample size
4. The ease and cost of sampling
5. Production volumes

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SigmaXL Control Chart Selection Tool





Process Capability: Capability Studies

Capability Studies:

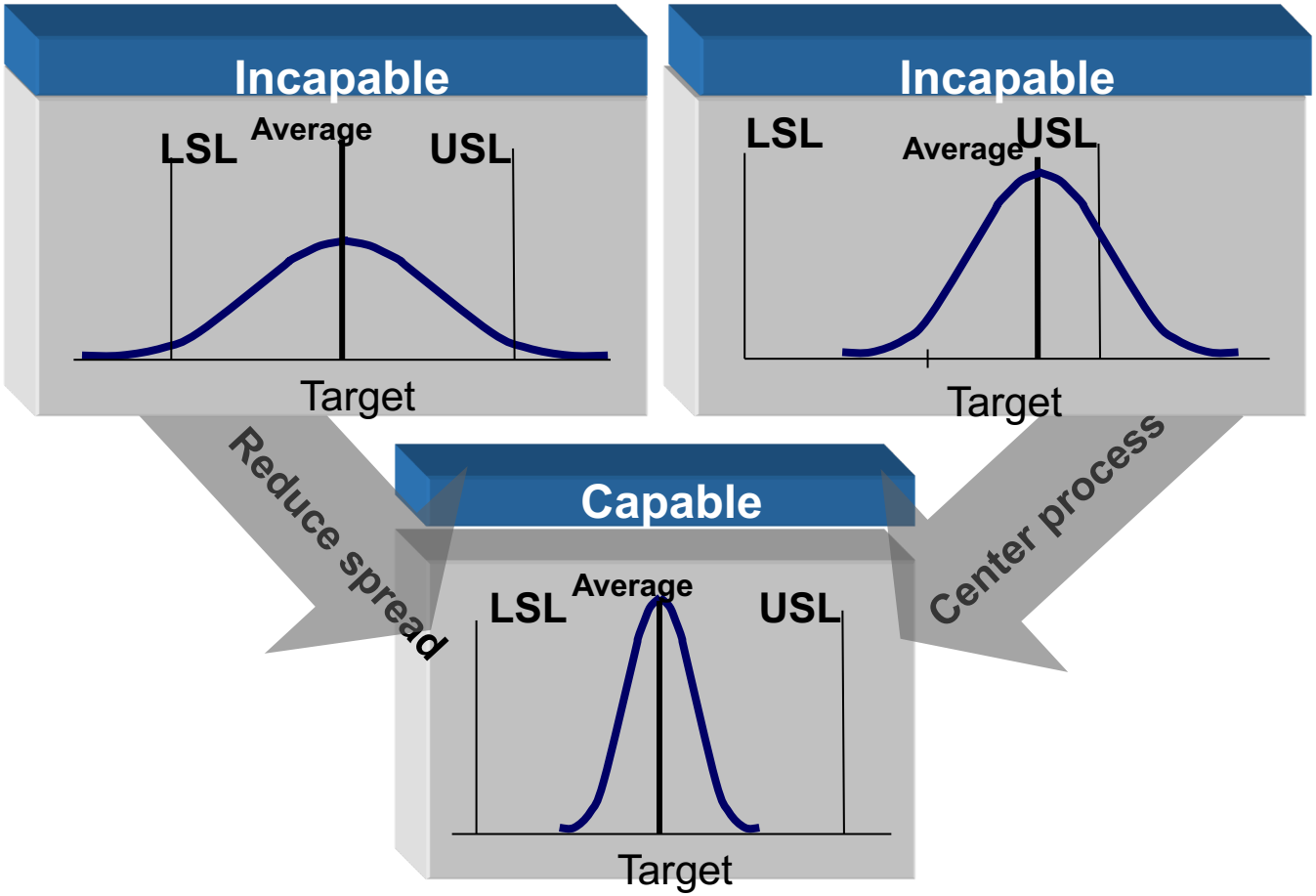
- Are intended to be regular, periodic, estimations of a process's ability to meet customer requirements.
- Can be conducted on both Variable and Attribute Data.
- Are most meaningful when conducted on stable, predictable processes.

Understanding Process Capability

Process Capability / Process Performance :

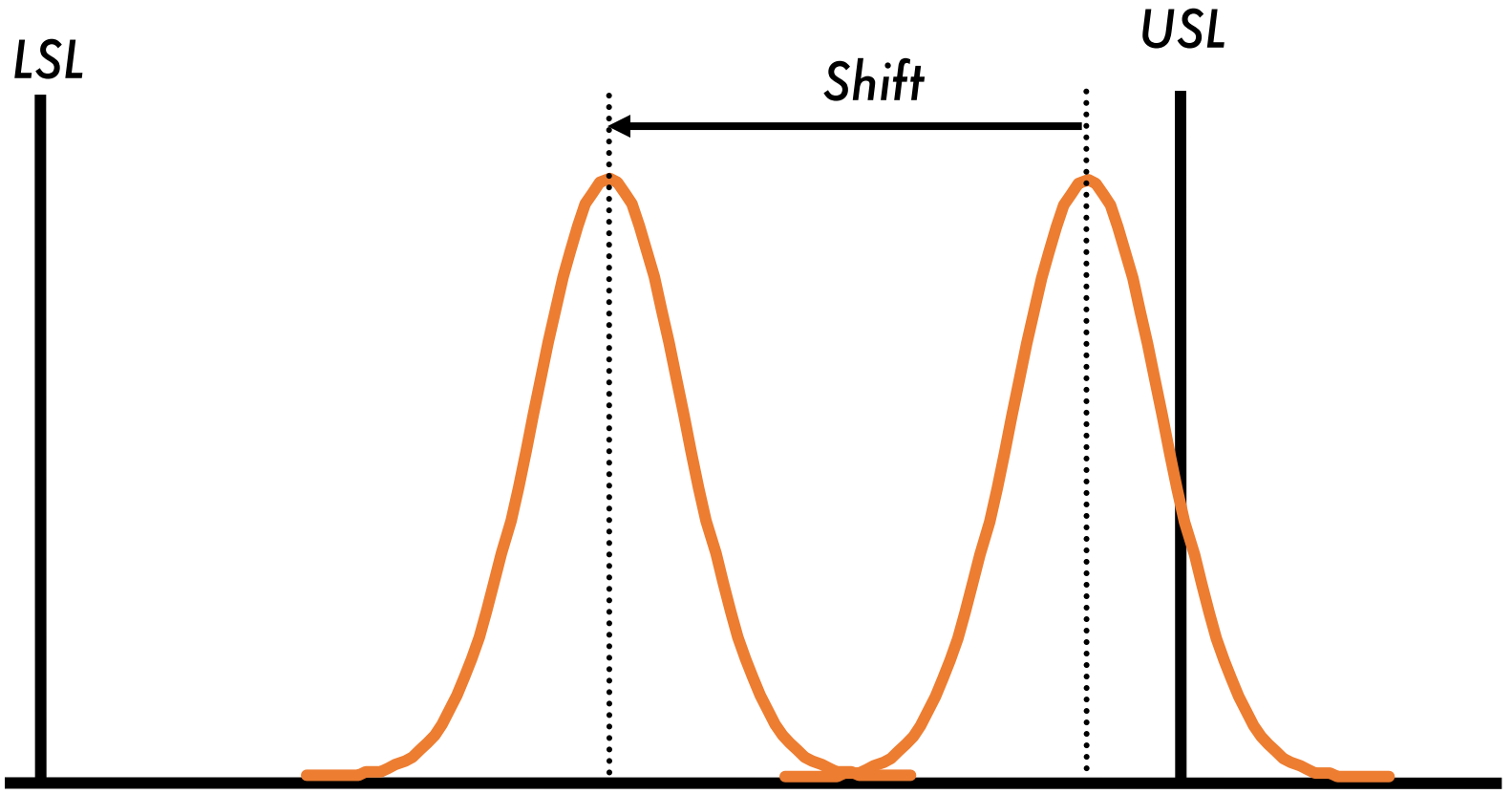
- **The ability of a process to meet the expectations of the customer**
- **Provides insight as to whether the process has a:**
  - **Centering Issue (relative to specification limits)**
  - **Variation Issue**
  - **A combination of Centering and Variation**
  - **Inappropriate specification limits**
- **Provides a baseline metric for improvement.**

Capability Defined



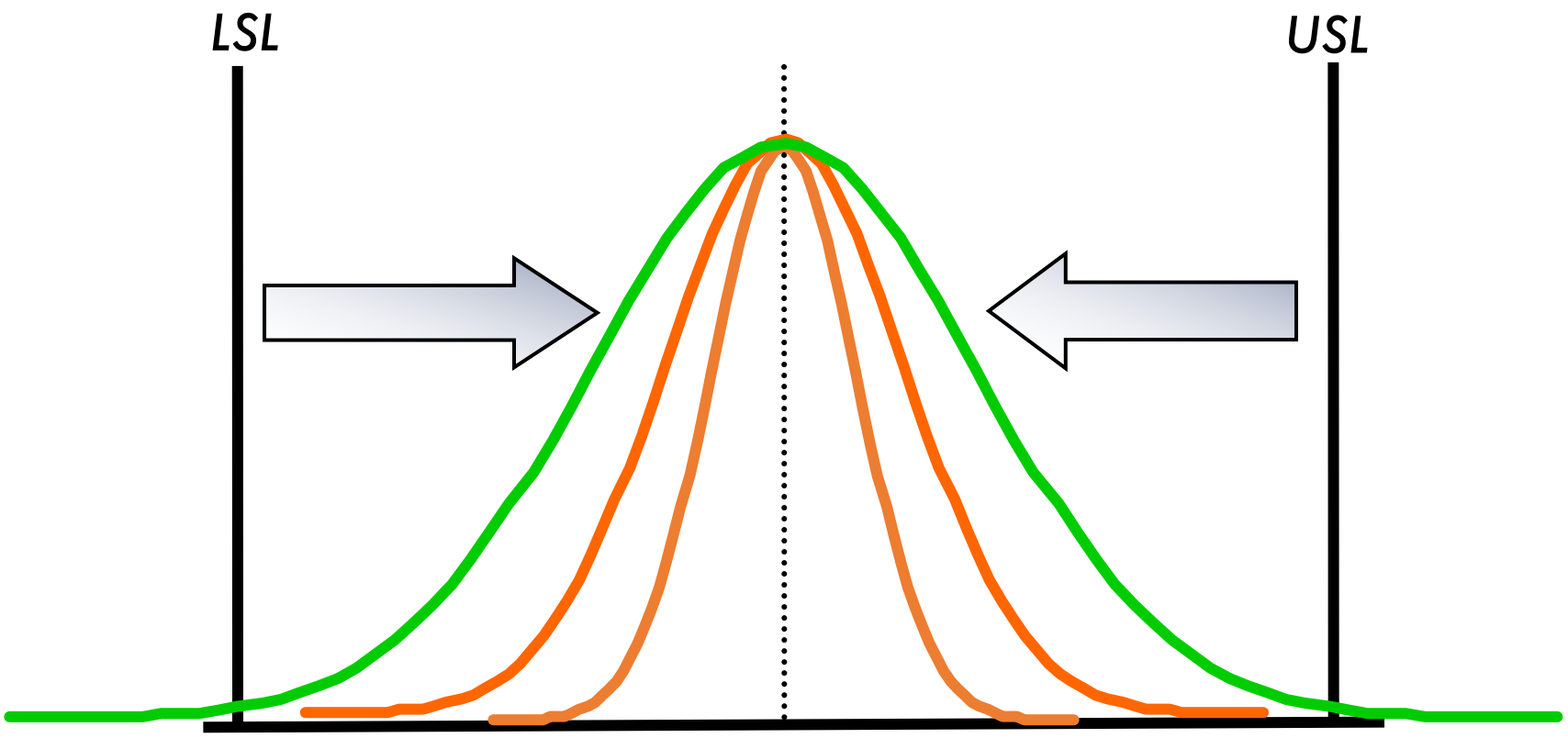
Step 1 – Shift the Mean

This involves finding the variables that will shift the process to the target. This is what is done first.



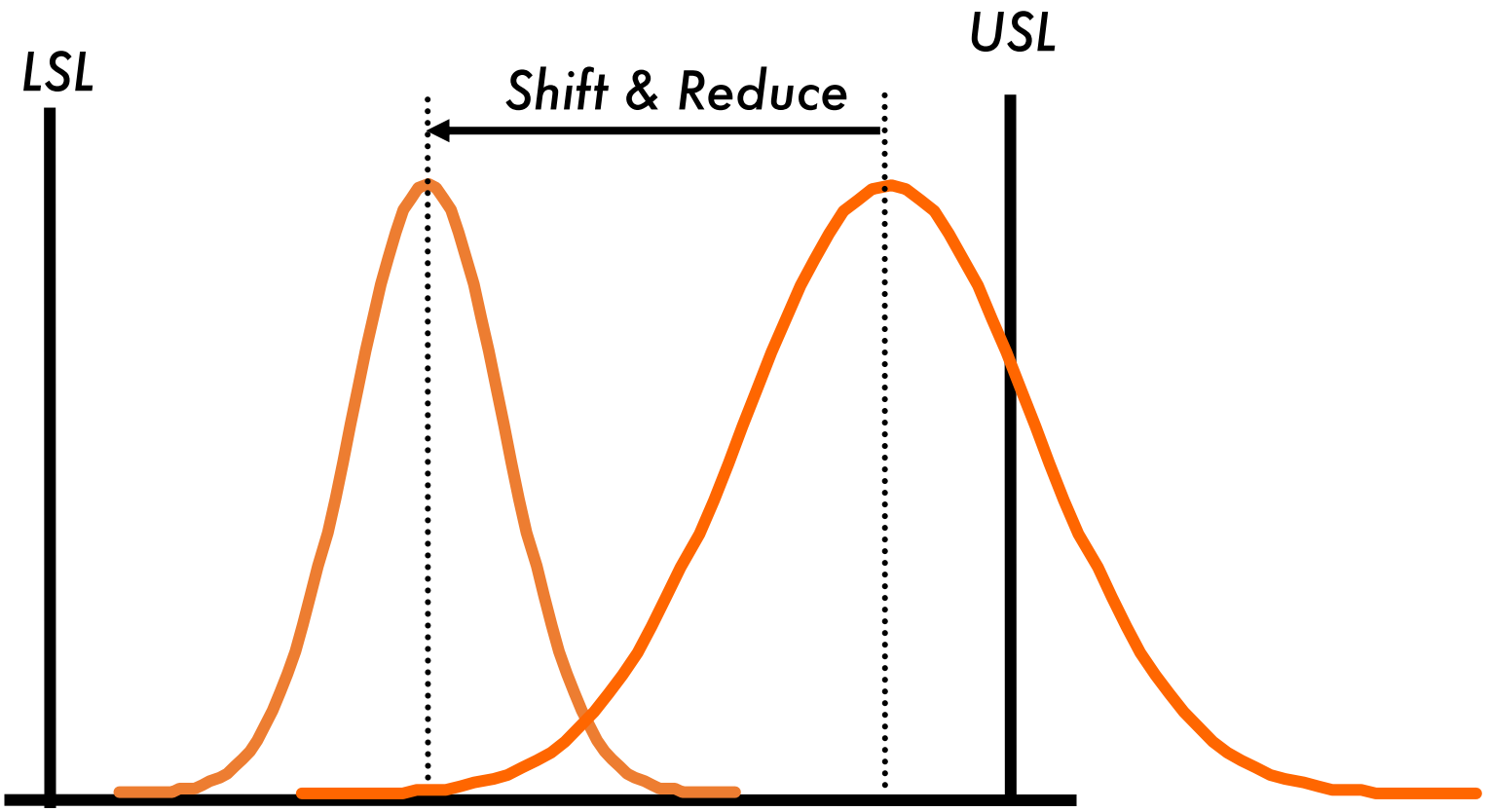
Step 2 – Reduce Variation

Reducing Variation is typically not so easy to accomplish and is a main focus of Six Sigma projects.



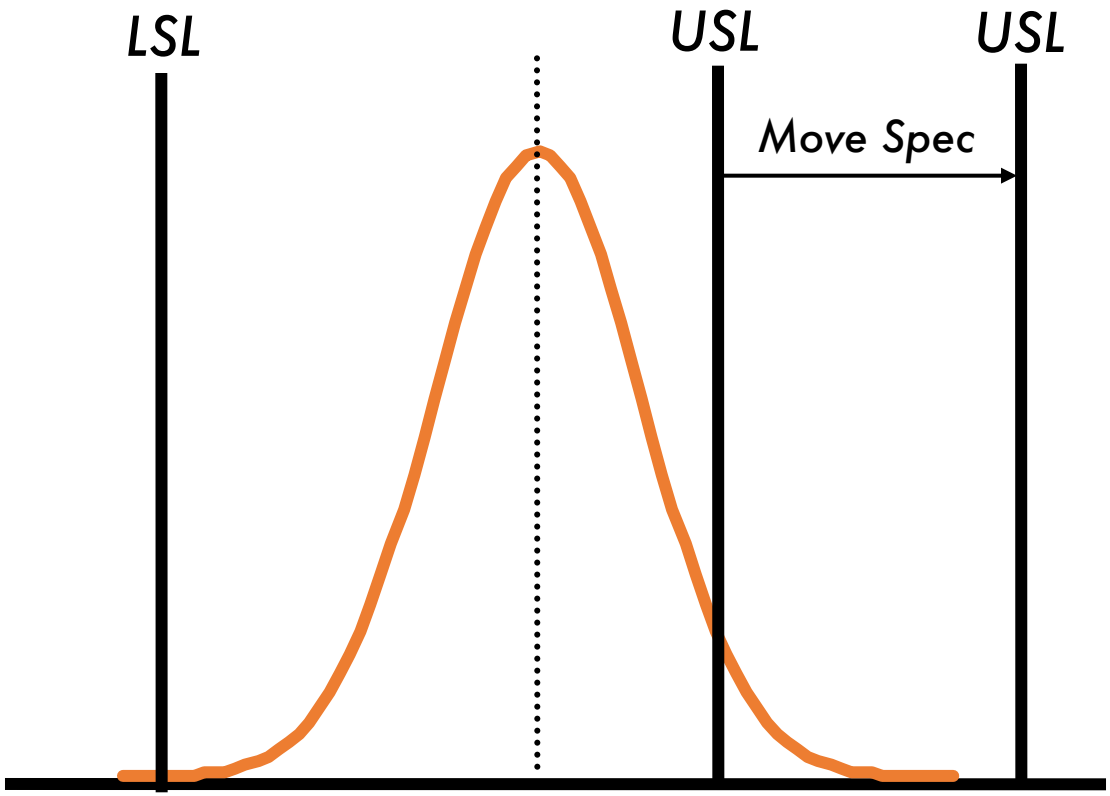
Shift Mean & Reduce Variation

This is the aim of most Six Sigma projects.



Moving Customer Specification limits

Customers usually do not go for this option but if they do…it is the easiest way to increase capability !



Measure Phase Overview - The Goal

Remember ….The goal of the Measure Phase was to:

Evaluate the “As-Is” Capability of the process.

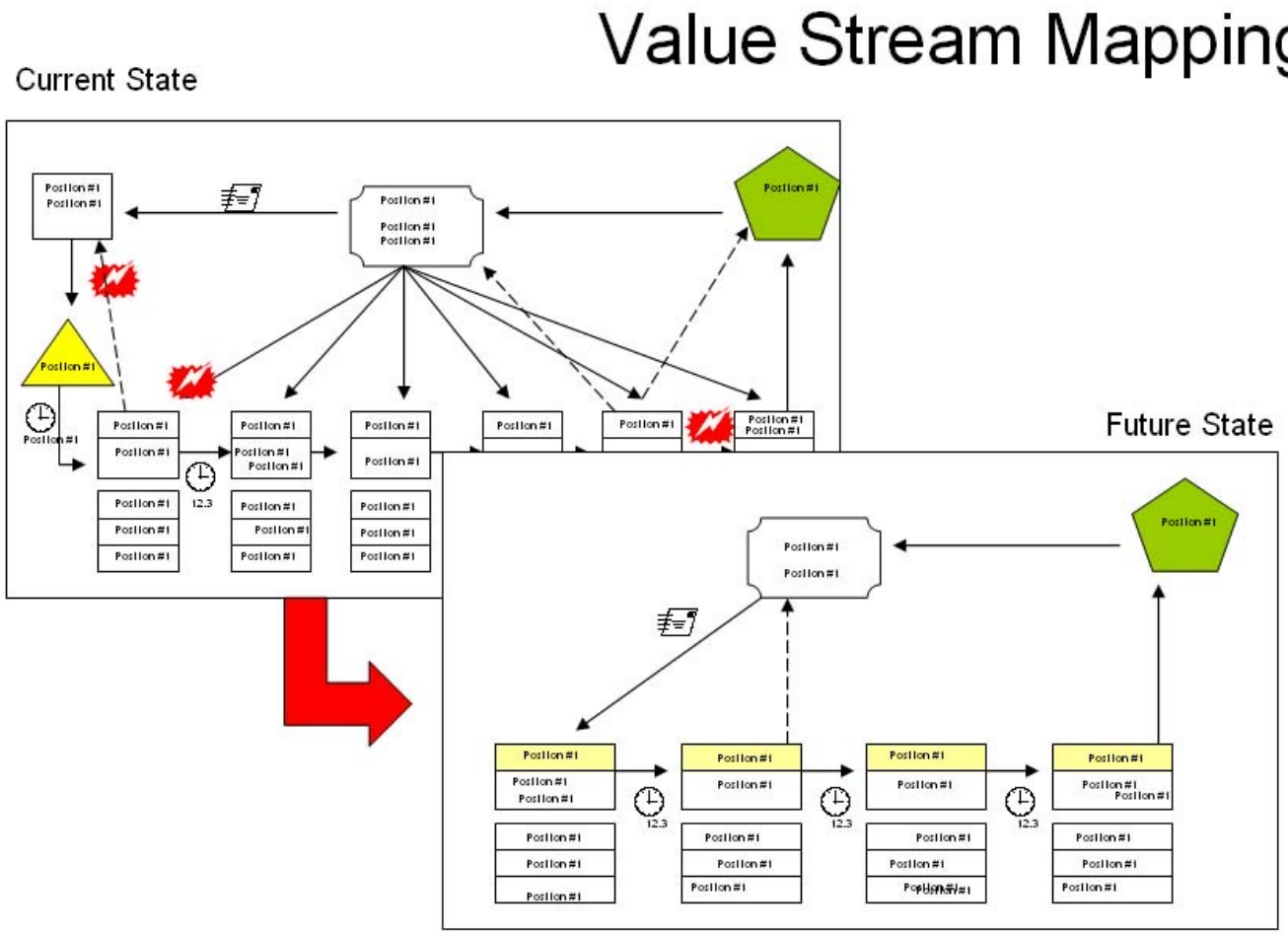
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Analyze Phase

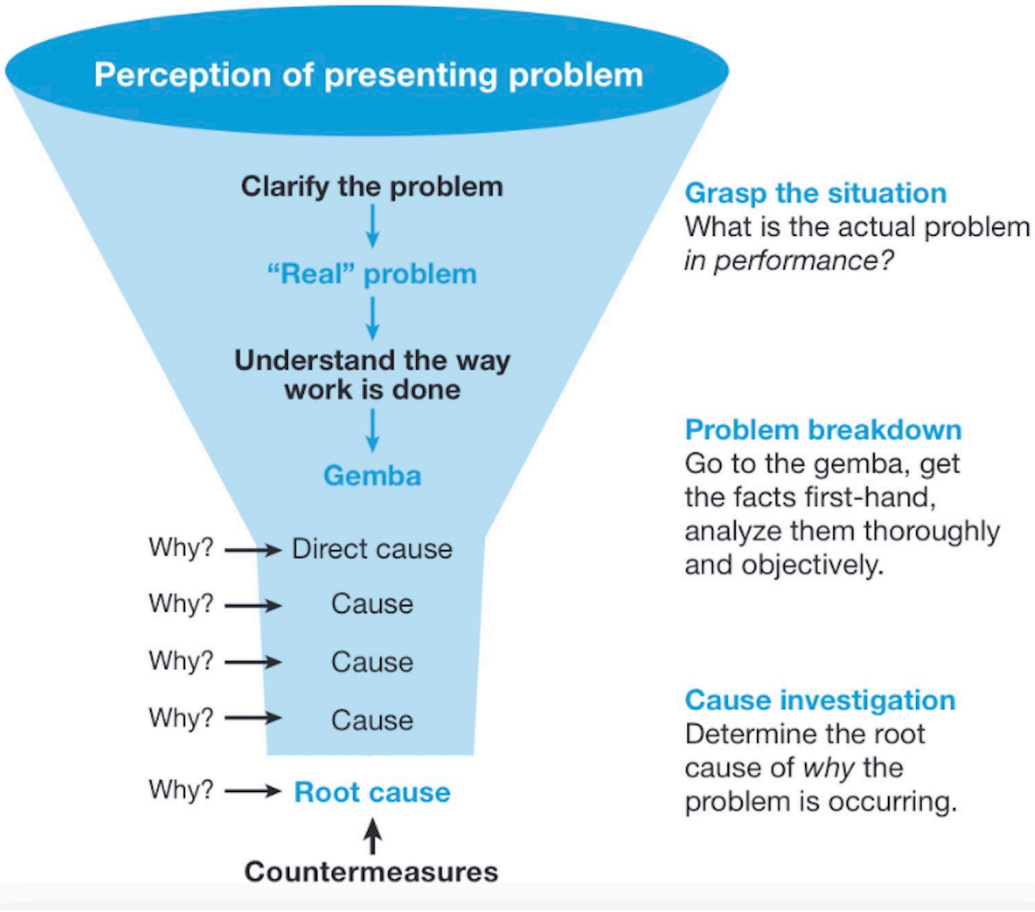
The Analyze Phase

The Analyze Phase is for determining the ROOT CAUSE of the problem that we are trying to solve.

Current & Future State Value Stream Map



Root Cause Analysis



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Improve Phase

Improve Phase Overview - The Goal

The goals of the Improve Phase are to:

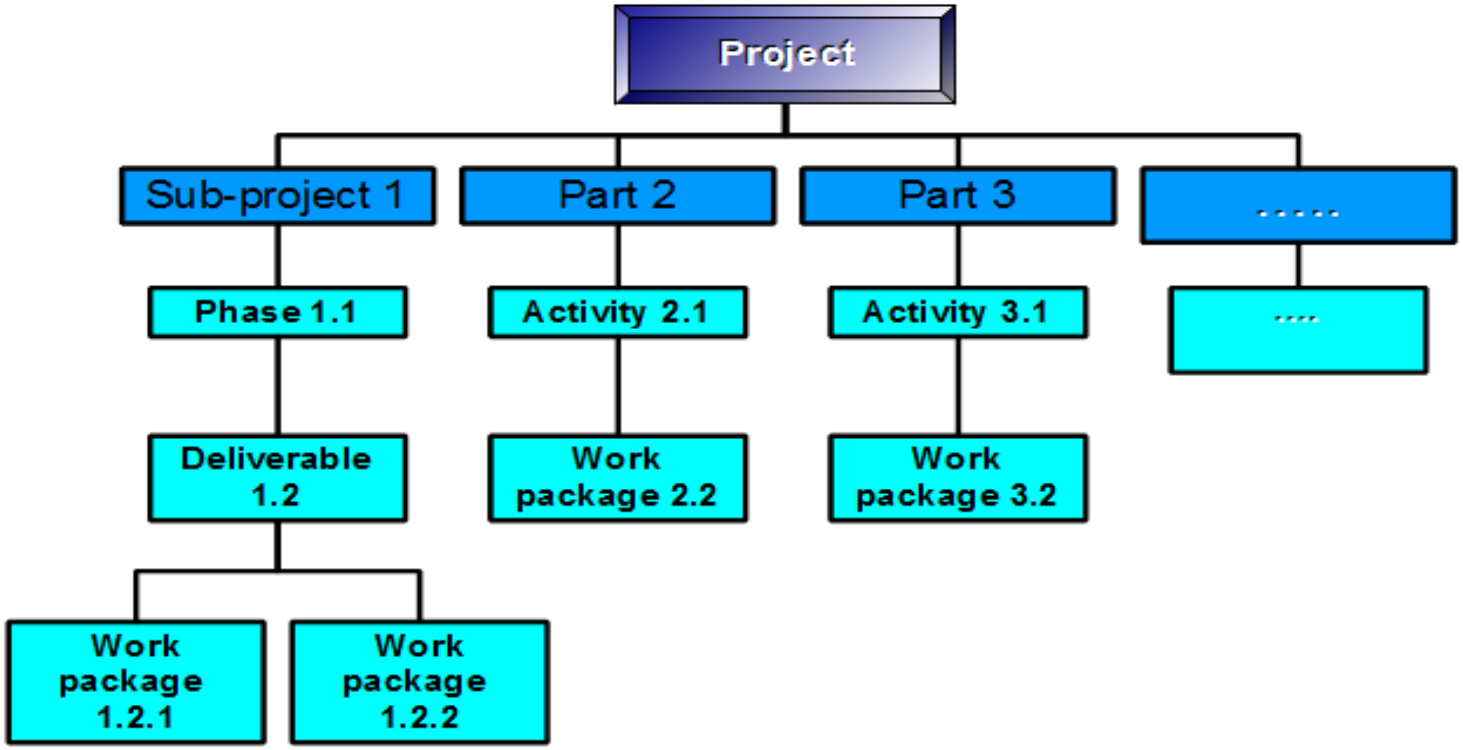
- Come to a Consensus to Select the best and most appropriate solution
- Pilot or Prototype the solution to test and evaluate its effectiveness
- Implement the improvements into production using good project management techniques

Impact/Effort Matrix



Implementing Solutions in Your Organization

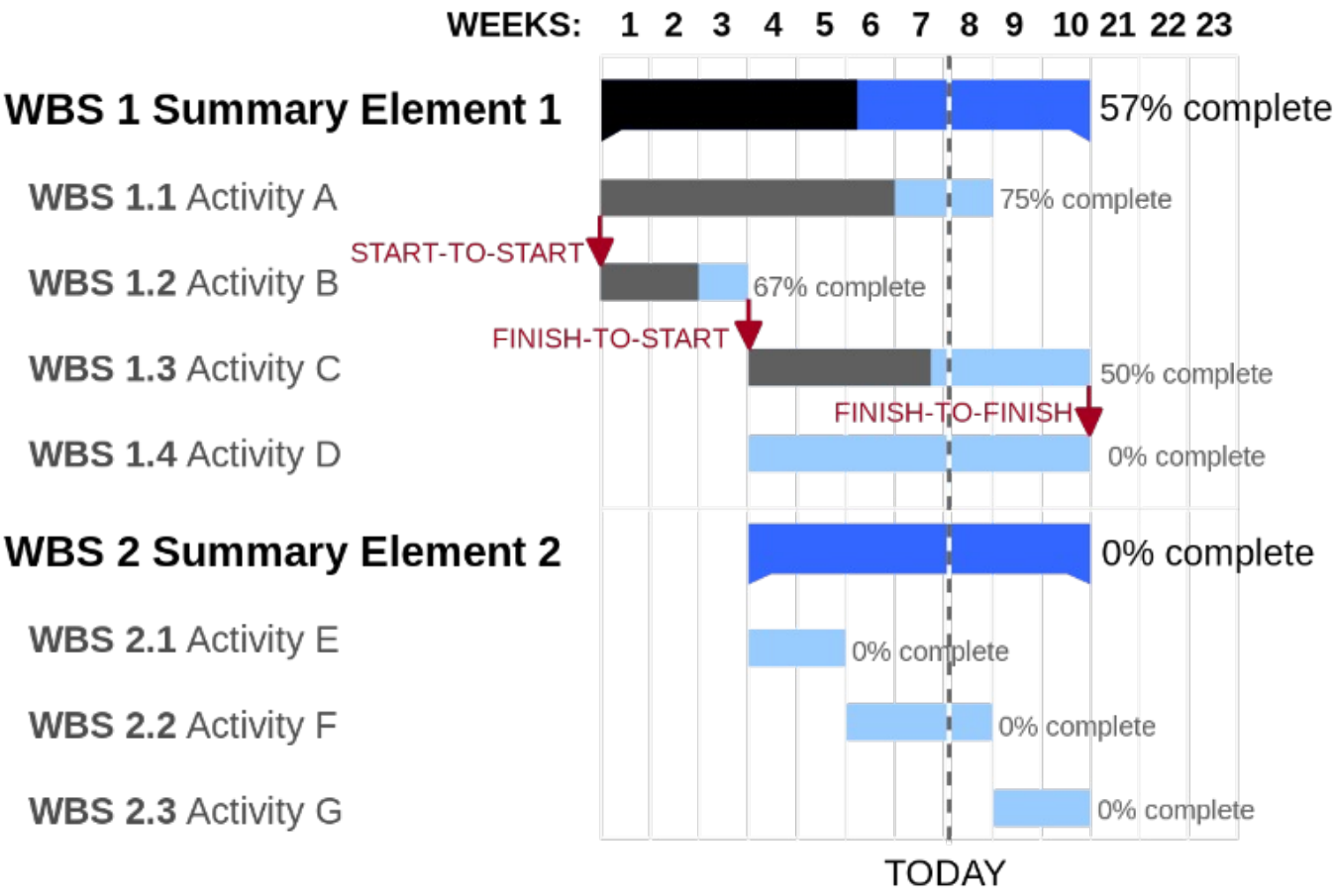
- Work Breakdown Structure (WBS) Chart
- Commonly now called ‘Tree Diagram’.



(Example of WBS)

Implementing Solutions in Your Organization

– Gantt Chart Example



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Control Phase

Lean Six Sigma Control



CHANGE
MANAGEMENT

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What is Change Management

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INTRODUCTION

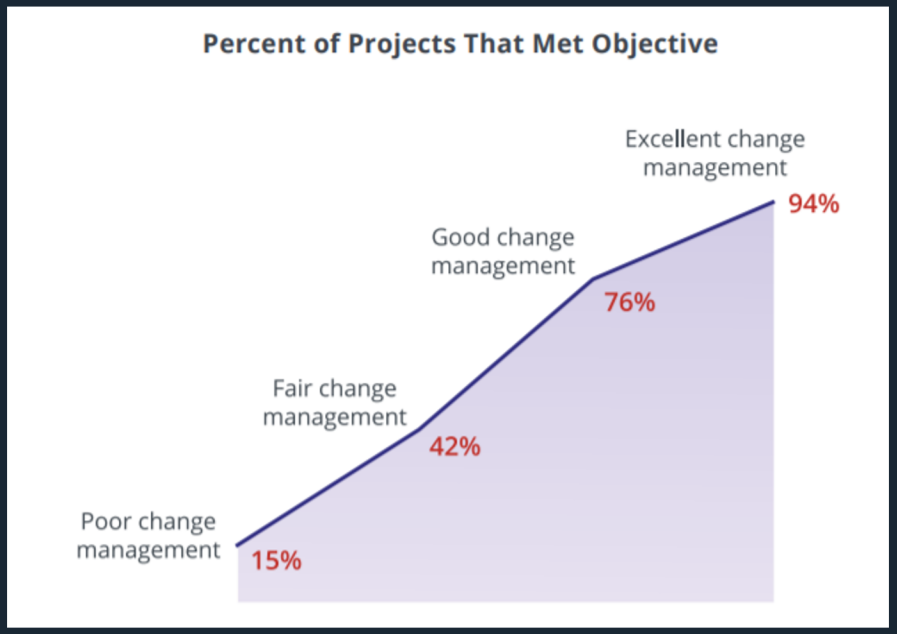
TO CHANGE MANAGEMENT

- Change Management is discipline that guides how we prepare, equip and support individuals to successfully adopt change in order to drive organizational success and outcomes
- Change management is proactively managing the people side of change, to achieve the desired business results
- Research shows that Change Management is the #1 success factor for any initiative

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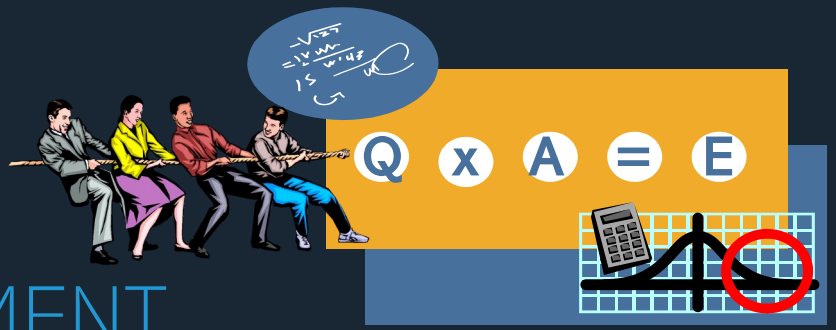
JUST HOW IMPORTANT
IS CHANGE MANAGEMENT TO YOUR PROJECTS?



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EFFECTIVE CHANGE MANAGEMENT



- **Effectiveness** = **Quality** of Change **x Acceptance** by your Stakeholders
- If you have a Change with Quality at 90% and only 10% on Acceptance, then your EFFECTIVENESS = 9%
- Good acceptance of your change drives high effectiveness in Change Management

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MANAGING THE CHANGE

Change Management is helping people become...

READY: Ensuring that people know what will happen, when it will happen, and how it will happen

WILLING: Gaining buy-in or at least acceptance of the change

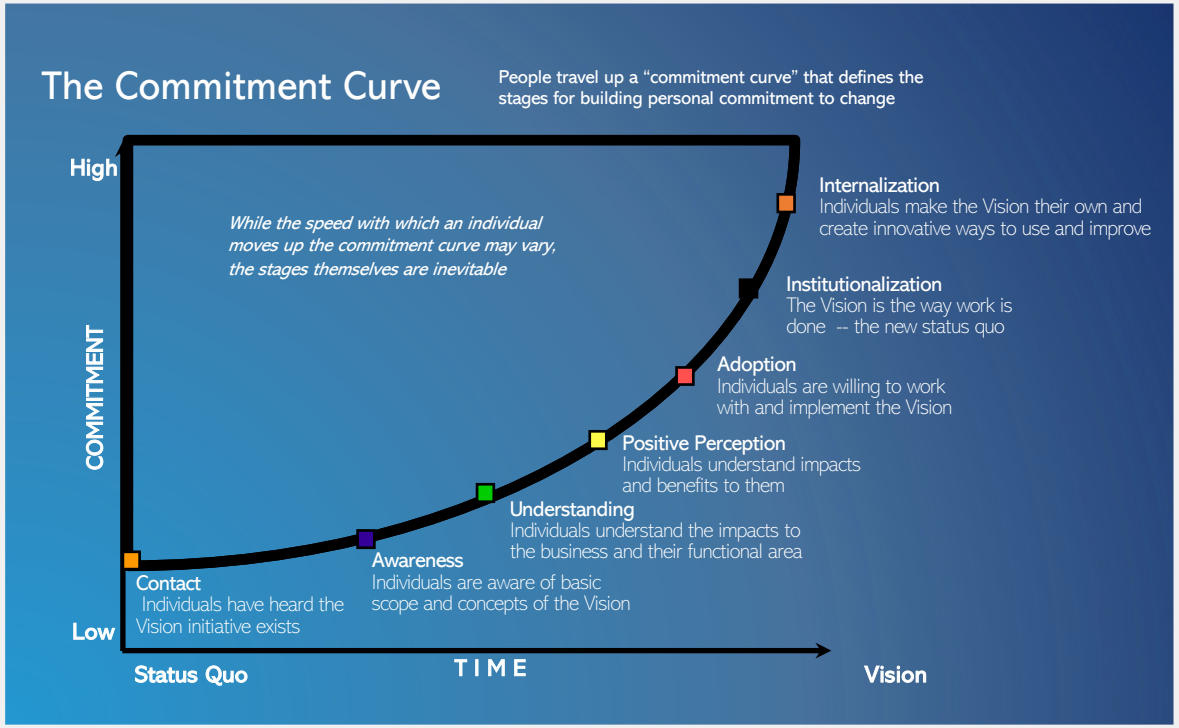
ABLE: Providing the information and tools necessary for people to be successful in the new work environment

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UNDERSTANDING

THE CHANGE

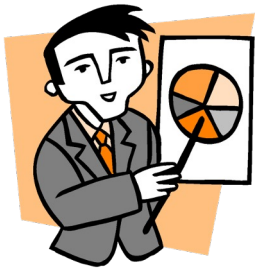


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PSYCHOLOGY OF CHANGE

Every change can be viewed from the perspective of a sender and a receiver

SENDER



Business issues &
need to change



RECIEVER



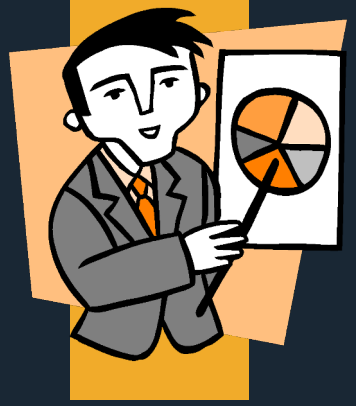
Personal implications & risk

What a sender says and what a receiver hears can be 2 different messages!

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PSYCHOLOGY OF CHANGE



SENDER

EXPLAIN

- Why the change is necessary
- How the change affects them
- How the change impacts their group
- How this changes the day-to-day

PRACTICES

- Repeat key messages multiple times
- Use face-to-face communication
- Answer WIIFM (what's in it for me?)
- Use a question and answer format

Immediate supervisors are the preferred senders of messages related to personal impact

CHANGE MANAGEMENT & LEAN LEADERSHIP TOOLS

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CHANGE

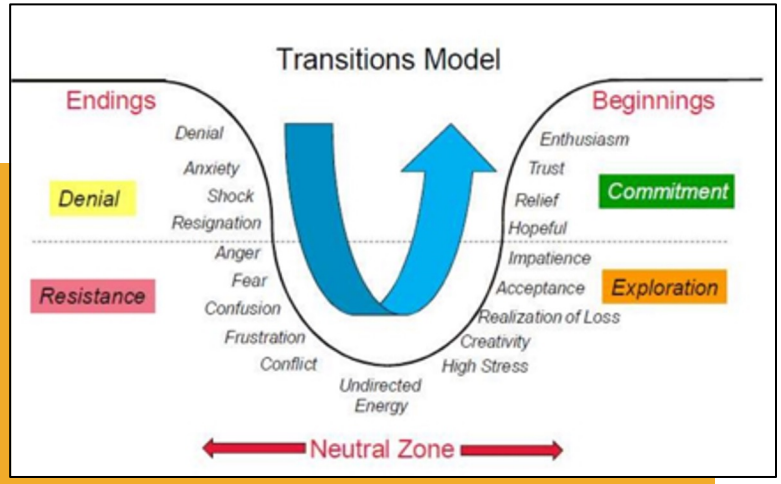
MANAGEMENT TOOLS

Taking charge of change

- Transition Grid
- Stop – Keep – Start
- Decision Quadrant
- Process Mapping
- ADKAR Analysis
- Metrics and Data Collection

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TRANSITION GRID

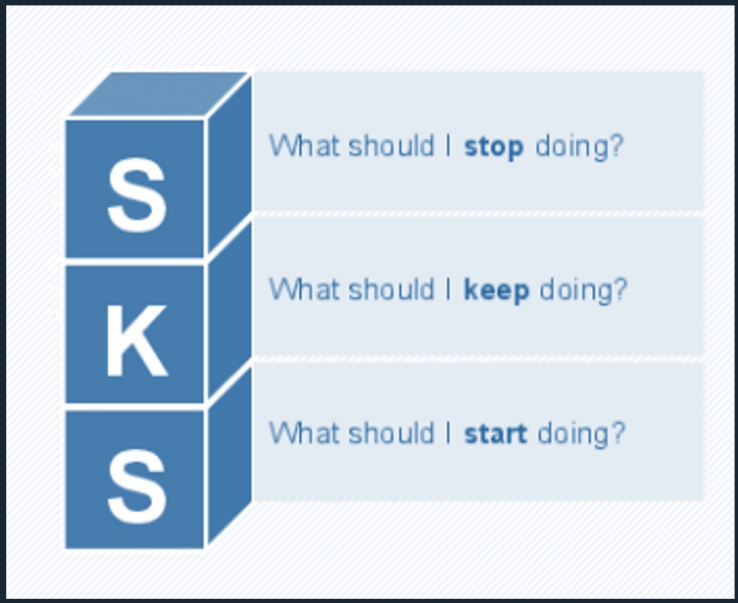
- Push problem solving / responsibility down the lowest levels via the work systems
- Work systems change behaviors, behaviors change attitudes, attitudes change values
- Change Management Tool:
  - The Transition Grid

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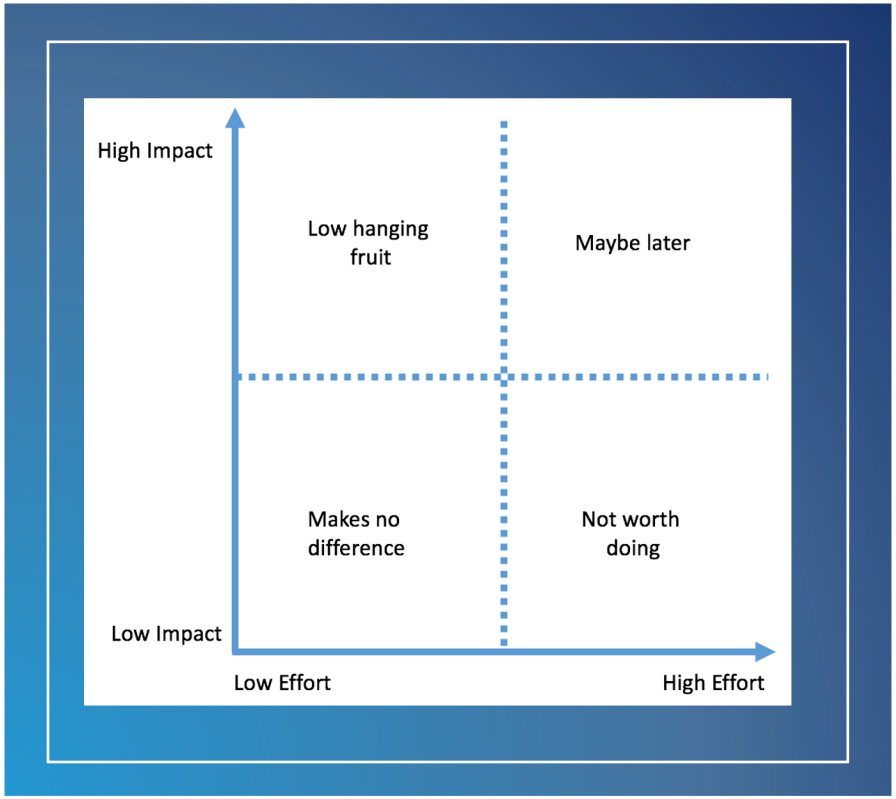
STOP-KEEP-START

- Ask to realize, why change?
- Change Management Tool:
  - Start-Keep-Start (SKS)
- What does the data tell us?



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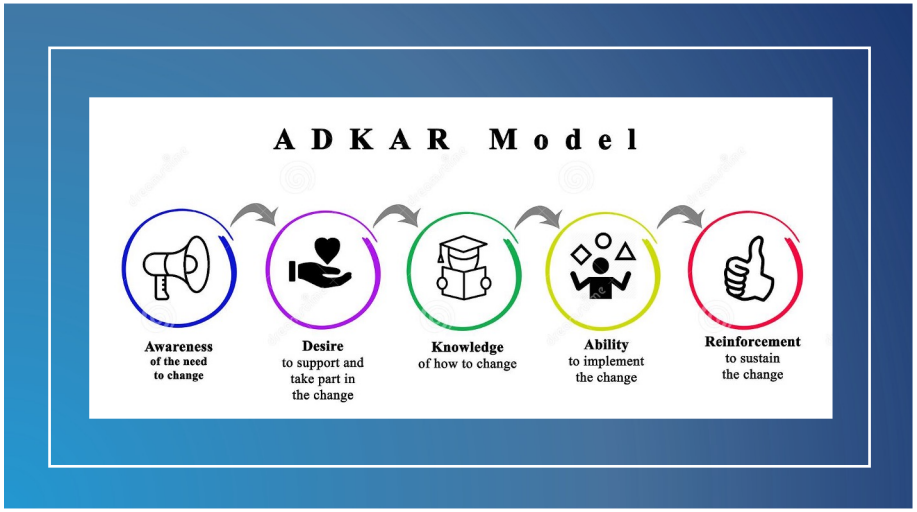


THE
DECISION QUADRANT

Many Variations
Use Low-Hanging Fruit
Modeled after Eisenhower Matrix

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ADKAR

ANALYSIS

How can we assist individuals to make personal transitions?

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METRICS

AND DATA COLLECTION

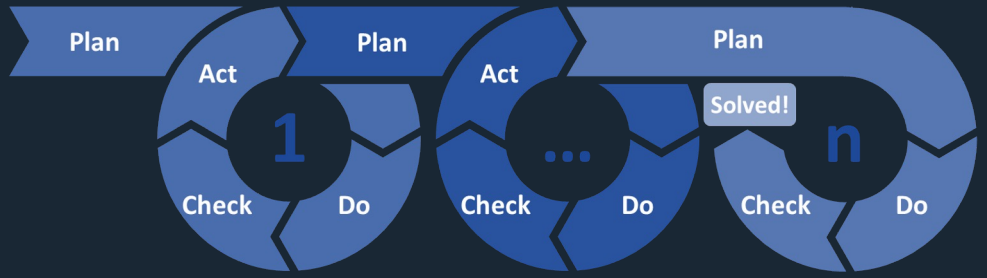
- Start with the end result in mind
- Carefully describe the evidence of that result
  - What would we see, feel, hear, or touch
- Identify the Measure(s)
  - Can we Count or Quantify
- Look at the Bigger Picture
  - Control, Influence, Consequences (good/bad)

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THE CHANGE LOOP

- Describe the desired state
- Share the future state
- Identify and eliminate barriers
- Work the PDCA cycle
- Leverage Lessons Learned



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LEADING CHANGE

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8 STEPS OF
LEADING CHANGE



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8 STEPS OF
LEADING CHANGE

Step 1: Establish a sense of urgency

Actions Needed:

- Potential Crisis
- Untapped Opportunities

Potential Pitfalls:

- Underestimating
- Paralyzed
- No Leadership

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8 STEPS OF
LEADING CHANGE

Step 2: Forming a powerful collation

Actions Needed:

- Assemble a Group
- Enough Power
- Teamwork

Potential Pitfalls:

- No Experience
- Team Leadership

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8 STEPS OF
LEADING CHANGE

Step 3: Creating a Vision

Actions Needed:

- Create a Vision
- Develop Strategies

Potential Pitfalls:

- Vision too Complicated
- You Got 5 Minutes

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8 STEPS OF
LEADING CHANGE

Step 4: Communicating the Vision

Actions Needed:

- Communication
- "Walk the Talk"

Potential Pitfalls:

- Under Communicating
- Inconsistent Actions

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8 STEPS OF
LEADING CHANGE

Step 5: Empowering Other to Act on the Vision

Actions Needed:

- Change Structures
- Recognize Contributions

Potential Pitfalls:

- Not Addressing the Naysayers



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8 STEPS OF
LEADING CHANGE

Step 6: Planning For and Creating Short-Term Wins

Actions Needed:

- Define What is Success
- Short-Term Wins
- Recognize and Rewards

Potential Pitfalls:

- Not Recognizing Improvements

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8 STEPS OF
LEADING CHANGE

Step 7: Consolidating improvements and still producing more change

Actions Needed:

- Use Credibility
- Dedicated Employees
- New Projects

Potential Pitfalls:

- Declaring Victory too Soon
- Not Proving a New Process is Repeatable



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8 STEPS OF
LEADING CHANGE

Step 8: Anchor the new approaches in your organization

Actions Needed:

- Articulate Connections
- Improve Performance

Potential Pitfalls:

- Ignoring the New Normal and Values
- Promoting or Hiring Non-Believers



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What is a Control Plan?

A Control Plan is:

- **Written summary describing systems used for monitoring/controlling process or product variation**
- **A Living document to be updated as new measurement systems and control methods are added for continuous improvement**
- **Often includes concise operator instructions (SOPs , SWIs, OCAPs)**
  - **OCAP = Out of Control Action Plan**
  - **SWI =Standard Work Instructions**
  - **SOP = Standard Operating Instruction**
- **Made in conjunction with the final project report**
  - **Lessons Learned**
  - **Actual Gains vs Planned Gains**

Control Plan Elements

Control Plan

4 Elements of a Control Plan

1. Training
2. Documentation
3. Monitoring
4. Response

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Control Plan

Control Plan

Item #	Subject	Control Description	Type(s)	Control Cycle(s)	Control Owner(s)	Status	References / Other
1	**Maintain compliance to the new Operator SOP.**	Train personnel on new SOP Track parts per hour & downtime/fault occurences/times and take action on largest issues. Respond to operator challenges of new design to sustain the improvements.	Training Fix & Train Monitoring	Daily Daily Weekly review at production mtg.	Dan Krueger Brian Buchanan John Stewart (supv.)	Training completed on _____ Spreadsheet tool provided Onging	SOP #12345 Fault Tracking Log
2	**Maintain compliance to the new Lead/Setup SOP.**	Train personnel on new SOP Track reasons for being pulled off route and take action on largest issues. Respond to lead challenges of new design to sustain the improvements.	Training Fix & Train Monitoring	One time Daily Weekly review at production mtg.	Dan Krueger Brian Buchanan John Stewart (supv.)	Training completed on _____ Spreadsheet tool provided Onging	SOP #12345 Tracking Log
3	**Escalation Plan for Lead/Setup**	Train personnel on new response plan	Training	One time	Dan Krueger	Training completed on _____	
4	**Maintain compliance to the new Parking Lot SOP.**	Train personnel on new SOP	Training	One time	Dan Krueger	Training completed on _____	
5							

Control Plan Approval and Acknowledgement	Control Owner Action Acknowledgement
Process Owner(s) - Date	Name and Date
APPROVAL	Name and Date
	Name and Date
	Name and Date

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Congratulations !

You have completed the Lean Six Sigma course.

Good Luck in your Exam !

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