ART OF LEAN

4 Types of Problems

Coaching Problem Solving & Developing People Toyota Style

Learning Session Outline

- Background
- 4 Types of Problem Situations
- Type 1 – Troubleshooting
- Type 2 – Gap from Standard
- Type 3 – Target State
- Type 4 – Innovation
- Situational Leadership & Development
- Summary

Background - Lean / Toyota

Toyota Kamigo
Overhead

Kamigo
Entrance

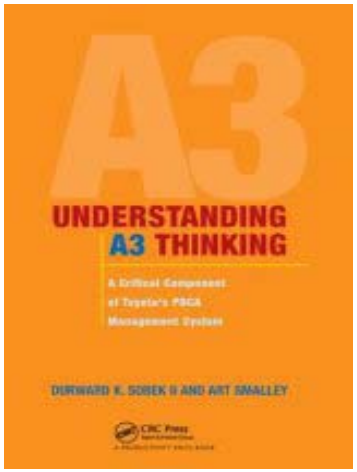
Taiichi
Ohno

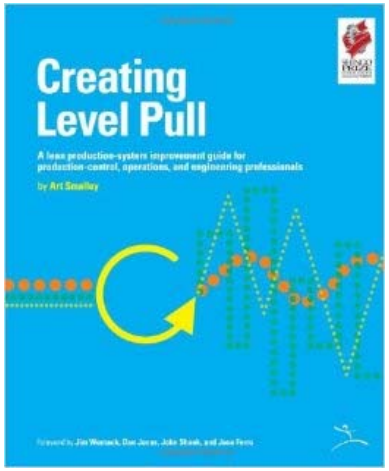
Precision & Machine
Intensive

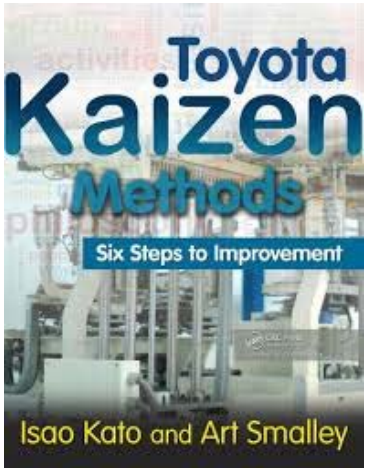
Lower Volume &
Higher Mix

High Volume &
Lower Mix

Other Background - Work







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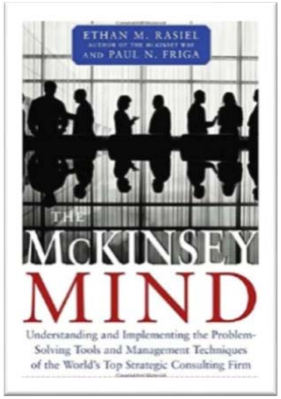
WELCOME TO ART OF LEAN

Leadership Development, Lean Thinking, and Continuous Improvement.

Other Background - Stuff



TPS Development Timeline

Western Influences:

Mass Production & moving conveyor lines

Scientific Principles Of Management

Standardization Of Parts

Many Others….

Taiichi Ohno

TPS Development

Loom Business

Automotive Company

1902 1937 1950 1973 2016

Sakichi Toyoda

Kiichiro Toyoda

Taizo Ishida

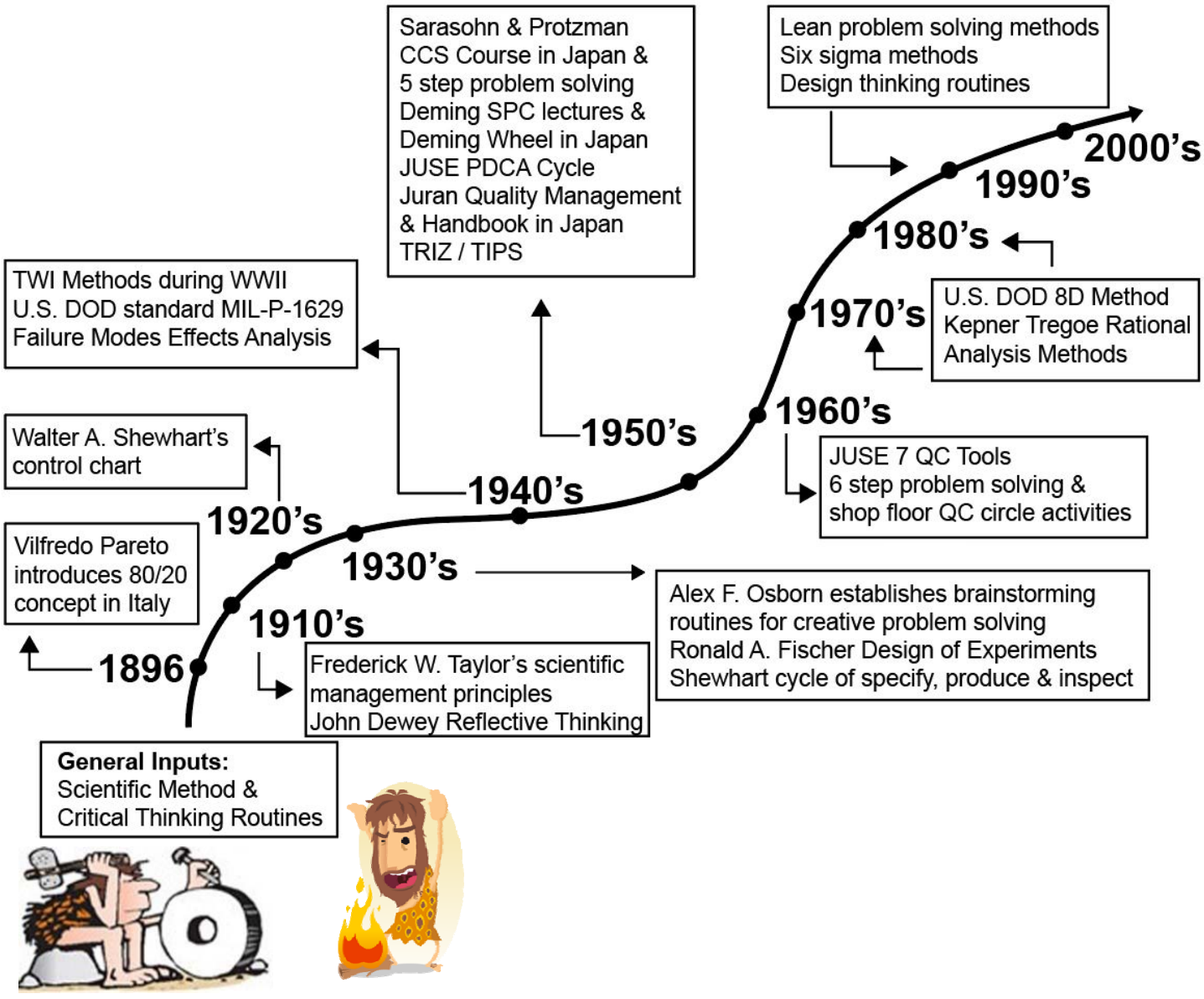
Fukio Nakagawa

Eiji Toyoda

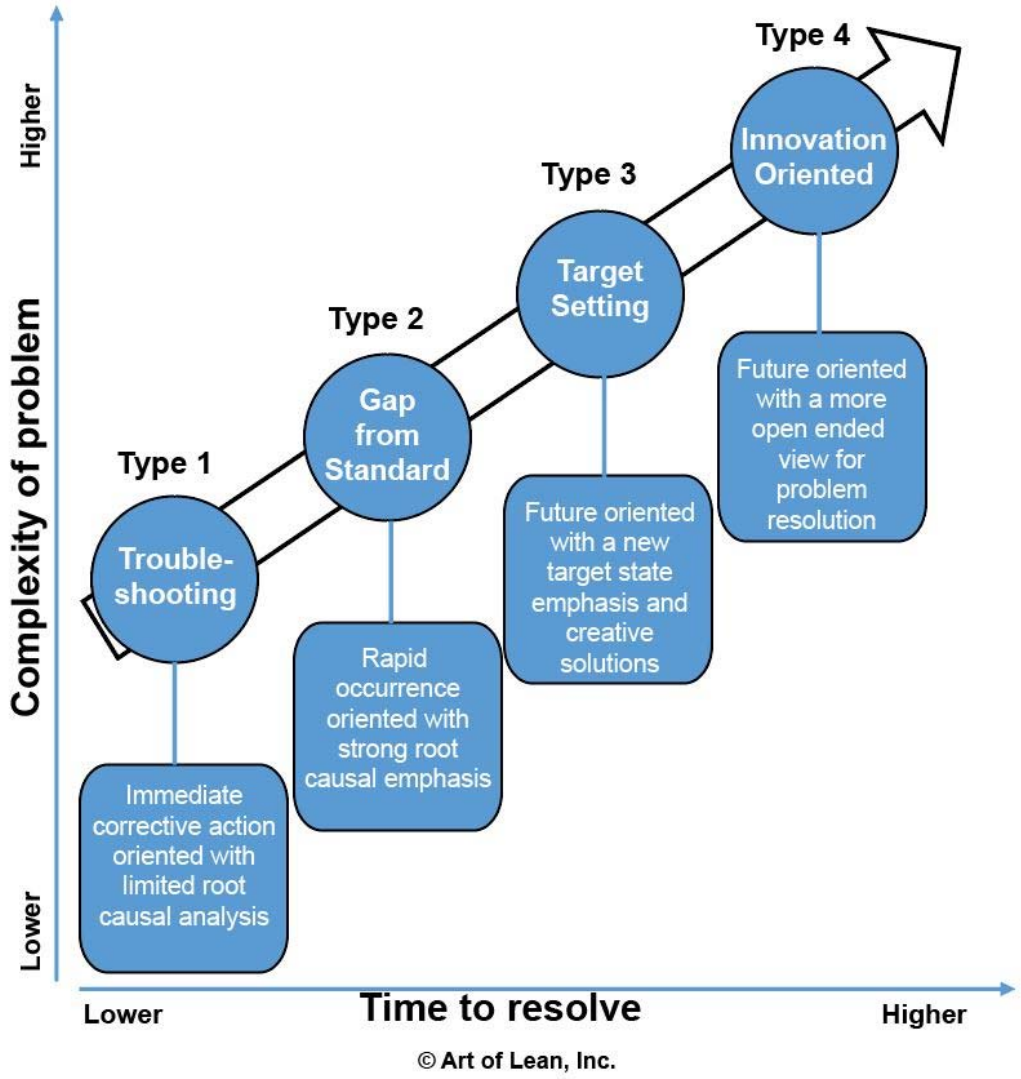
Fujio Cho

Various parties and key individuals involved over a long period of time

20th Century & Problem Solving



4 Types of Problem Situations



4 Types & Benkei Analogy

Benkei

7 QC Tools

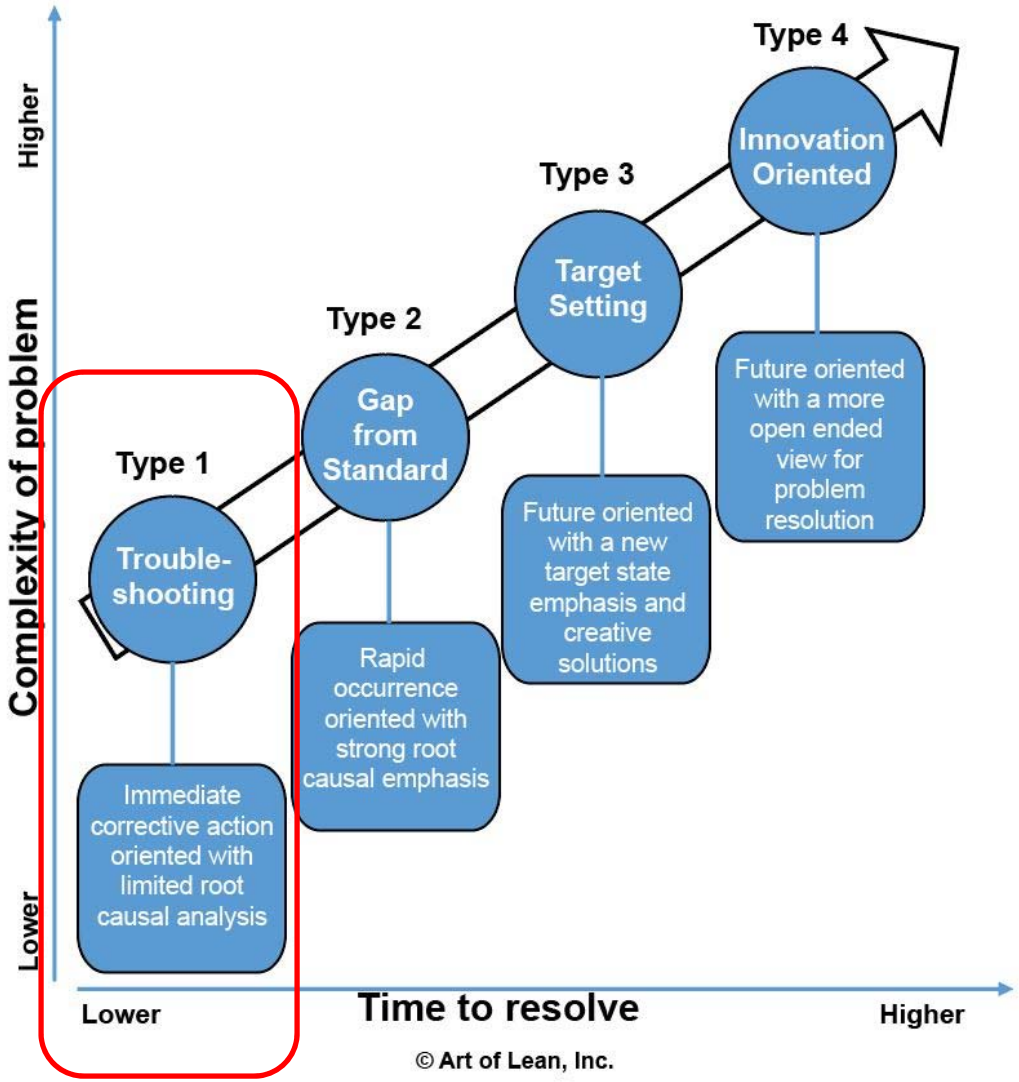
1. Data Collection / Check sheets
2. Cause-and-effect diagram
3. Flow charts
4. Histogram
5. Pareto chart
6. Control chart
7. Scatter diagram

Kaoru Ishikawa

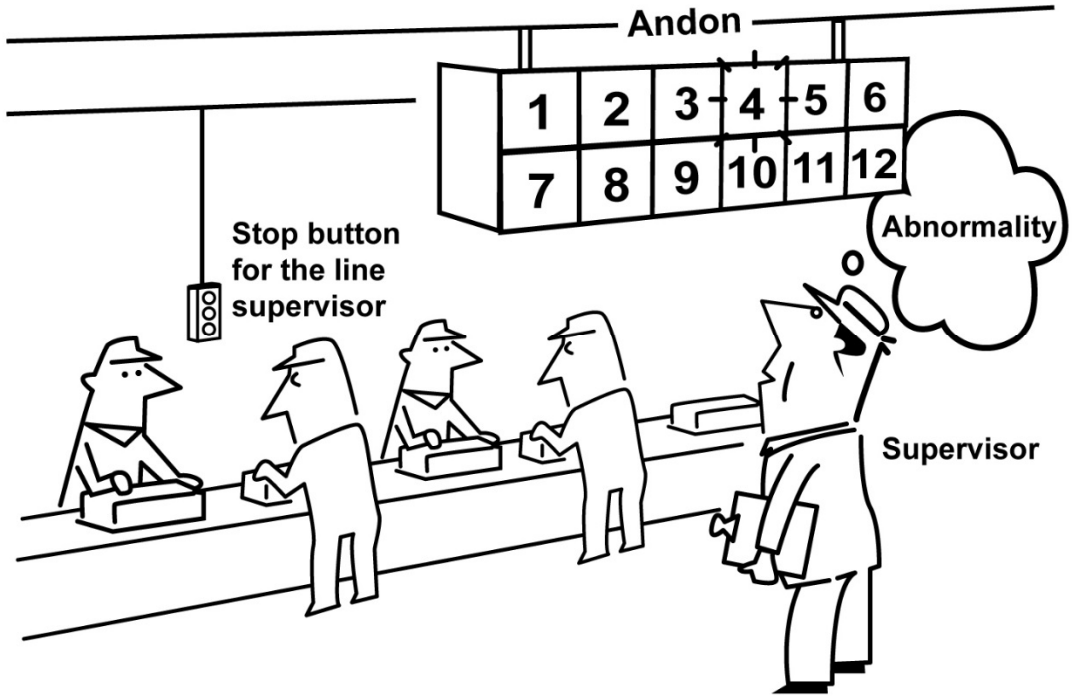
The term "7 QC tools" is named after the seven tools of Musashibo Benkei the famous warrior monk. Benkei owned seven weapons which he used to win all his battles. Similarly from my own experience you will find that you will be able to solve 95% of the problems you face if you properly use the 7 QC tools.

Professor Emeritus
University of Tokyo

4 Types of Problem Situations

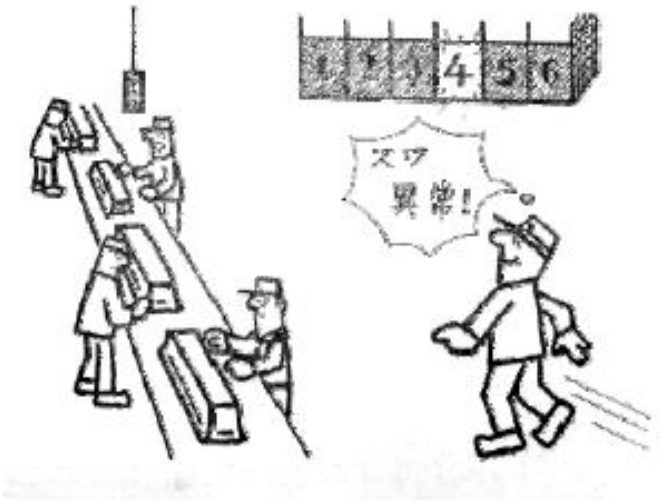


Type 1 – Troubleshooting



Condition based trigger
Either human or machine

Toyota Supervisor Image



Rapid response to problems and abnormal conditions by production

- -Team Member
- -Team Leader
- -Group Leader
- -Manager
- -Plant Manager

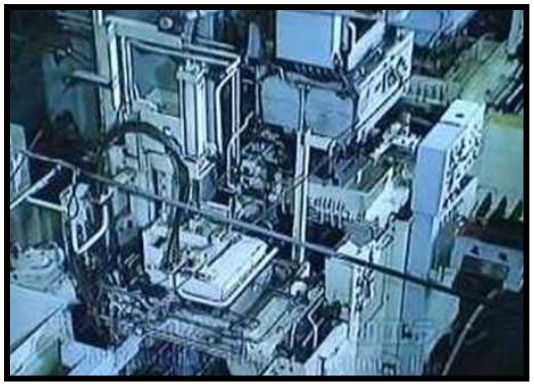
"All Mighty" Supervisor Image

1. Safety
2. Job Ability
3. Team Leadership
4. Kaizen Skills / Problem Solving
5. Technical Knowledge
6. Human Relations

Daily Meeting & 4C’s

Start of 8 hour shift
Daily performance trend
Major problem communication
Departmental coordination
Priority alignment & clarification
Hop topics, etc.

Andon Response Example



1. Automated process cycling normally

2. Mechanical probe detects broken cutting tool and stops the machine

3. Probe signals an “andon” board for visual display

4. The operator **immediately takes corrective action** and confirms good products to the following process

Type 1 – Troubleshooting

Production Analysis Board

Line/Cell Name:		Team Leader:		Date:	
Quantity Required:		Takt Time:		Shift:	
				Num of Operator:	

Time	Hourly Plan / Actual	Cumulative Plan / Actual	Problem/Causes	Sign-off
: ~ :	/	/		
: ~ :	/	/		
: ~ :	/	/		
: ~ :	/	/		
: ~ :	/	/		
: ~ :	/	/		
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Kaizen Express

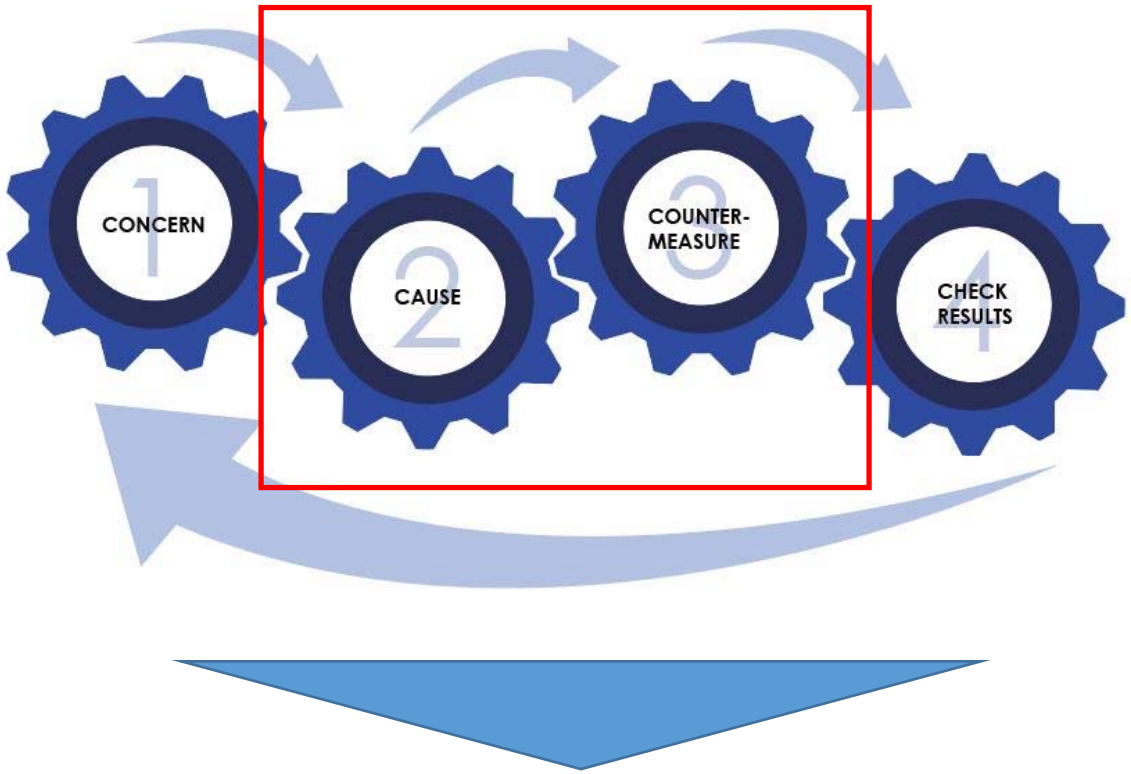
Lean Enterprise Institute
lean.org

Rapid Problem Solving

- Concern
- Cause
- Countermeasure
- Check

Time & quantity based triggers
Reviewed hourly by supervisor

4 C’s Thinking



Minimal (if any) documentation involved. No A3’s.
Mainly discussion, thinking, rapid action & follow up.

4C's Example

- Concern: Machine cycle time is 4 seconds slow
- Cause: Bearing shaft is worn
- Countermeasure: Replace the bearing shaft
- Check: Machine cycle time is back to normal

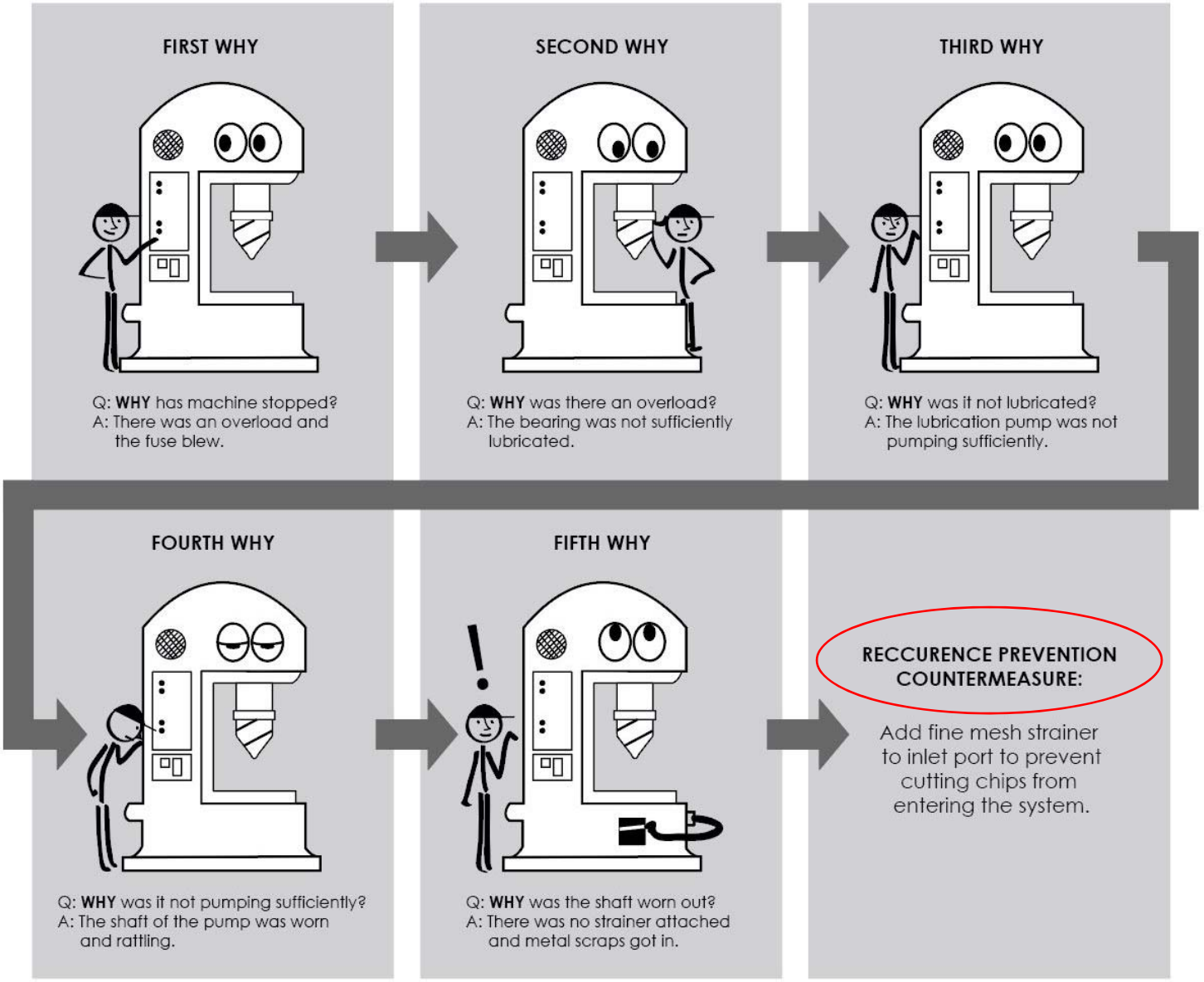
What is almost always the weak point?

“5 Why” Thinking is Critical

Situation: A machine tool has stopped working halting production.

1) “Why did the machine stop working?”
    - “Because the machine overloaded blowing the fuse in the control panel.”
2) “Why did the overload condition result?”
    - “Because there was insufficient lubrication to the spindle bearing.”
3) “Why was there insufficient spindle bearing lubrication?”
    - “Because there was insufficient lubrication drawn up by the pump.”
4) “Why was there insufficient lubrication draw from the pump?”
    - “Because the pump shaft was worn and rattling.”
5) “Why was the pump shaft worn?”
    - “Because there was no strainer on the lubrication device inlet port, and small metal cutting chips entered the system causing damage.”

Key Point is also the Countermeasure!



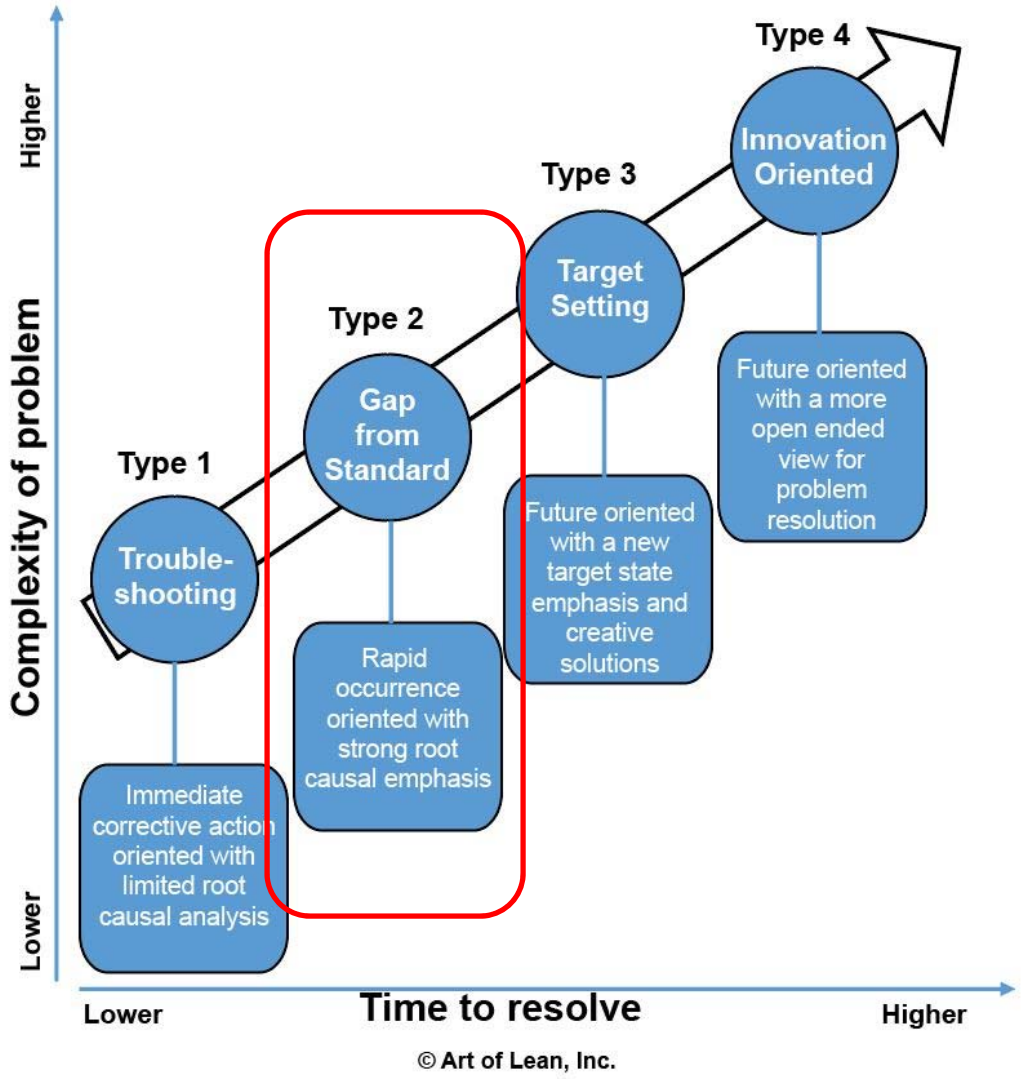
Summary Slide

- Troubleshooting is part of life and lean
- Developing good troubleshooting skills in lead personnel is part of TPS
- Reactive work is sometimes needed to “gain” time to do the correct proactive work to permanently fix the problem
- For lean to function you must have adequate time and condition based triggers to signal abnormalities
- First line supervision must respond immediately and problems must escalate up the management chain by some form of protocol
- 4C’s are good for verbal problem solving routines. Not everything is a Six Sigma project or an A3 report!

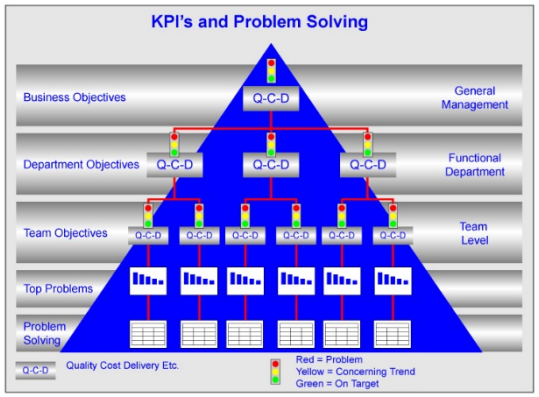
Homework Exercise

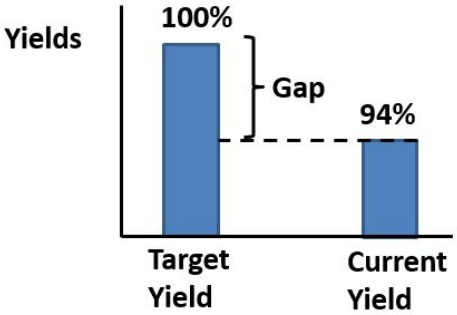
- Select a critical process or area for observation
- Clarify the goal (minute/hour/shift/day)
- Monitor closely by observation for xx hours (tbd)
- Set time and condition signals
- Catch all the minor problems / concerns
  - 4C's Thinking
- Evaluate how well it is going
- What needs to be improved

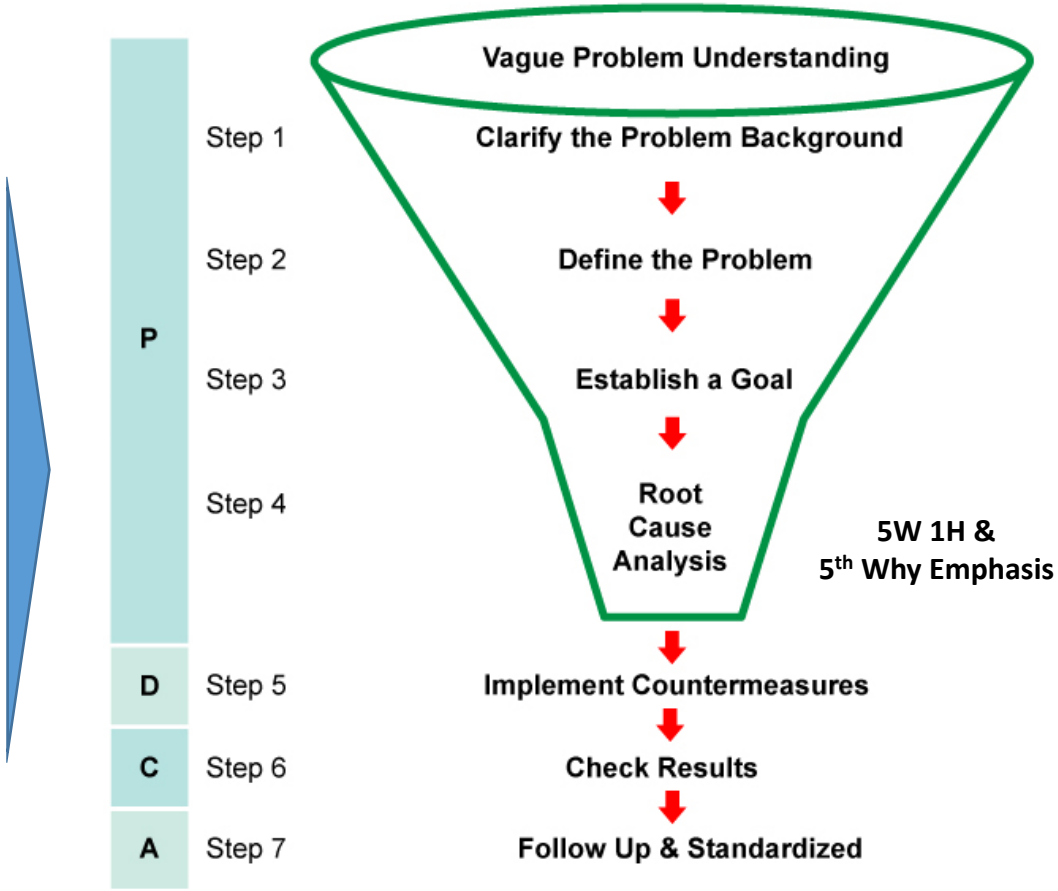
4 Types of Problem Situations



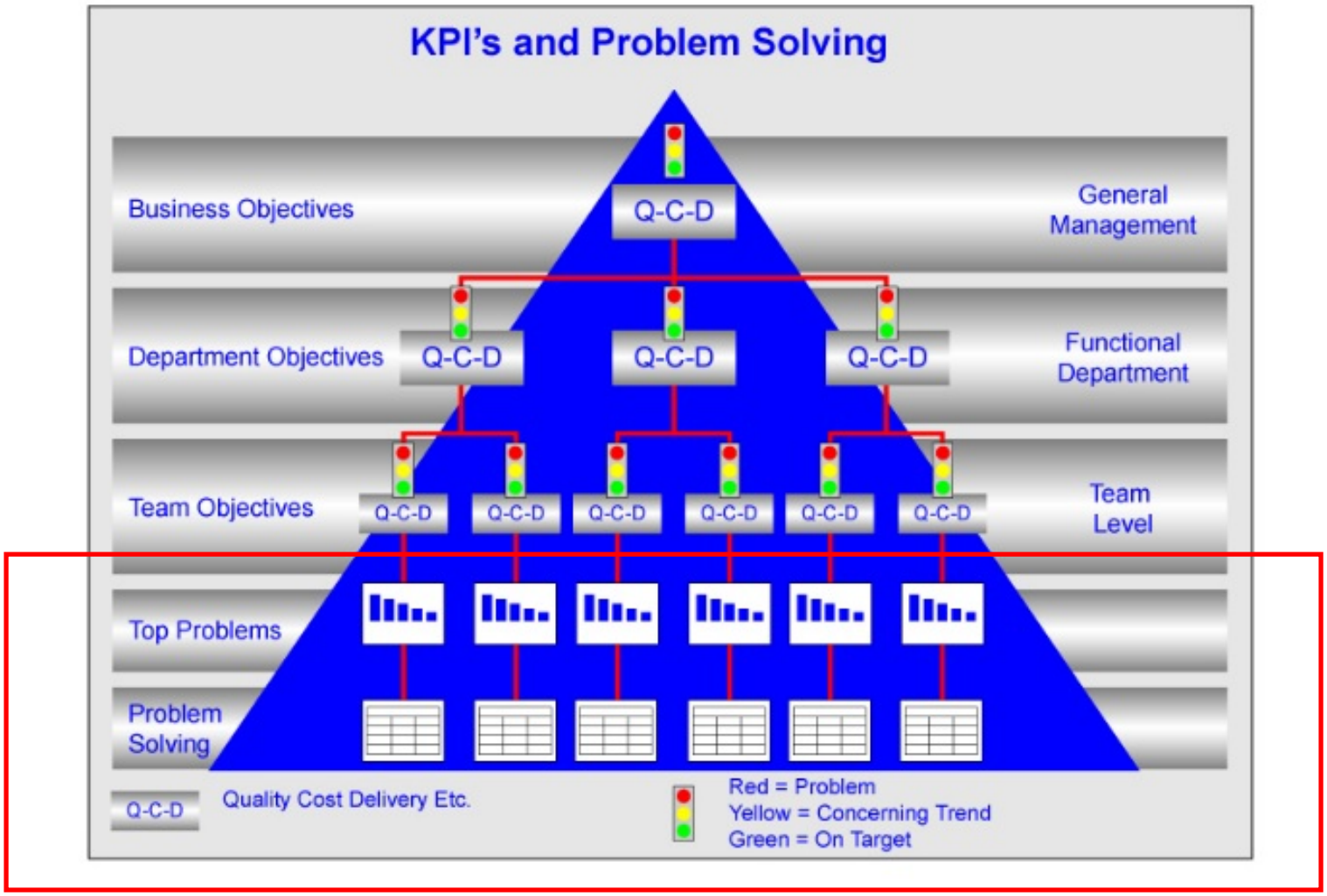
Type 2 – Gap from Standard







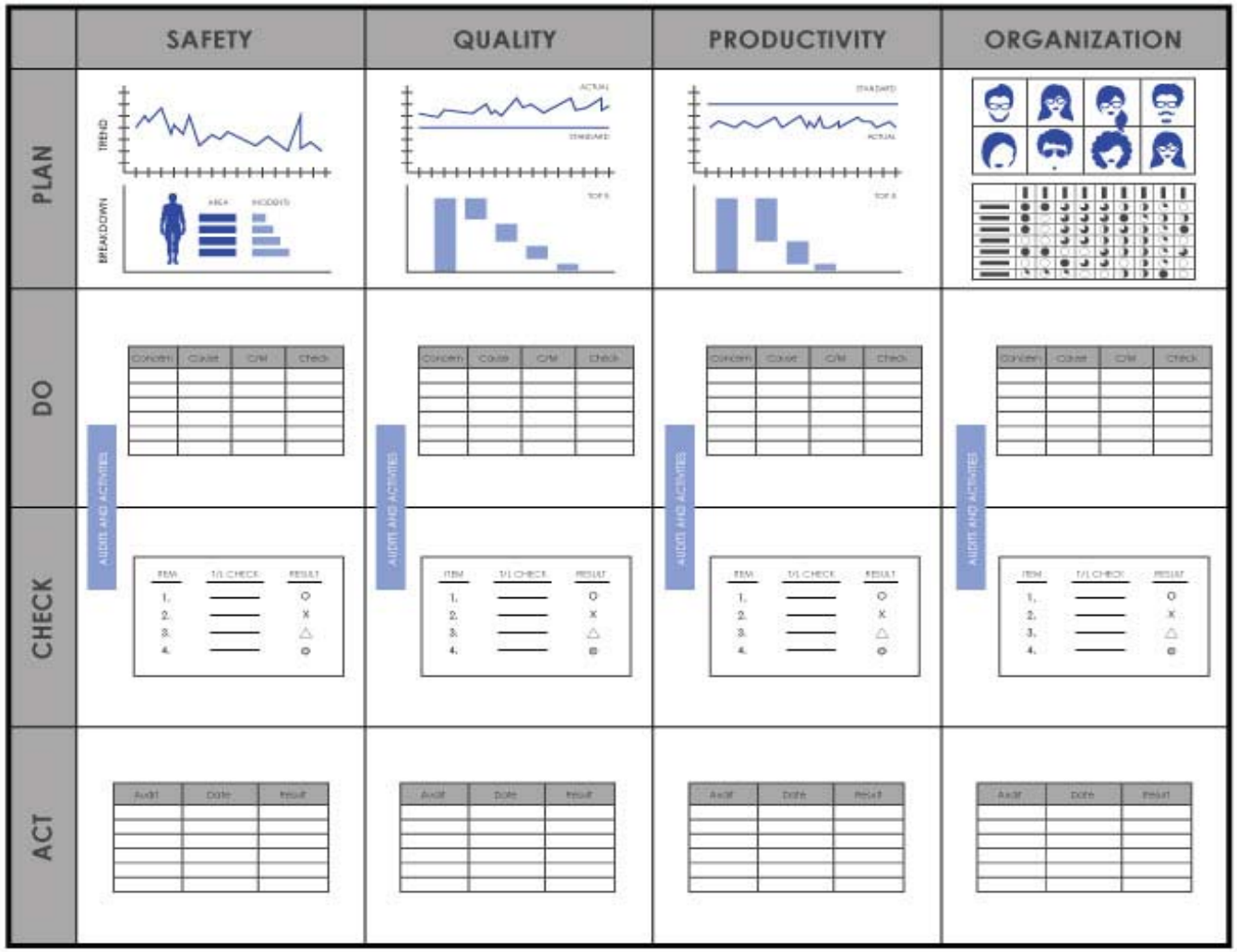
KPI's & Problem Solving



Daily Meeting & Type 2 Problems

Start of 8 hour shift
Daily performance trend
Major problem communication
Departmental coordination
Priority alignment & clarification
Hop topics, etc.
May or may not have problem type A3's posted here

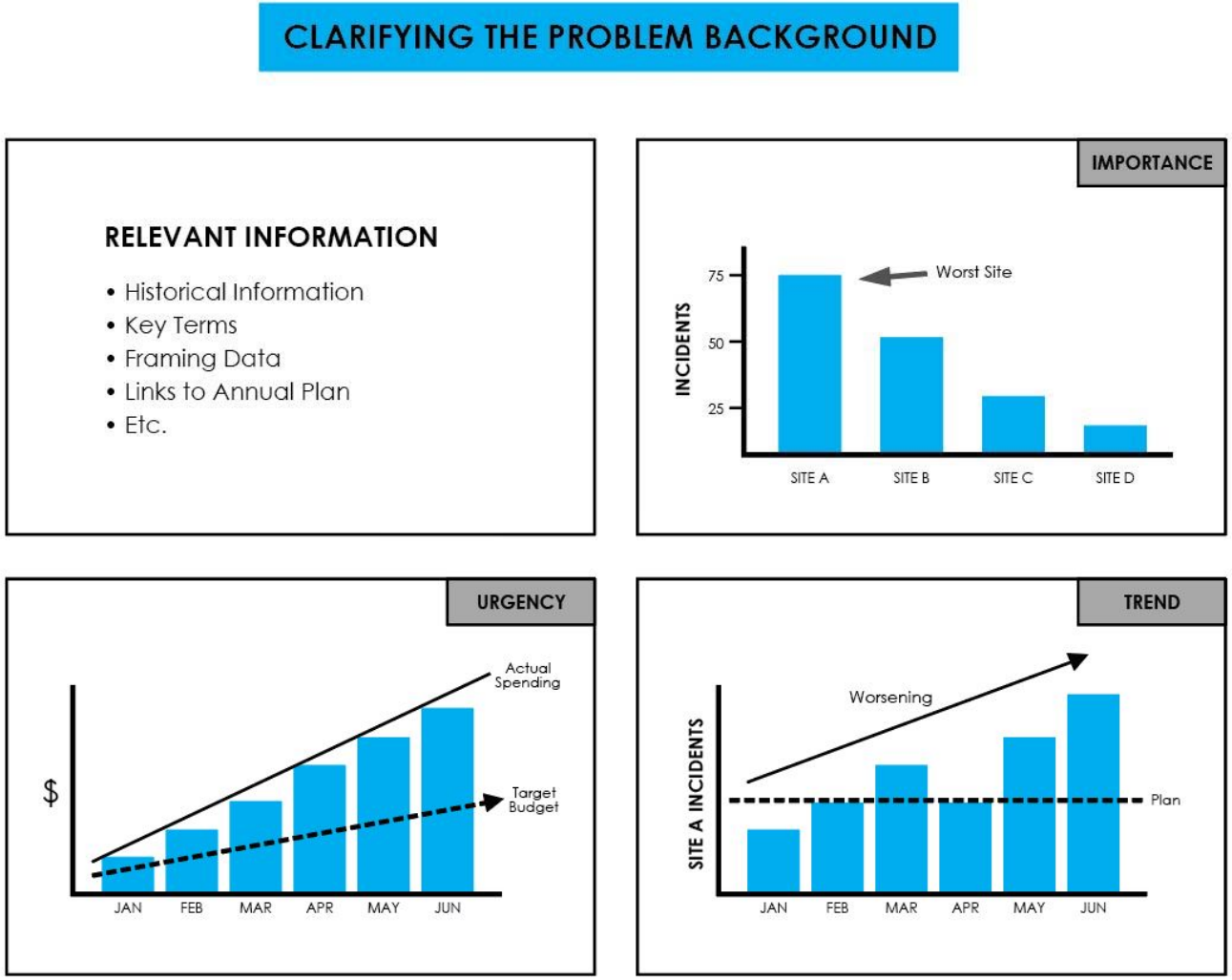
Shop Floor Management Board



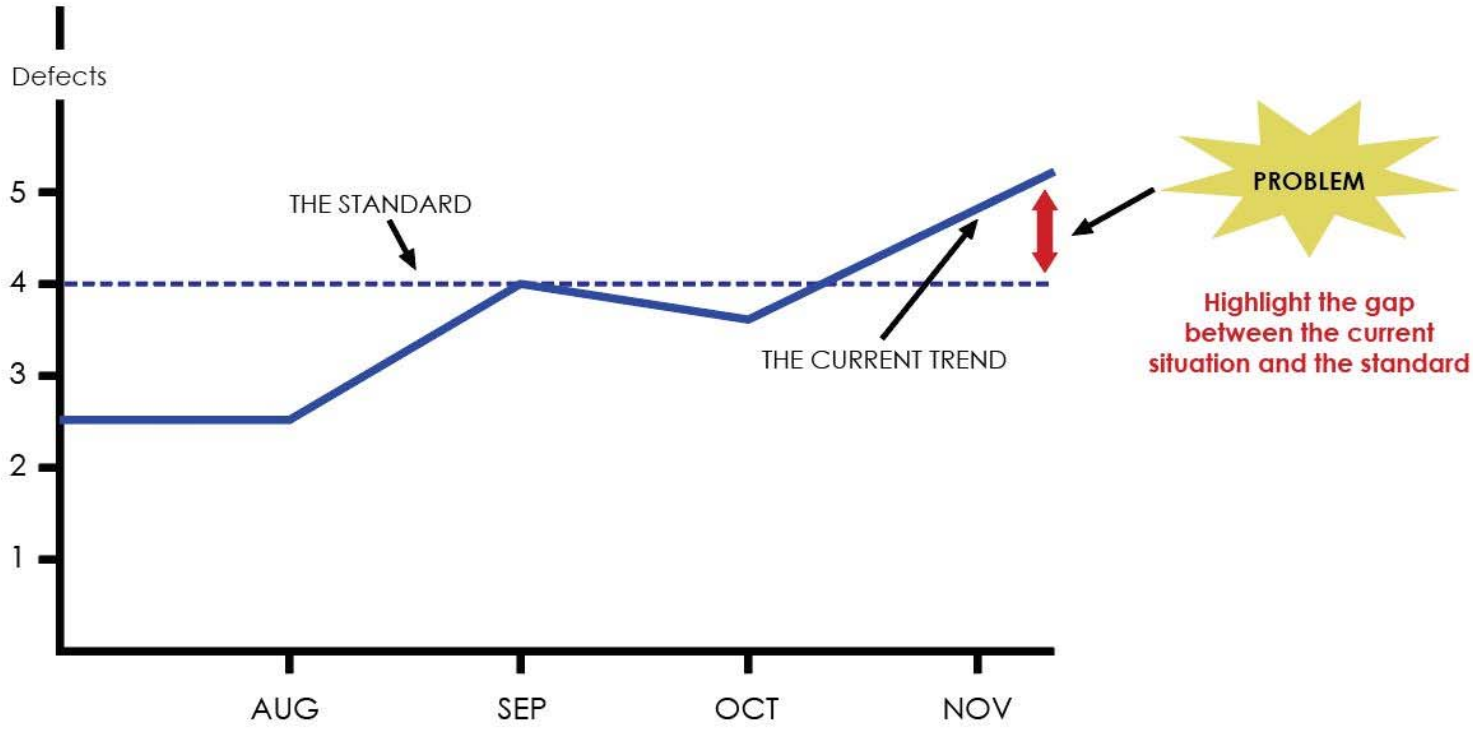
Problem Solving Report / A3

Problem Background	**Countermeasures**
Problem Definition	
Goal	**Check Results**
Root Cause Analysis	**Follow Up & Standardize**

Clarify the Problem Background



Define the Problem



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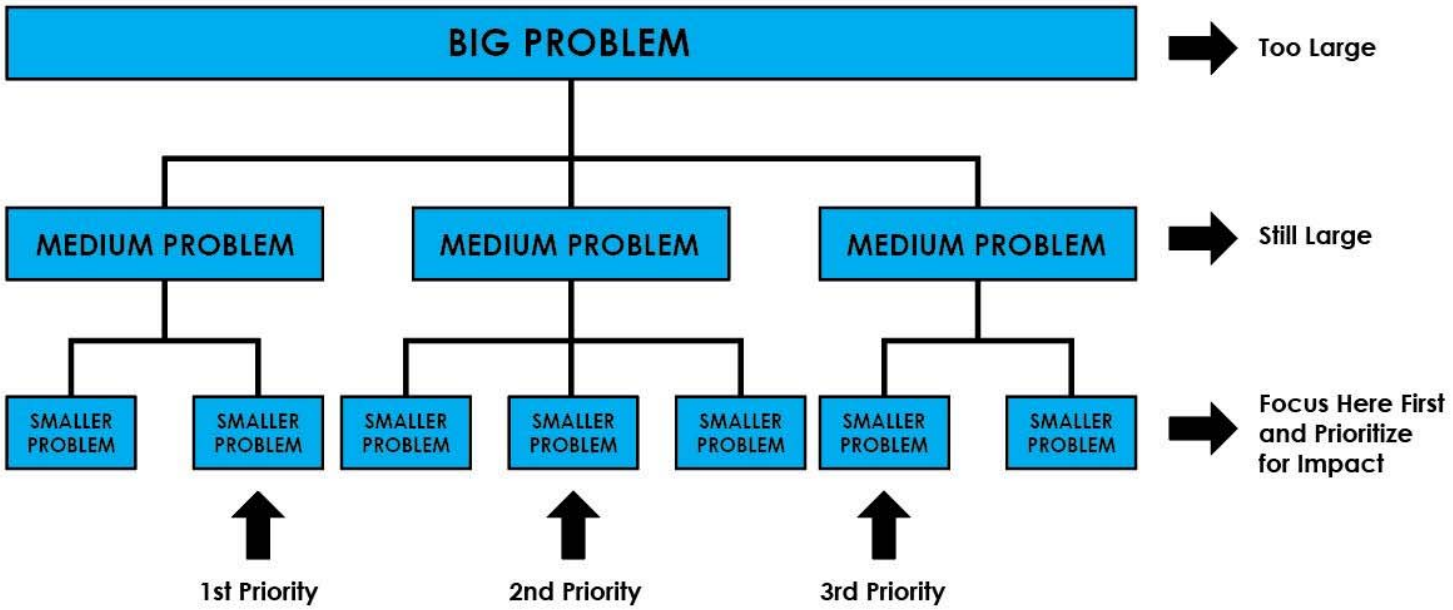


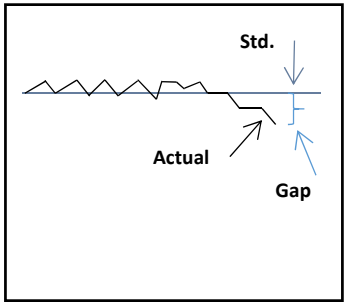
Problem Investigation

TPS

TPS

A. Immediate abnormality signal

B. Go to actual machine and see status

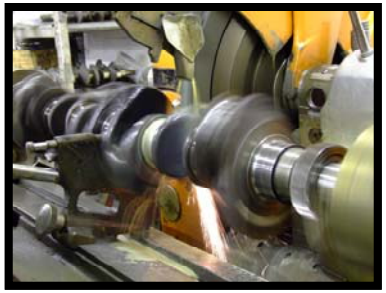


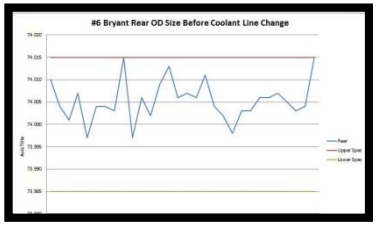
C. Ascertain actual problem situation

TPS

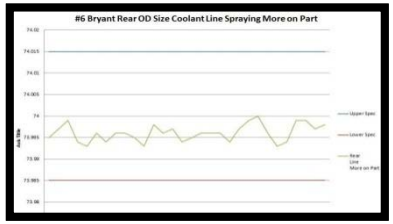
D. Problem Investigation Sequence

1. Measure actual dimensional extent of problem
2. Look for obvious contamination or abnormalities
3. True and re-dress grinding wheel and observe status
4. Check actual grinding wheel (check “pores”)
5. Confirm actual (not theoretical) stock removal
6. Send part to QC Mat’l lab for hardness and HT depth check
7. Check actual cutting conditions
   - Wheel RPM
   - Feed Rate, Depth of Cut, etc.
   - SFPM
8. Confirm status of datum features
9. Measure spindle run out
10. Coolant check
    - Flow rate / pressure
    - Nozzle condition and direction
    - Temperature
    - Concentration





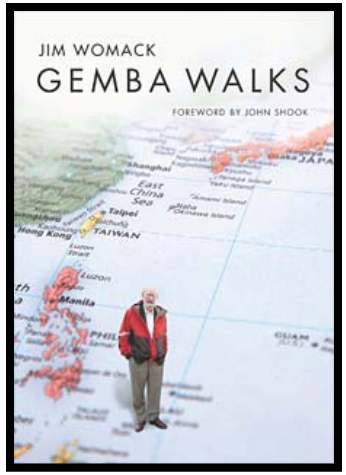
Cpk 1.15



Cpk 2.33

Dig Deeper! 8G's

- Genba 現場 Actual Place
- Genjyou 現状 Actual Condition
- Genchi 現地 Actual Location
- Genbutsu 現物 Actual Object
- Genjitsu 現実 Actual Facts
- Genji 現時 Actual Time
- Genpō 現法 Actual Method
- Genin 現因 Actual Cause



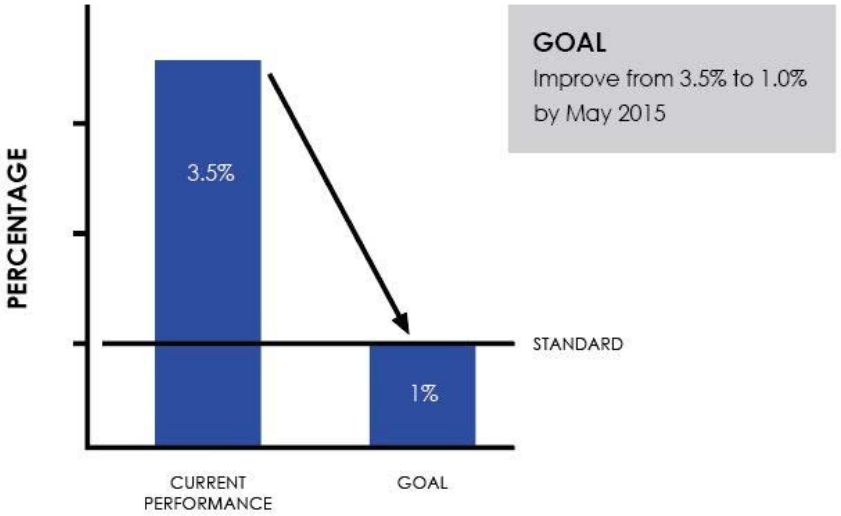
現地現物

Genchi Genbutsu - "Go and See"

Dig Deeper! Plain English

5W 1H	Level 1	Level 2	Level 3	Level 4	Level 5
Who?	Site	Department	Group	Team	Individual
When?	Day	Shift	Hour	Minute	Actual instant of occurrence
Where?	General area	Specific production line level	Specific process	Actual location in the process	Actual point of occurrence
What?	Occurrence	Symptom	Broad problem	Categorical problem	Specific problem
Why?	1st cause	2nd cause	3rd cause	4th cause	5th cause
How / How much?	Non-conformance issue	Dimensional variation	Above standard allowed	Comparison to actual Standard	Gap from actual standard: e.g., .001 mm

Set a Goal



3 Factors

From what level?
To what level?
By when?

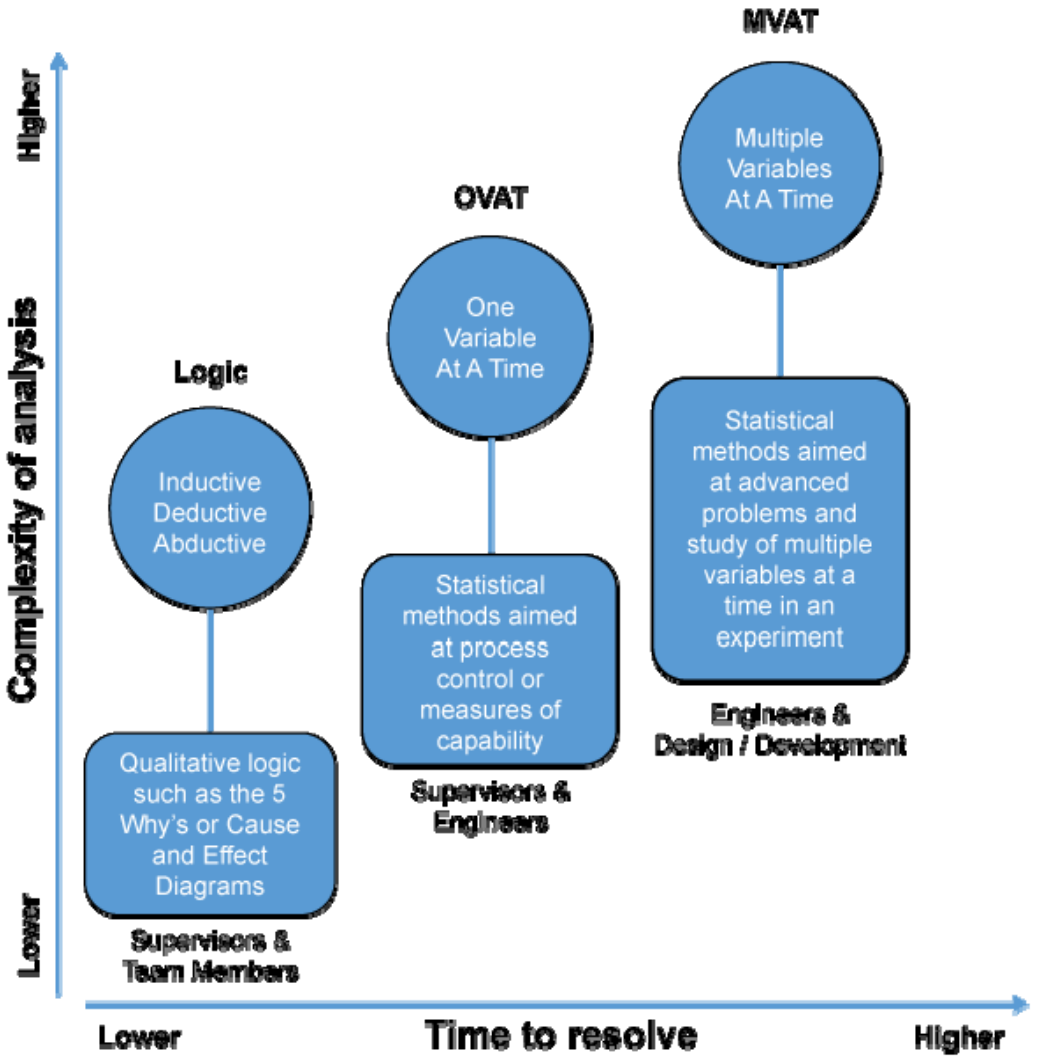
SMART

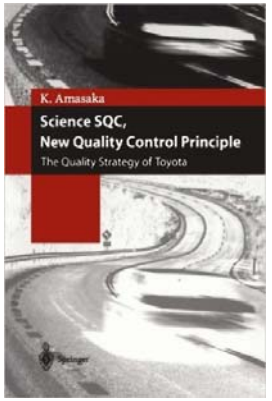
Specific?
Measurable?
Attainable?
Relevant / Realistic?
Time bound?

Poor examples include:

1) Find the root cause! (This is the next step of the process)
2) Implement lean tools like 5S or Standardize Work, etc. (This is an action item)
3) Train the employee (This is jumping to conclusions)

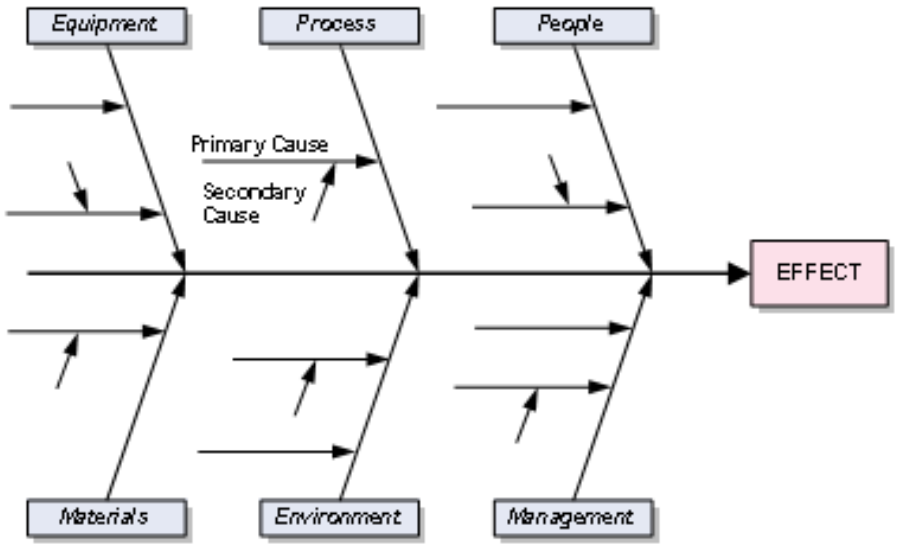
Analyze the Problem





Right type for the right problem…

Logic Based - Fishbone



Fishbone is the common name for a structured Cause & Effect diagram
You do not “brainstorm” a fishbone
Distinguish between critical thinking and creative thinking
Simply writing down random opinions = Wishbone diagram

Logic Based – 5 Why

Situation: A machine has stopped working halting production.

1) **"Why did the machine stop working?"**
   - **"Because the machine overloaded blowing the fuse in the control panel."**
2) **"Why did the overload condition result?"**
   - **"Because there was insufficient lubrication to the spindle bearing."**
3) **"Why was there insufficient spindle bearing lubrication?"**
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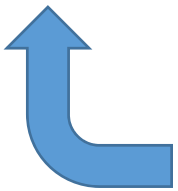
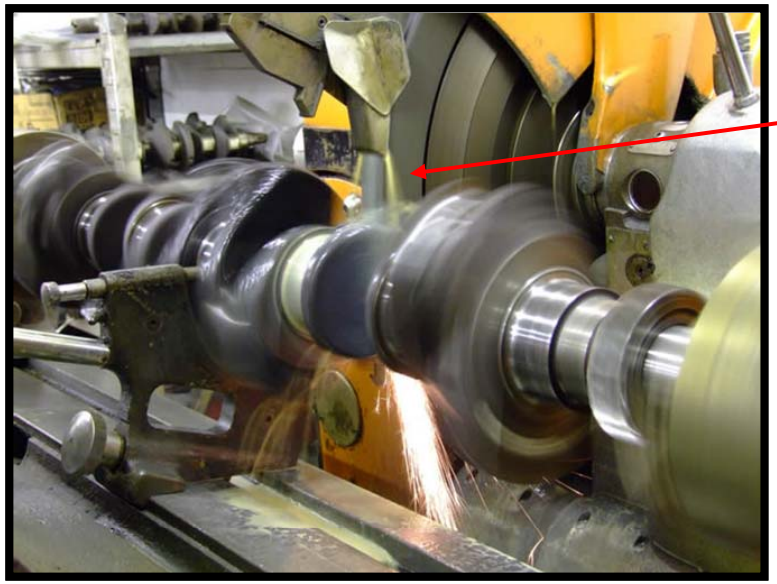


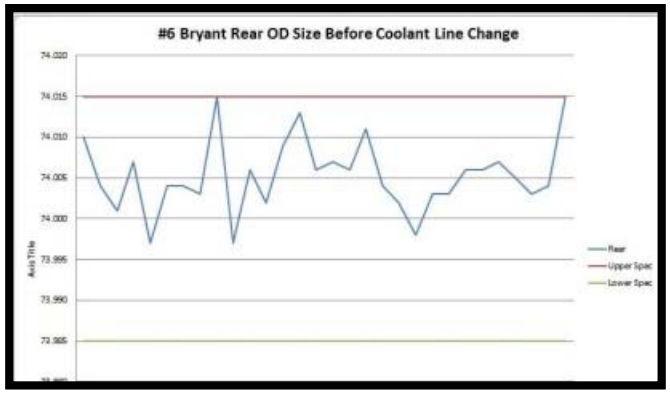
Note deeper causes exist!!!!
However here at this level a quick, inexpensive, and effective countermeasure can be established

OVAT

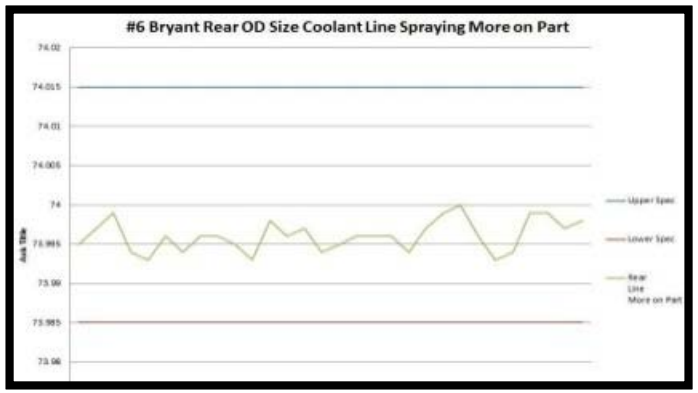


Simple case of inadequate coolant flow to the part due to a blocked / damaged coolant line.

One variable (coolant flow) cause the entire problem….

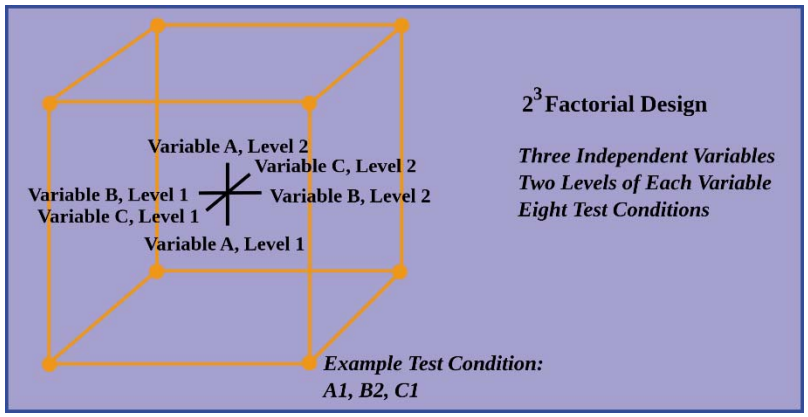


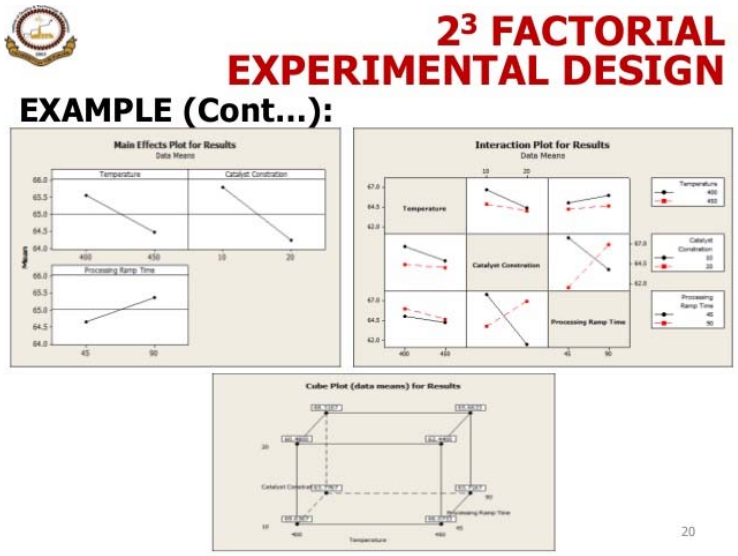
Before Cpk 1.15



After Cpk 2.33

MVAT





Complex case of multiple <u>independent variables</u>

-Temperature
-Pressure
-Processing time
-Etc.

<u>Basic OTD Case & Multiple Factors</u>

-Inventory amount
-Order entry system
-Lead time to produce
-Material storage
-Production schedule
-Set up time
-Production execution

Key Points in RCA

Area of emphasis	Key Points
Analytical	Break it down to the proper level for study. No one technique is always best.
Quantitative / Qualitative	Measure and organize carefully in order to understand relationships.
Detailed	Get the facts using 8G's or 5W 2H to the proper level for the problem in question.

Establish Countermeasures

ADMINISTRATION	DETECTION	PREVENTION
• Examples include increasing inspection duties, adding training or altering work instructions for the operator. • These controls are generally weak and mainly acceptable as temporary short term countermeasures.	• Examples include any instances of sensors or alarms used to signal that an abnormality has occurred in the product or process and stops the defect from moving downstream. Mistake or error proofing in the process. • These controls are stronger in nature and contain defects internally better than administrative ones.	• Examples include creative usage of techniques to prevent the defect or abnormality from occuring in the product or process. Or elimination of the underlying condition or potential. • These controls either alone or in conjunction with detection for the strongest type of defect control.

Weaker ← STRENGTH → Stronger

Select countermeasures which are most likely the prevent recurrence of the problem. Training and inspection are not satisfactory countermeasures.

Administration Countermeasures

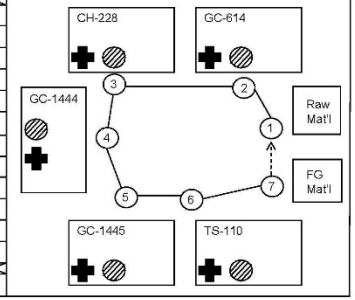
Standardized Work Chart

Acme Corp.			Plant: Acme	Product: 8" Pinion Gear
Standardized Work Combination Table			Area: Gear Machining	Op. _1_ of _1_
			Process: Gear cutting exercise	Pg. _1_ of _1_
Date:	By:	Approved By:	Shifts: 2	Takt Time: 46 secs. Cycle Time: 46 secs.
			Volume: 600	

No.	Major Steps	MAN TIME	AUTO TIME	WAIT TIME	WALK TIME
1	Pick up raw material	1	--	--	2
2	Unload, load part and start M/C GC614	5	38	--	2
3	Unload, load part and start M/C CH228	6	7	--	2
4	Unload, load part and start M/C GC1444	6	38	--	2
5	Unload, load part and start M/C GC1445	6	30	--	2
6	Unload, load part and start M/C TS110	7	3	--	2
7	Pack FG in pallet	1	--		2

Working Sequence
Walking
Return to Start

Safety | SWIP | Quality



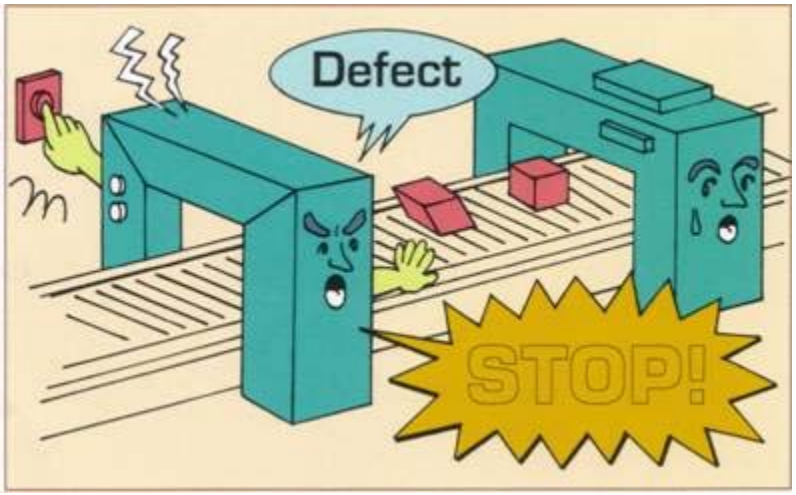
Slide 4-7

<u>Examples of Administrative C/M</u>

Standardized Work / Work Instructions
Inspection Frequency or Method
Training and Communication

Detection Countermeasures

Jidoka concept



Automatically stop the process at any detection of a defect or abnormal condition

Examples of Detection C/M

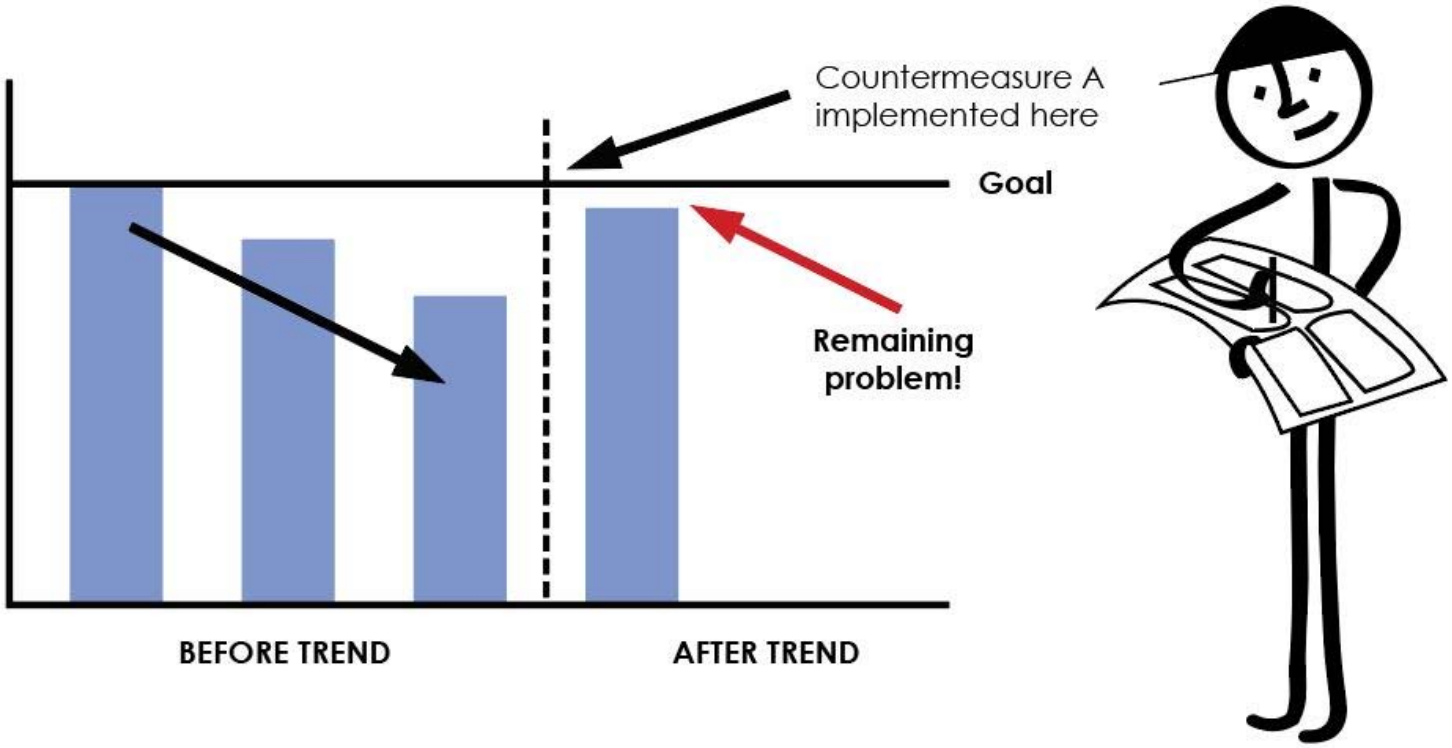
Error proofing
Sensors (Mechanical, Electrical, Optical, etc.)
In-process auto measurement
Immediate post process auto measurement

Prevention Countermeasures

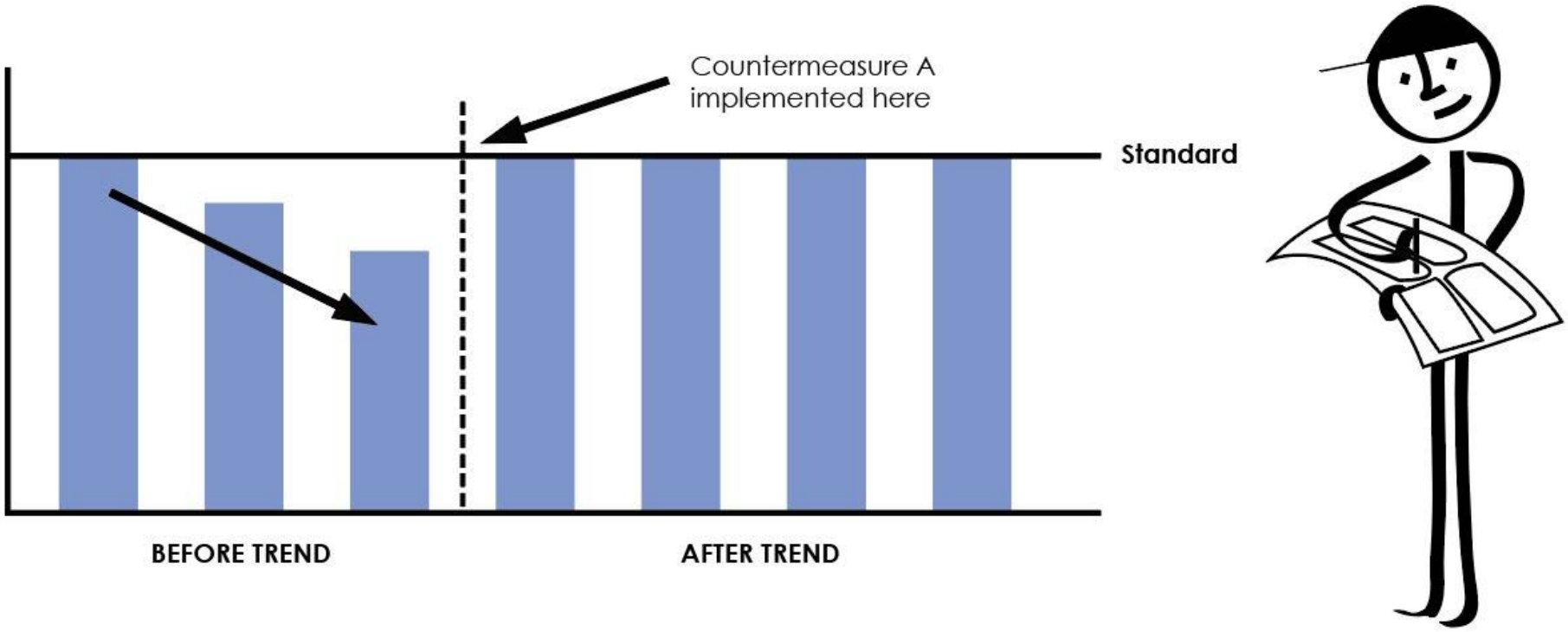
3 Stages of Prevention

STAGE OF PREVENTION	PRIMARY	SECONDARY	TERTIARY
STAGE OF DISEASE	NONE (YET)	IMMINENT	ESTABLISHED
PRIMARY OBJECTIVE	DISEASE AVOIDANCE	EARLY DETECTION	MINIMIZE DAMAGE
INTERVENTION TOOLS	HEALTH RISK ASSESSMENT HEALTH/WELLNESS PORTAL SELF-CARE BOOK/CLASSES LIFESTYLE COACHING EXERCISE PROGRAMMING HEALTH EDUCATION	BIOMETRIC SCREENING CVD SCREENING CONSUMERISM CLASSES COMPLIANCE PROGRAM NURSE HELP LINE	ON-SITE MEDICAL CARE PREDICTIVE CARE MGMT. LARGE CASE MGMT. MATERNITY MGMT. UTILIZATION MGMT.

Check Results

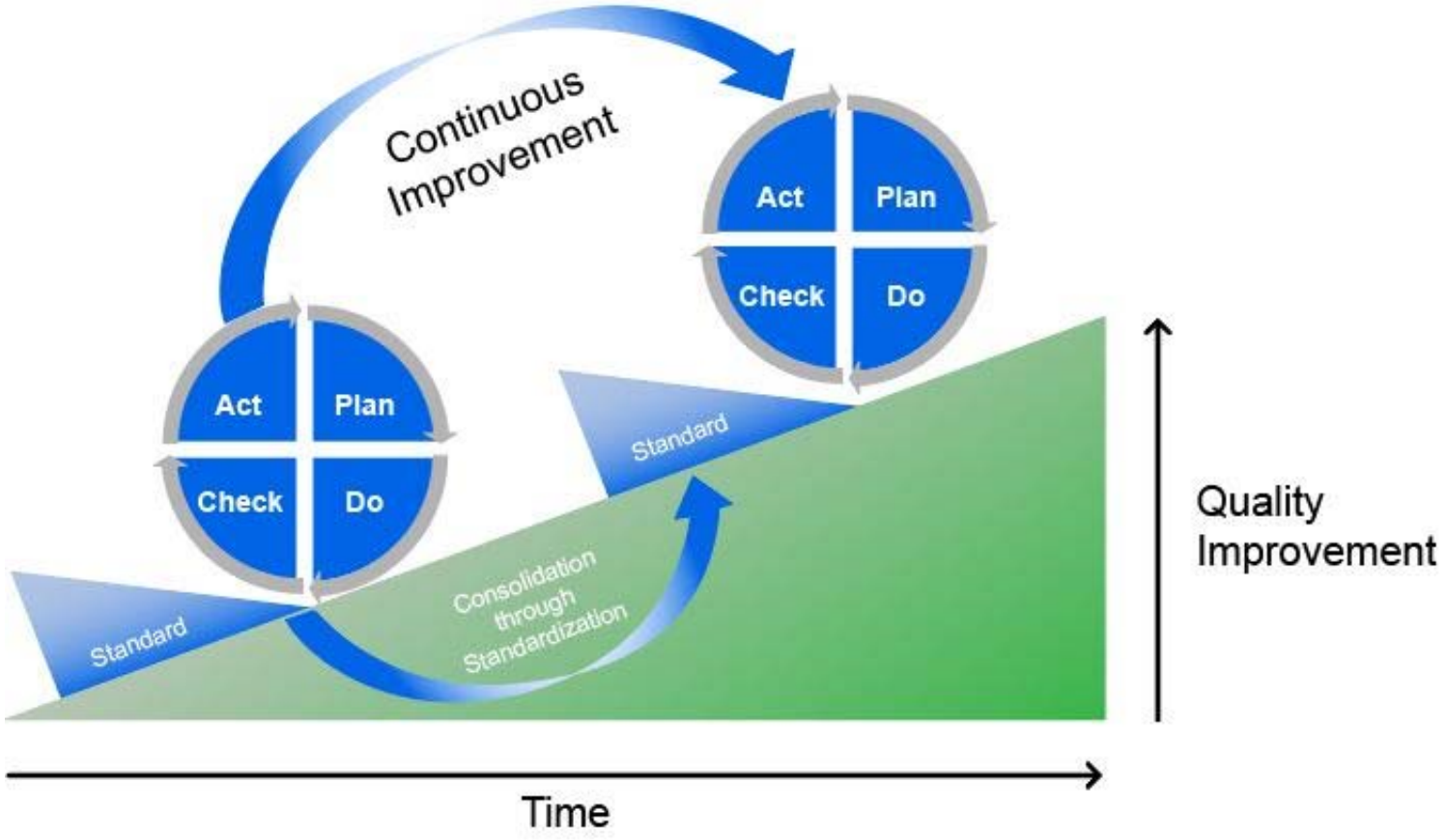


Check Results

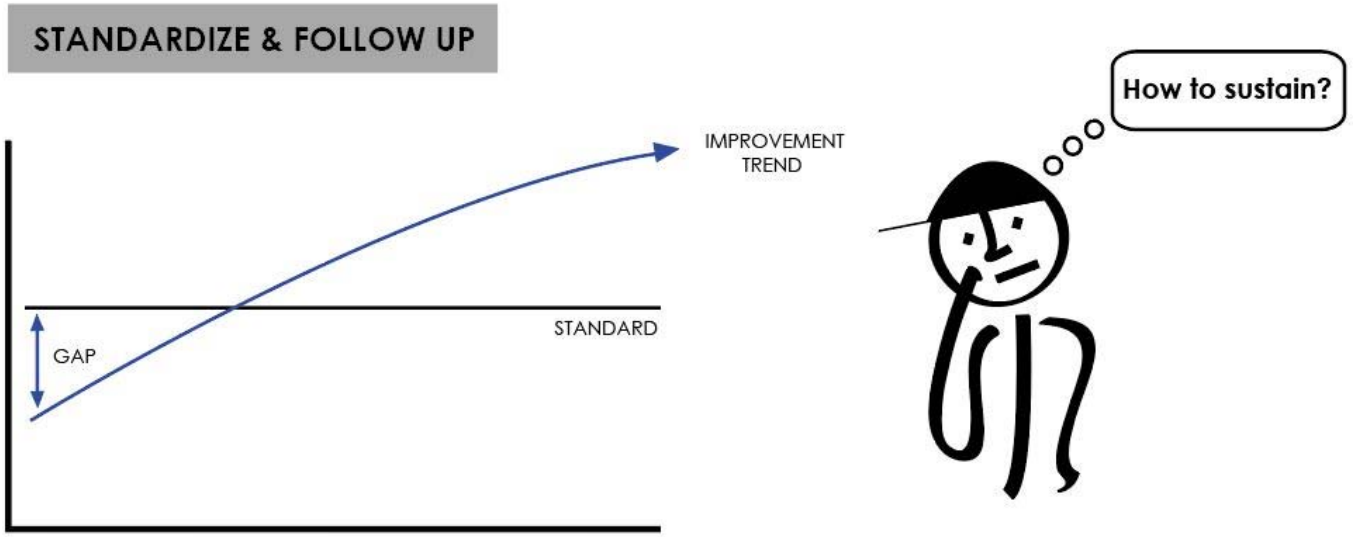


Note: Do not fall into the mistake of checking the completion of action items. That is not the same thing as checking whether or not you have accomplished the goal!

Follow Up & Standardize

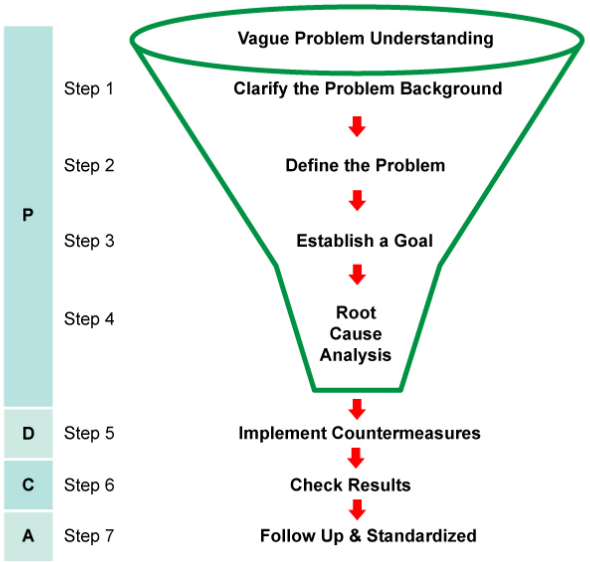


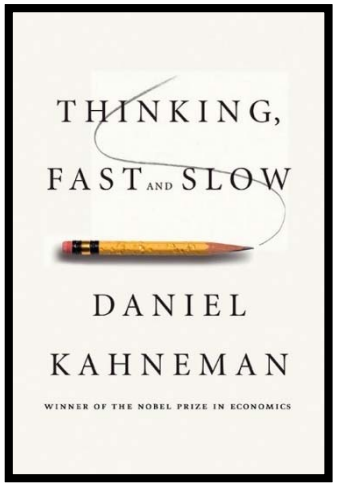
Follow Up & Standardize



WORK INSTRUCTIONS	FORMS	CHECKLISTS	AUDITS
SPARE PARTS	TRAINING	COMMUNICATION	MANUALS

Type 2 Summary



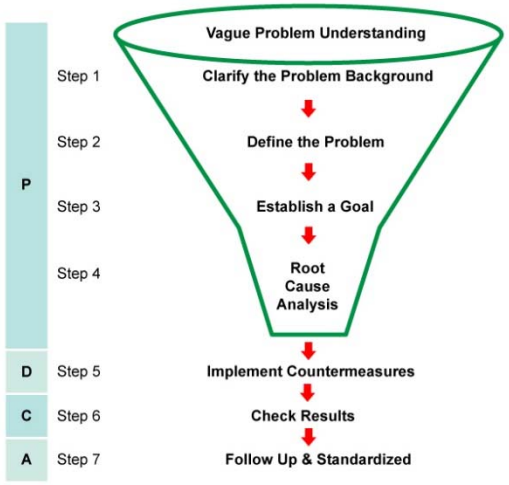


Type 1 Troubleshooting is about rapid action and response to the abnormal condition…an analogy is thinking fast.

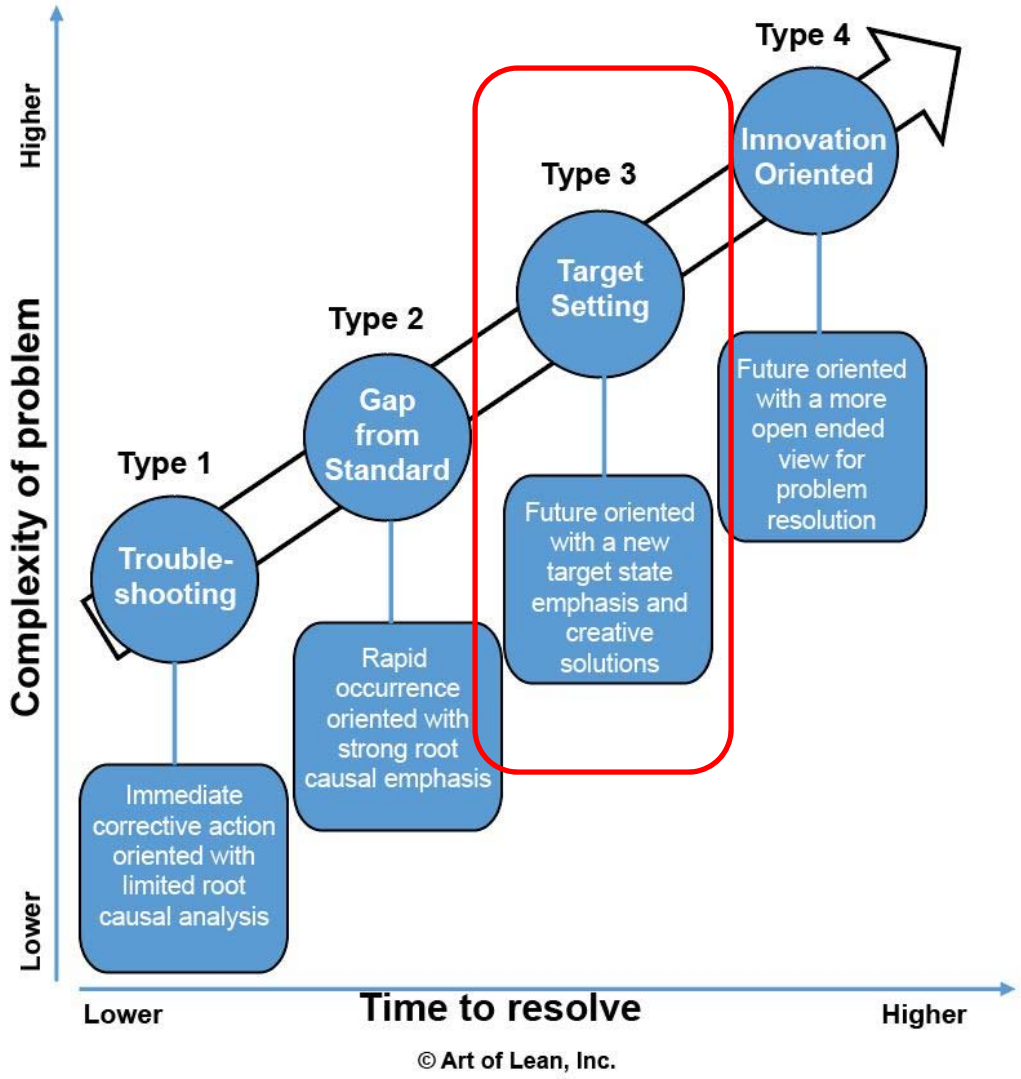
Type 2 Gap from standard problem solving is about being more deliberate and slowing down to consider what is the **real problem** or **root cause**…an analogy is thinking slow.

Homework Exercise

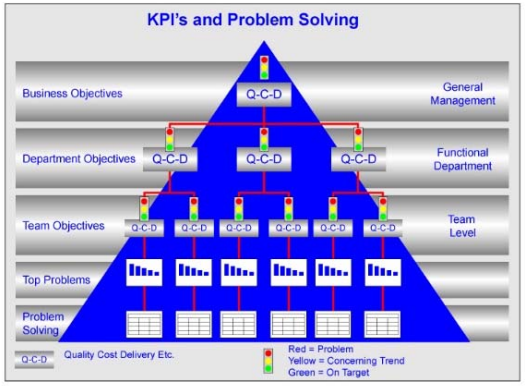
- Pick a problem that involves a gap from standard involving a KPI, or the annual performance plan.
- Execute Basic Steps
  1. Problem Background
  2. Problem Definition
  3. Set a Goal
  4. Root Cause Analysis
  5. Countermeasures
  6. Check Results
  7. Standardize & Follow Up



4 Types of Problem Situations



Type 3 – Target State



(Future) Ideal Situation

GAP

Acceptable (Current State) Situation

Normal Status

GAP

Current Situation

Type 3 - "Target State"

Type 2 - "Gap from Standard"

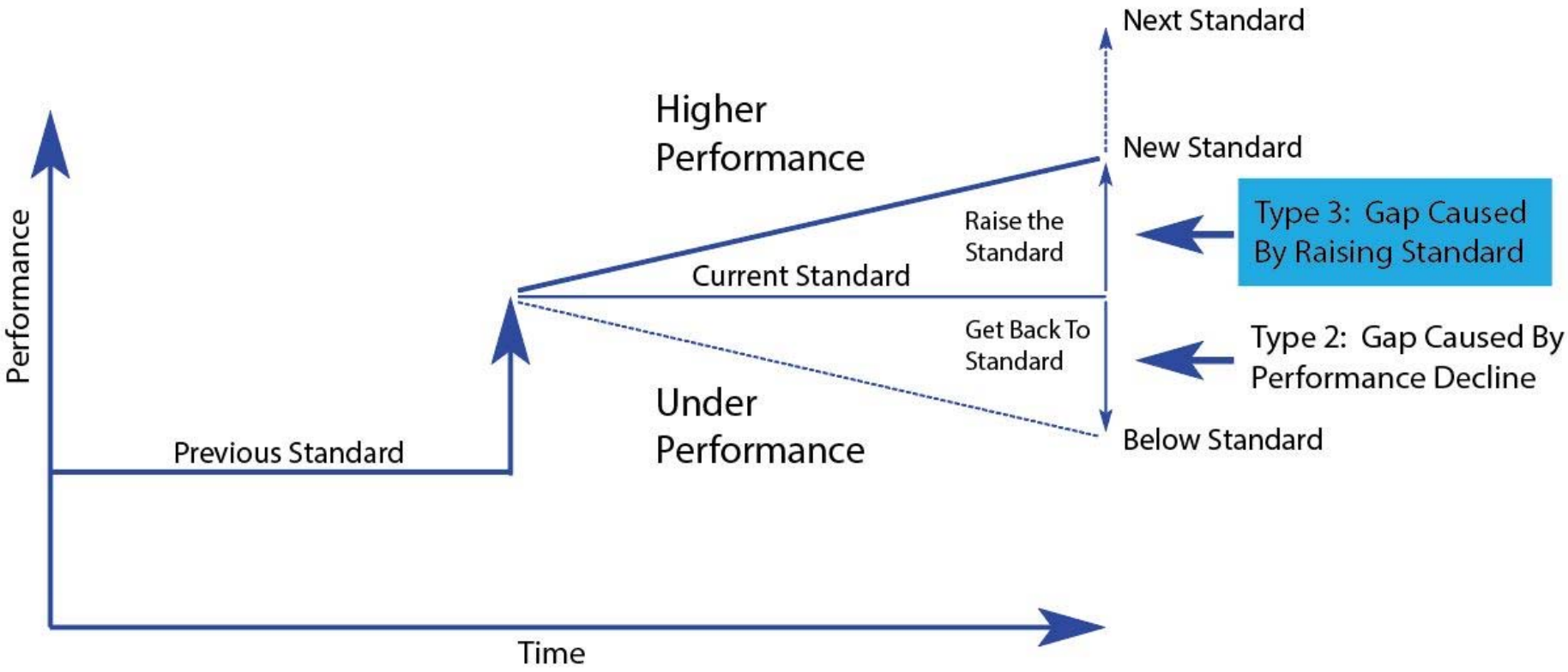
Kaizen Methods

改善方法

問題解決

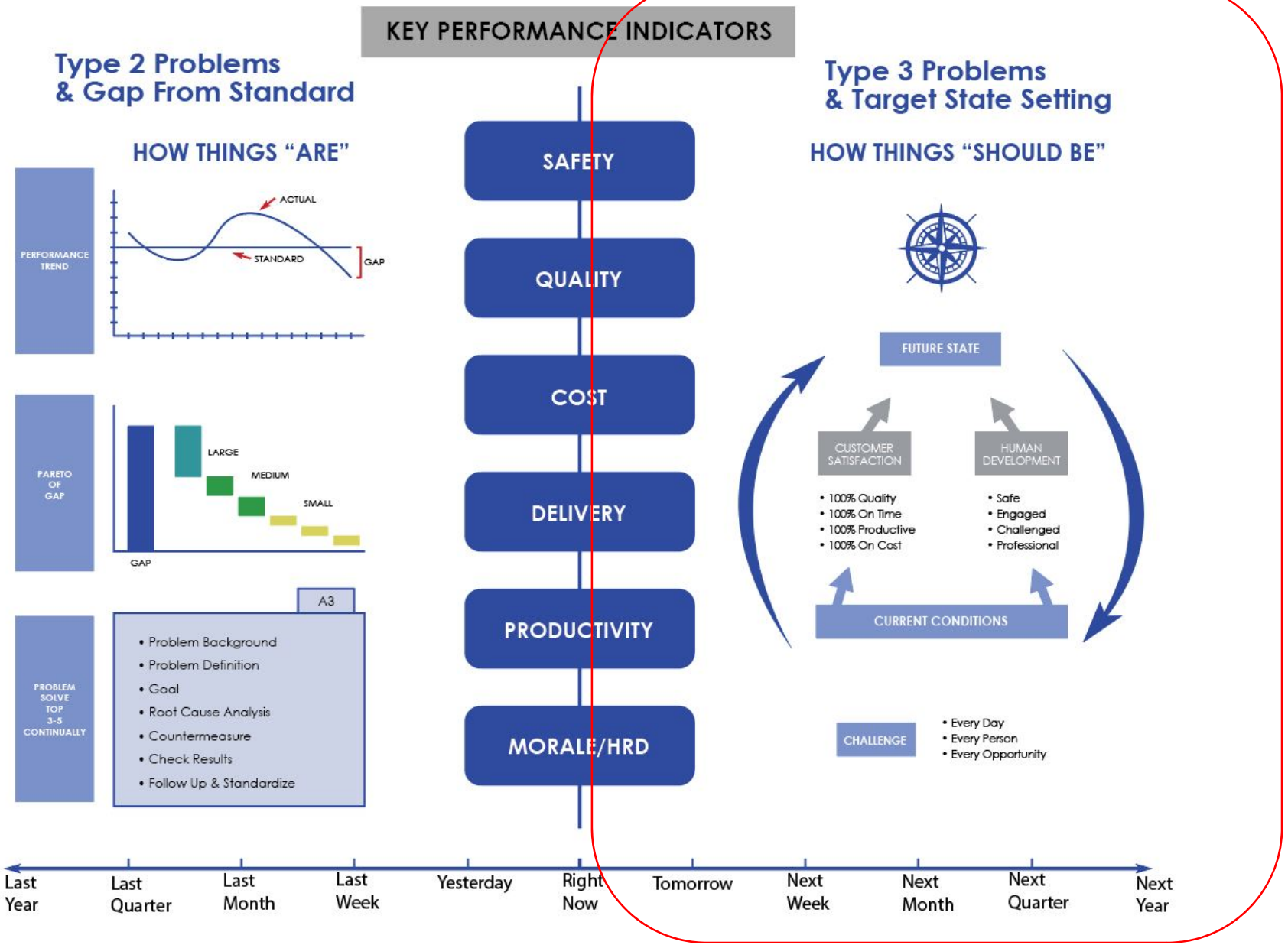
Problem Solving

Type 3 – Raise the Bar



Two Types of Thinking

Target State Concept (Time Frame)

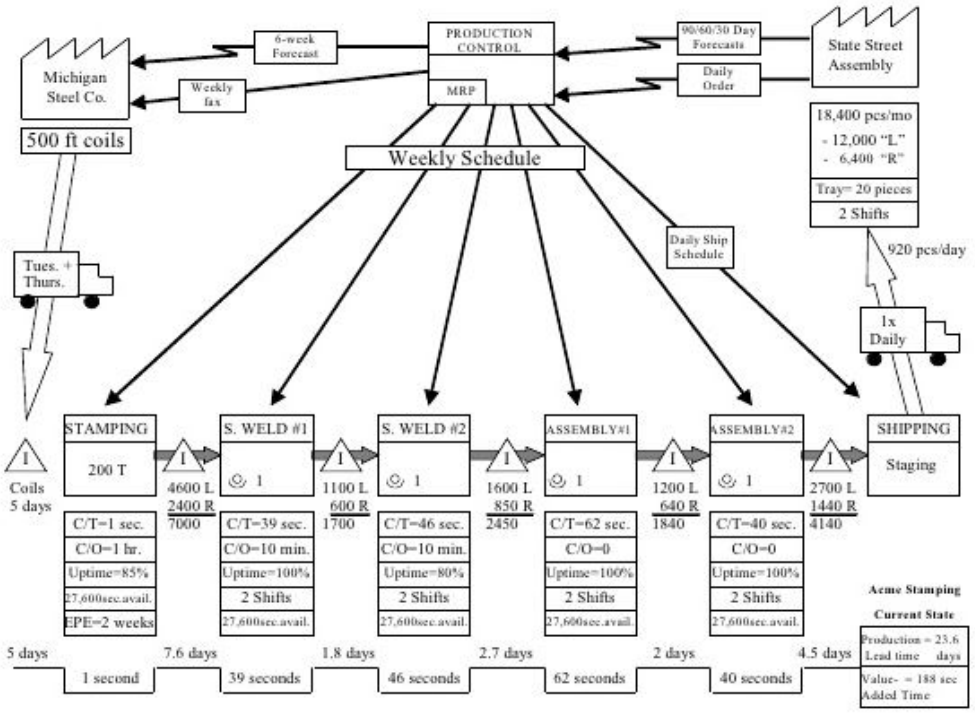


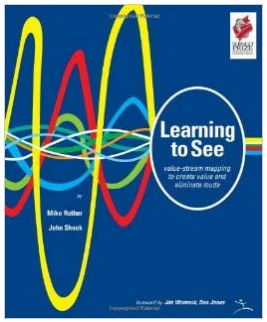
You Can Target State Anything!

- Products
- Processes
- Services
- Sports
- Metrics

But you have to think
and not just copy…

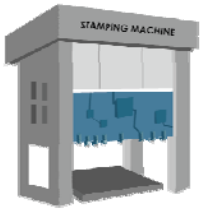
Value Stream Example





Multiple process flow depiction with emphasis on lead time reduction

Process Example SMED Example

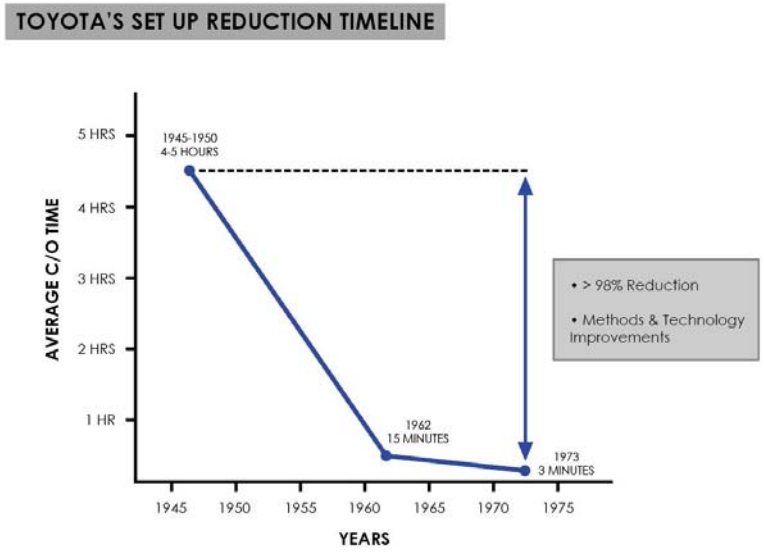


Dedicated Press
Part A

Dedicated Press
Part B

Dedicated Press
Part C

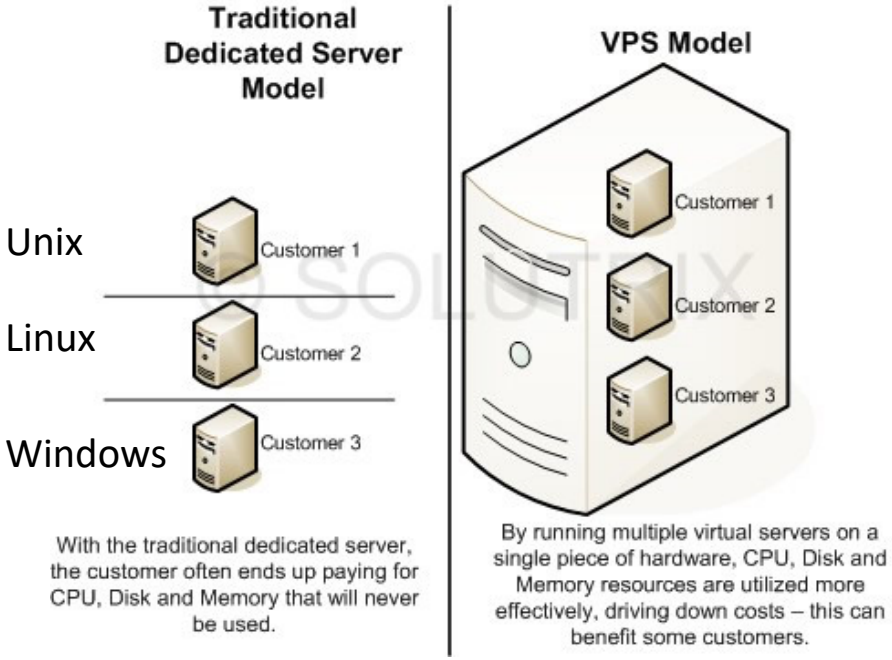
3 Dedicated Machines
No Flexibility
Each 30% Utilization
Make lots of inventory!



Flexible Press
Parts A, B, & C

1 Machine / 3+ Tools
Change Over Flexibility
90% Utilization
Run more JIT style

Software Example



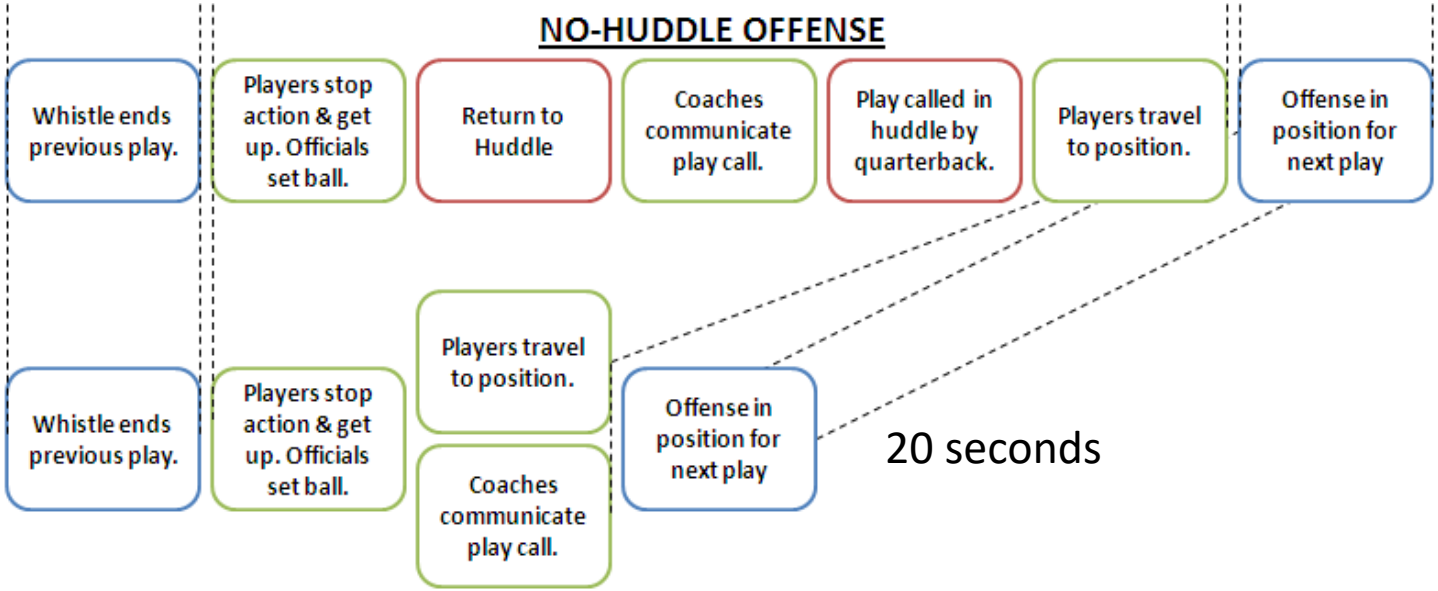
Same basic principle as SMED in die exchange…

Key here is not the time change over aspect but the software ability to act and host multiple server types…

3 Dedicated Servers
Each 30% utilized
No flexibility
Stranded resources

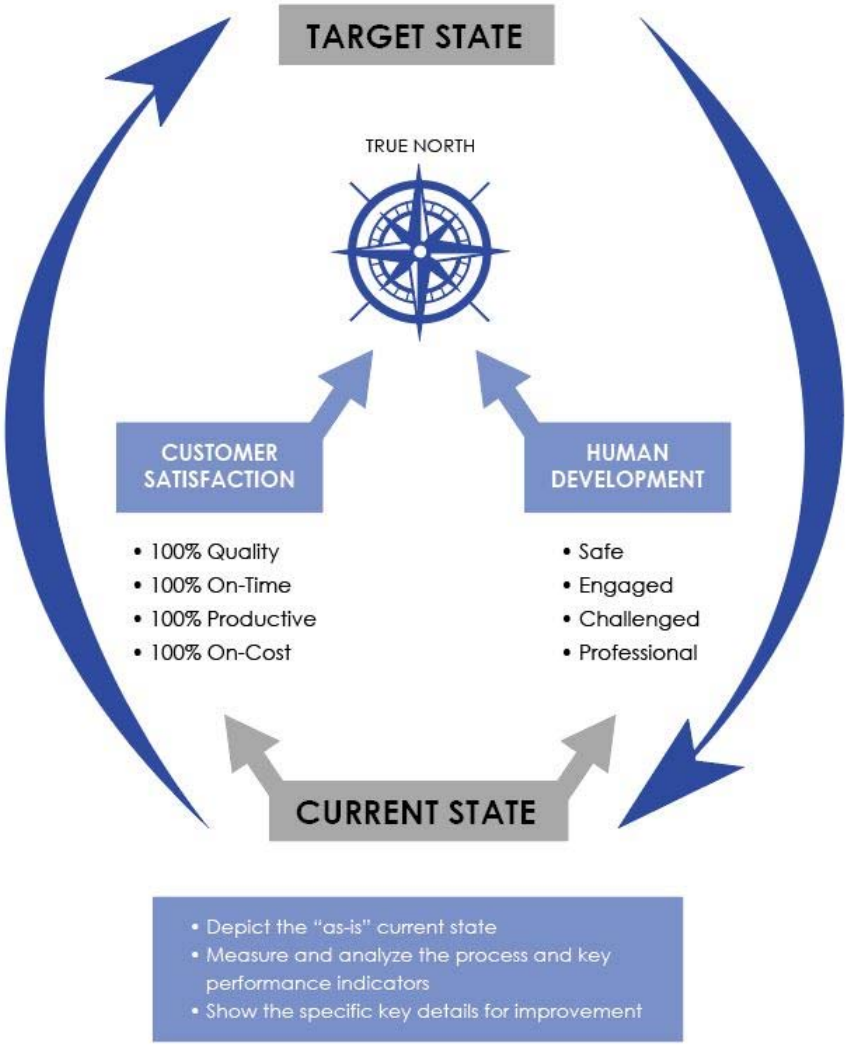
1 Virtual Server
Now 90% utilized
Flexibility
Less waste

Sports Example



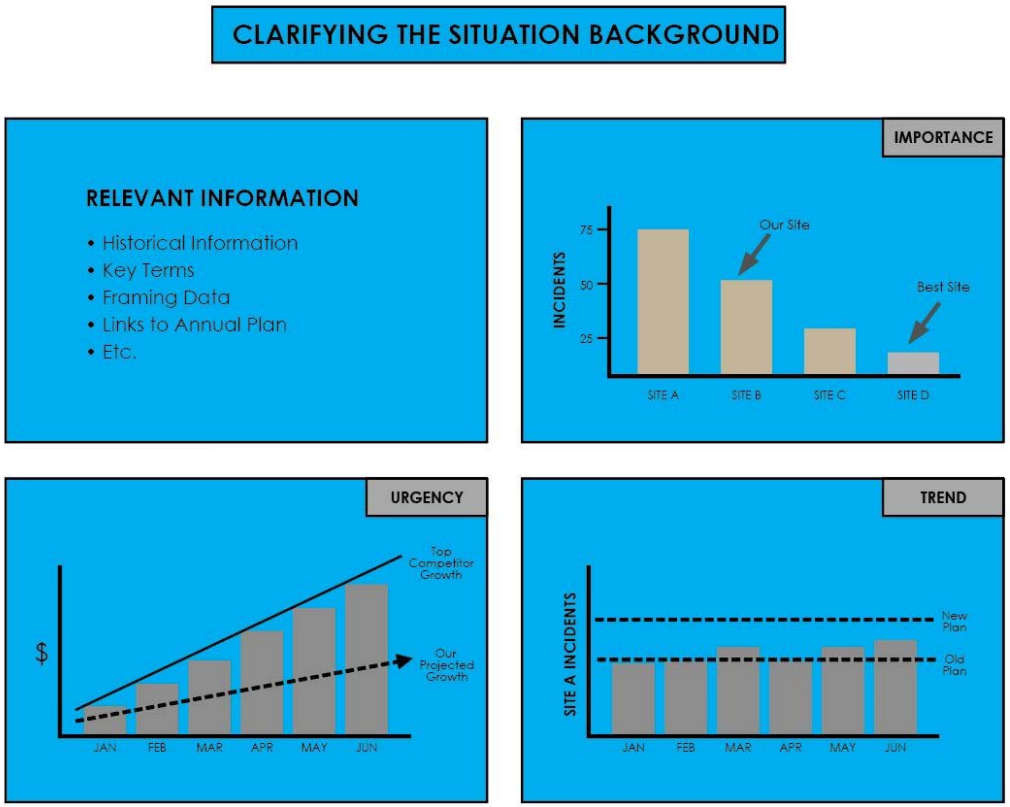
Also teams now run as many different plays as possible from one basic formation. SMED for sports.

Target State Improvement Steps



1	BACKGROUND
2	CURRENT STATE DEFINITION
3	CURRENT STATE ANALYSIS
4	GOALS
5	TARGET STATE DEFINITION
6	IMPLEMENTATION PLAN
7	CHECK RESULTS
8	FOLLOW-UP & STANDARDIZE

Background Situation



Generic Example

Purpose:

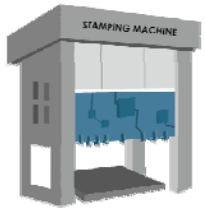
Provide context

Bigger picture

Relevant information

Logic for next sections

Current State Definition



Dedicated Press
Part A, B, C

Dedicated Press
Part D, E, F

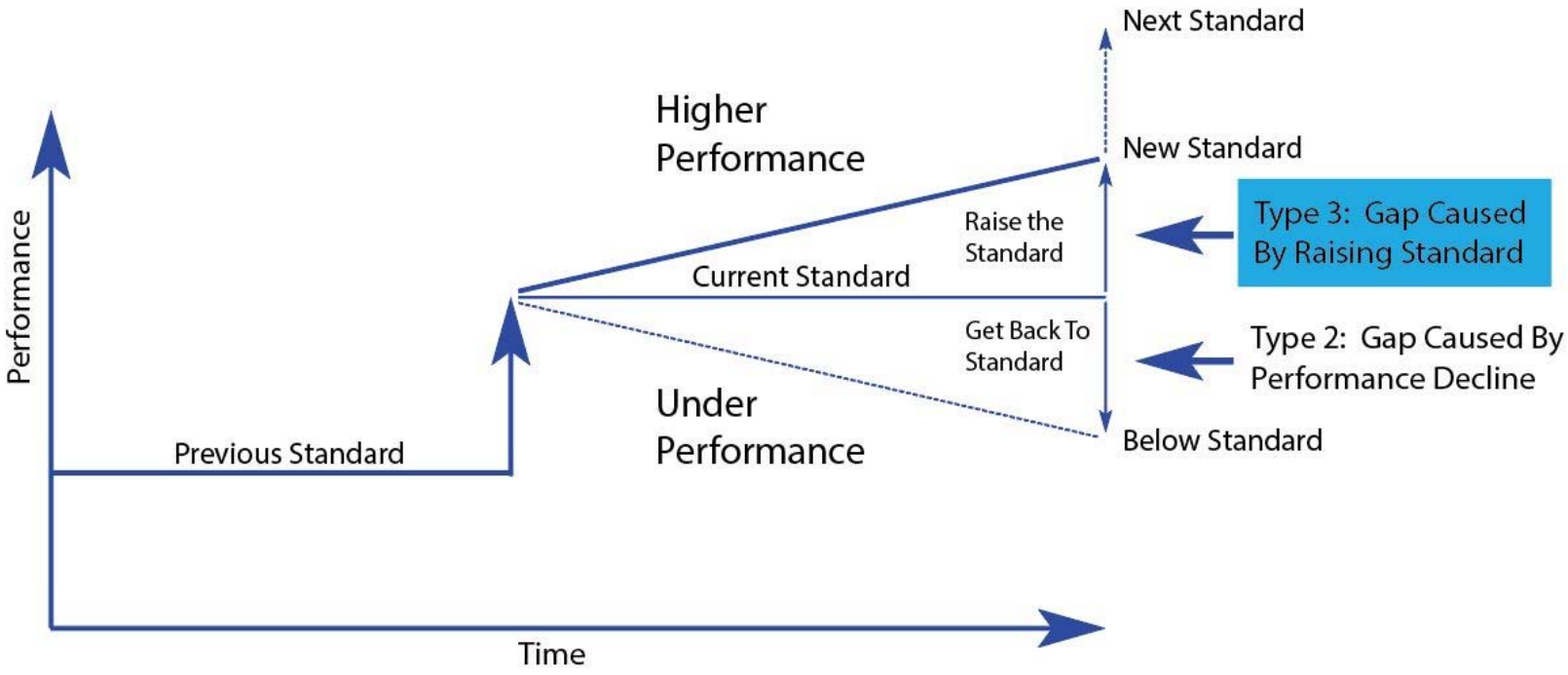
Dedicated Press
Part G, H, I

- Zero safety incidents
- 100% On-Time Delivery
- <1% Scrap
  Satisfied customers
- No major problems…

…However

- 3 Dedicated Machines
- Each 30% Utilization
- Minimal Flexibility
- 3 Underutilized Operators
- 75 Minute Changeover

Goal Setting



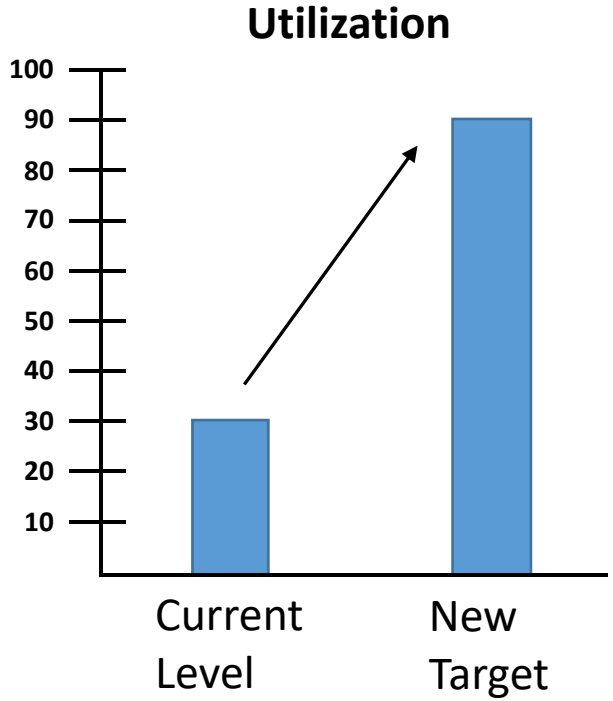
3 Consideration Points:

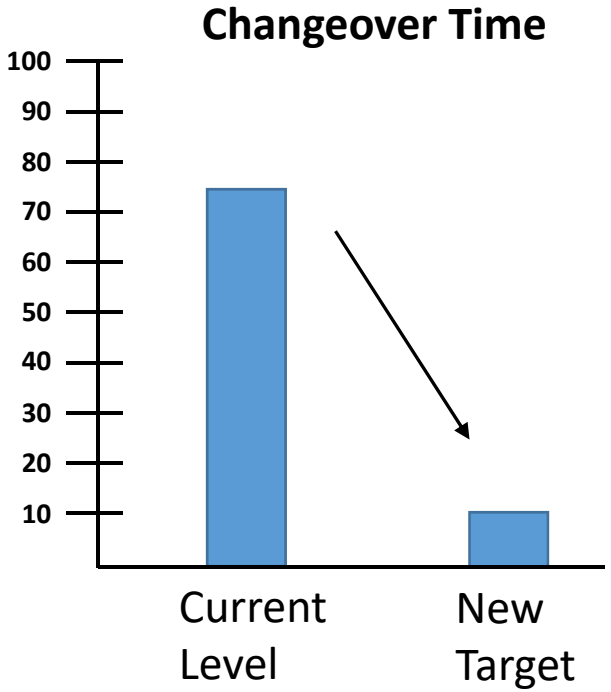
- From What Level
- To What Level
- By When

SMART Concept:

- Specific
- Measurable
- Actionable
- Relevant / Realistic
- Time Bound

Goal Setting

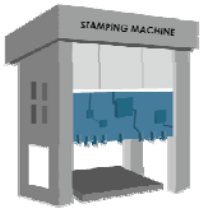




Improve utilization
From 30% to 90%
By July 15th, 2016

Reduce Set Up Time
From 75 Minutes to 10 Minutes
By July 15th, 2016

Current State Analysis

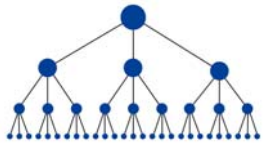


Dedicated Press
Part A, B, C

Dedicated Press
Part D, E, F

Dedicated Press
Part G, H, I

Analysis – Break it down

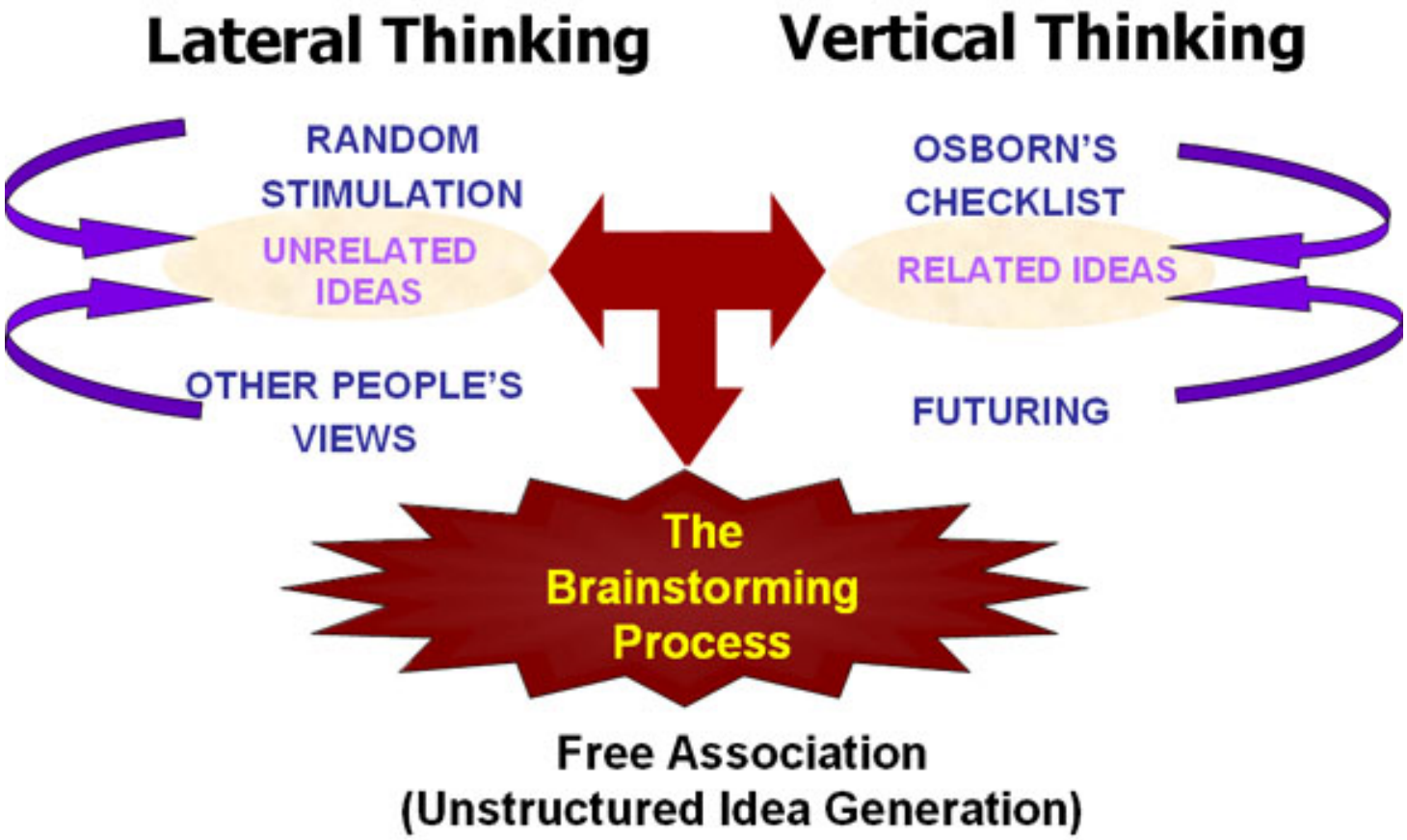


Quantify – Measure

Detail – Get specific facts

Two Types of Thinking

Idea Generation

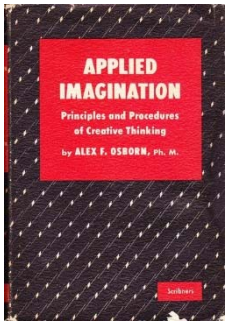


Brainstorming

Brainstorming is a group creativity technique by which efforts are made to find a conclusion for a specific problem by gathering a list of ideas spontaneously contributed by its members. The term was popularized by Alex Faickney Osborn in the 1953 book Applied Imagination.

Four Rules:

1) Seek quantity
2) Suspect judgement
3) Free association / wild ideas
4) Combine and improve ideas



Osborn / SCAMPER Checklist

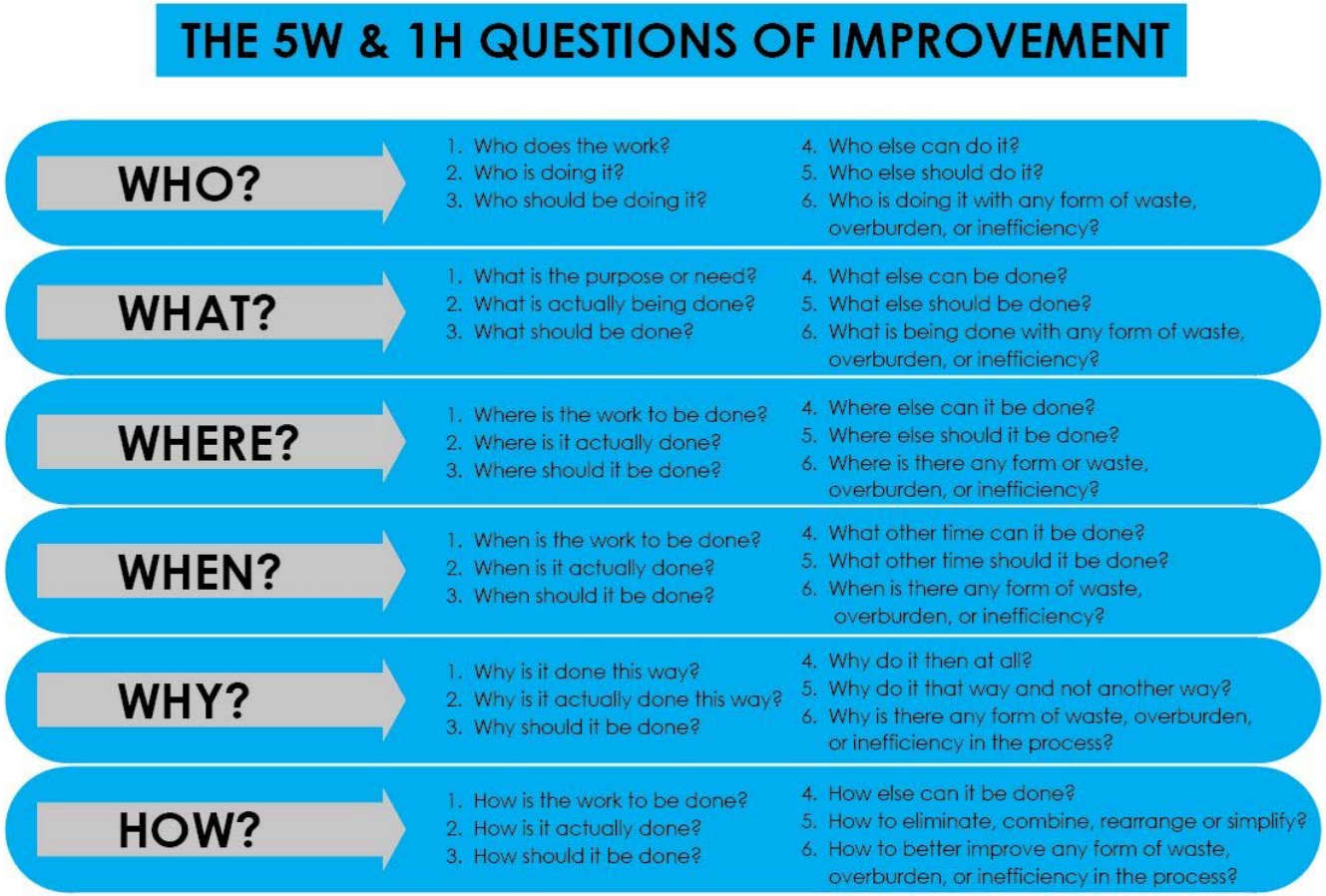
Scamper Questions

Item	Meaning	Example Questions
S	Substitute	What can you use instead? What components could change?
C	Combine	What can you add or put together? What can be combined into one?
A	Adapt	What can meet other needs? What can this also possible do?
M	Modify / Magnify / Minimize	What if you alter in some fashion? What if you make it larger? What if you make it smaller or lighter?
P	Put to other uses	What other uses might this serve? How might it benefit somewhere else?
E	Eliminate	What can be eliminated or taken away? What can be omitted?
R	Reverse / Rearrange	What if something was rearranged? What if something was reversed?

Others concepts to consider:

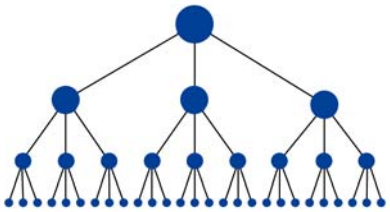
Simplify?
Error proof?
Standardize?
Synchronize?
Lighter?
Faster?
Efficient?

5W & 1H Improvement Q's



Set Up Reduction Time Analysis

PRODUCT LINE NAME		**SET UP REDUCTION WORKSHEET** (Work element analysis, time study, problem identification sheet)						
PRODUCTION PART NAME								
PROCESS NAME	MACHINE NAME				PART NUMBER			
NO.	MAIN SET UP (WORK ELEMENTS)	TIME STUDY			CATEGORY		IMPROVEMENT POINT	IMPROVEMENT IDEA
		START	END	TOTAL	INT.	EXT.		
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								



Analyze

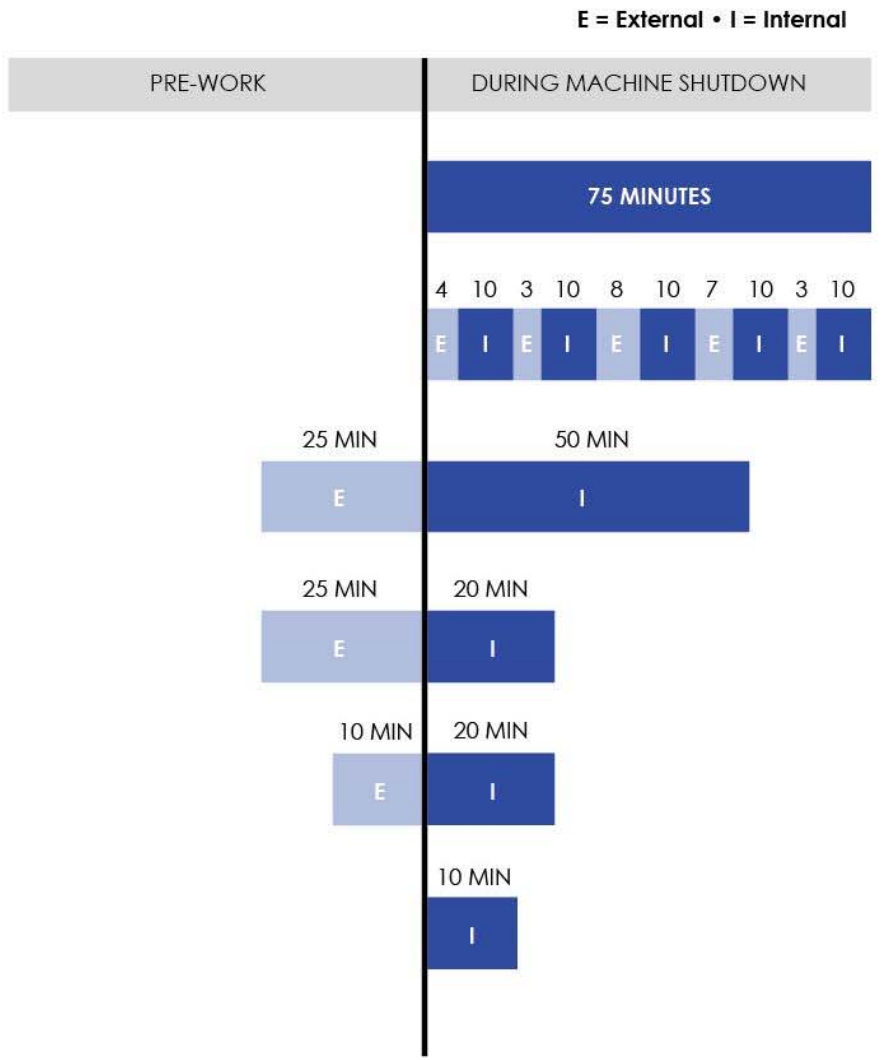
Quantify

Details

Set Up Reduction Time Analysis

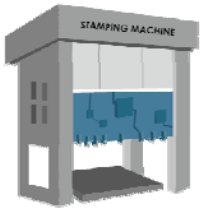
METHODS: CHANGEOVER REDUCTION STEPS

1	Measure total time required for changeover. Video tape is best.
2	Identify internal versus external elements and calculate individual times
3	Take the external elements and make sure they are done before the machine stops
4	Reduce and eliminate the internal elements (i.e. adjustments & fastener items in particular)
5	Reduce the time required for external elements
6	Standardize and improve the new procedure over time



Target State Definition

From:



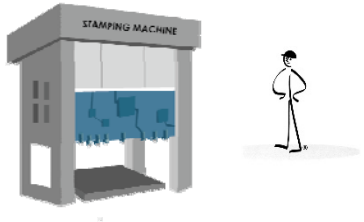
Dedicated Press
Part A, B, C

Dedicated Press
Part D, E, F

Dedicated Press
Part G, H, I

3 Dedicated Machines
3 Operators
No Flexibility
Each 30% Utilization
75 Minute C/O

To:



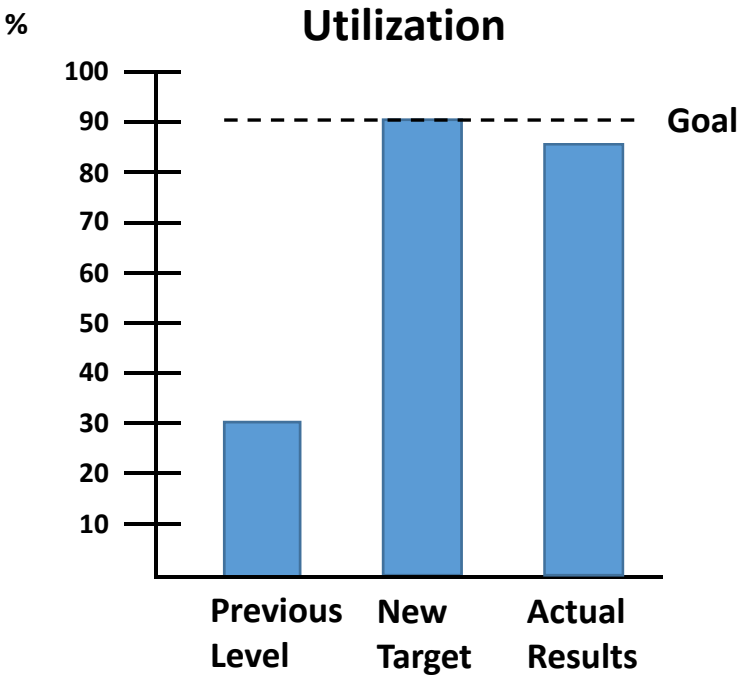
Flexible Press
Parts A, B, C, D, E, F, G, H, I
On Demand / Any Sequence

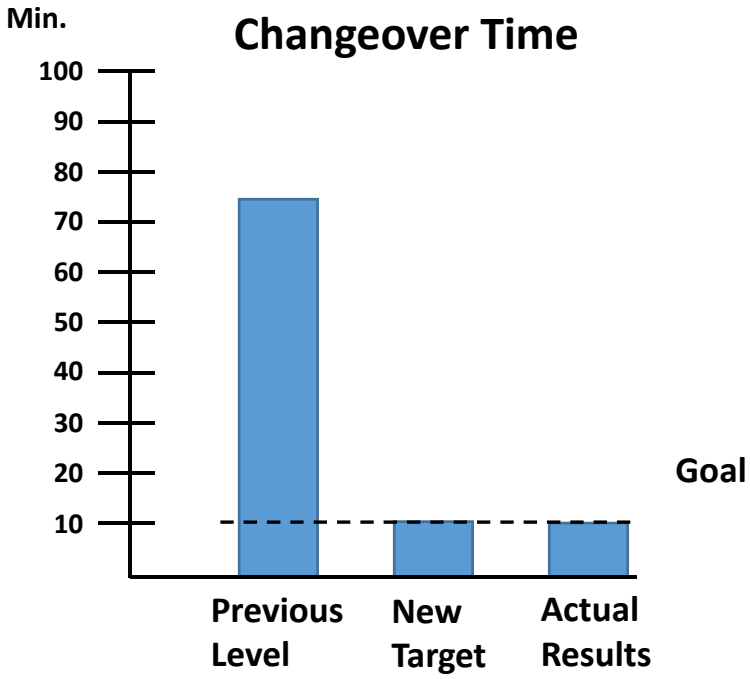
1 Machine / 9+ Tools
1 Operator
Change Over Flexibility
90% Utilization
10 Minute C/O

Implementation Plan

What Item	Who's Responsible	Due Date	Expected Outcome	Status Review (June 25th IPR)
Eliminate bolts & switch to clamps	Tom M.	June 20th	Time savings of 28 minutes	Complete. First trial showed 9 minute gain.
Preheat dies	Jeff R.	June 16th	Time savings of 22 minutes First part quality	Complete. First trial showed 10 minute gain.
Standardize hoses, manifold connectors, & quick disconnect	Kathy L.	June 25th	Time savings of 8 minutes	Complete. First trial showed 11 minute gain.
Create set up cart & 5S tool board	Tom M.	June 22nd	Time saving of 7 minutes	Complete. First trial showed 5 minute gain.
Alignment aids for die insertion	Jeff R.	June 16th	Work simplification & visual management	Confirmed easier die insertion.
Create new work instructions	Kathy L.	June 26th	Training document	Not complete yet.
Train all operators across 3 shifts	Kathy L.	June 30th	Same result each shift	Pending completion of new work instruction.

Check Results



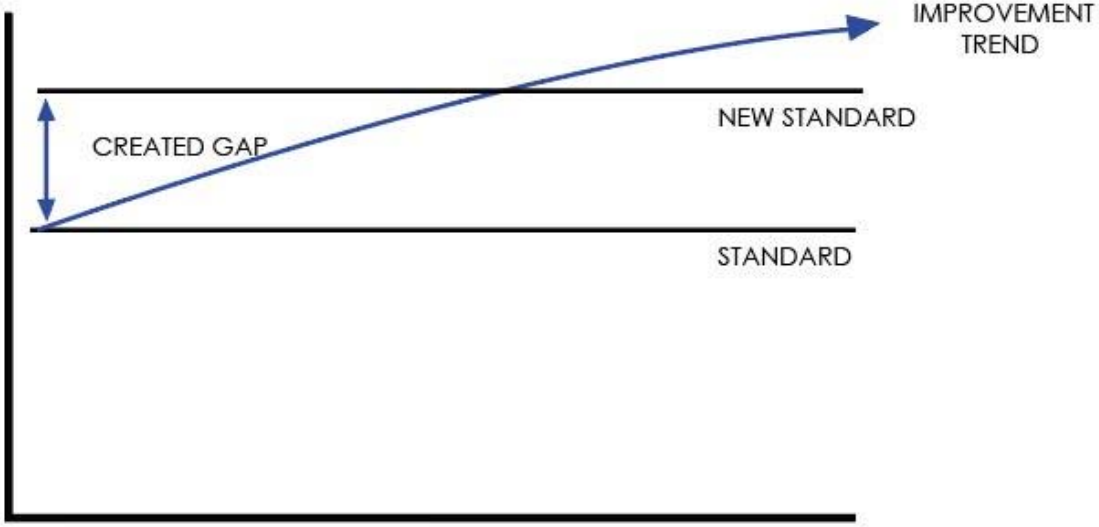


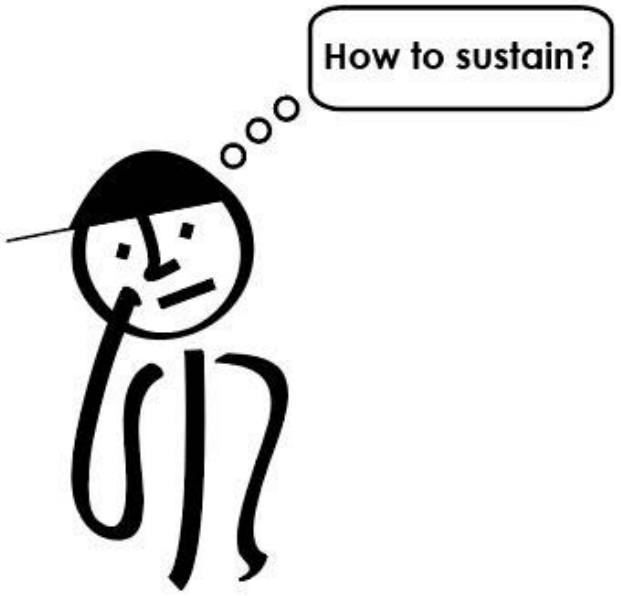
Did not achieve goal yet.
Small gap or problem remains.
Follow up & resolve

Successfully achieved goal.
Will focus on sustainment.
Follow up & sustain

Follow Up & Standardize

STANDARDIZE & FOLLOW UP





WORK INSTRUCTIONS	FORMS	CHECKLISTS	AUDITS
SPARE PARTS	TRAINING	COMMUNICATION	MANUALS

Set Up Reduction

METHODS: CHANGEOVER REDUCTION STEPS

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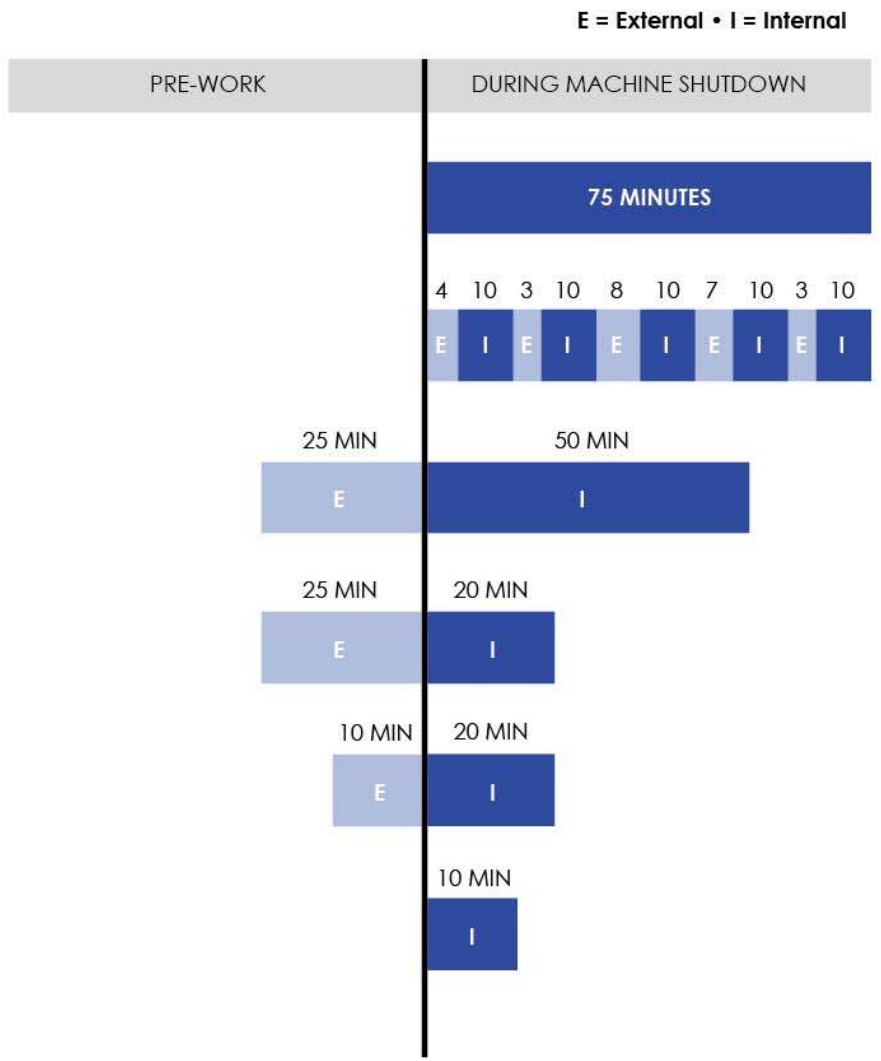
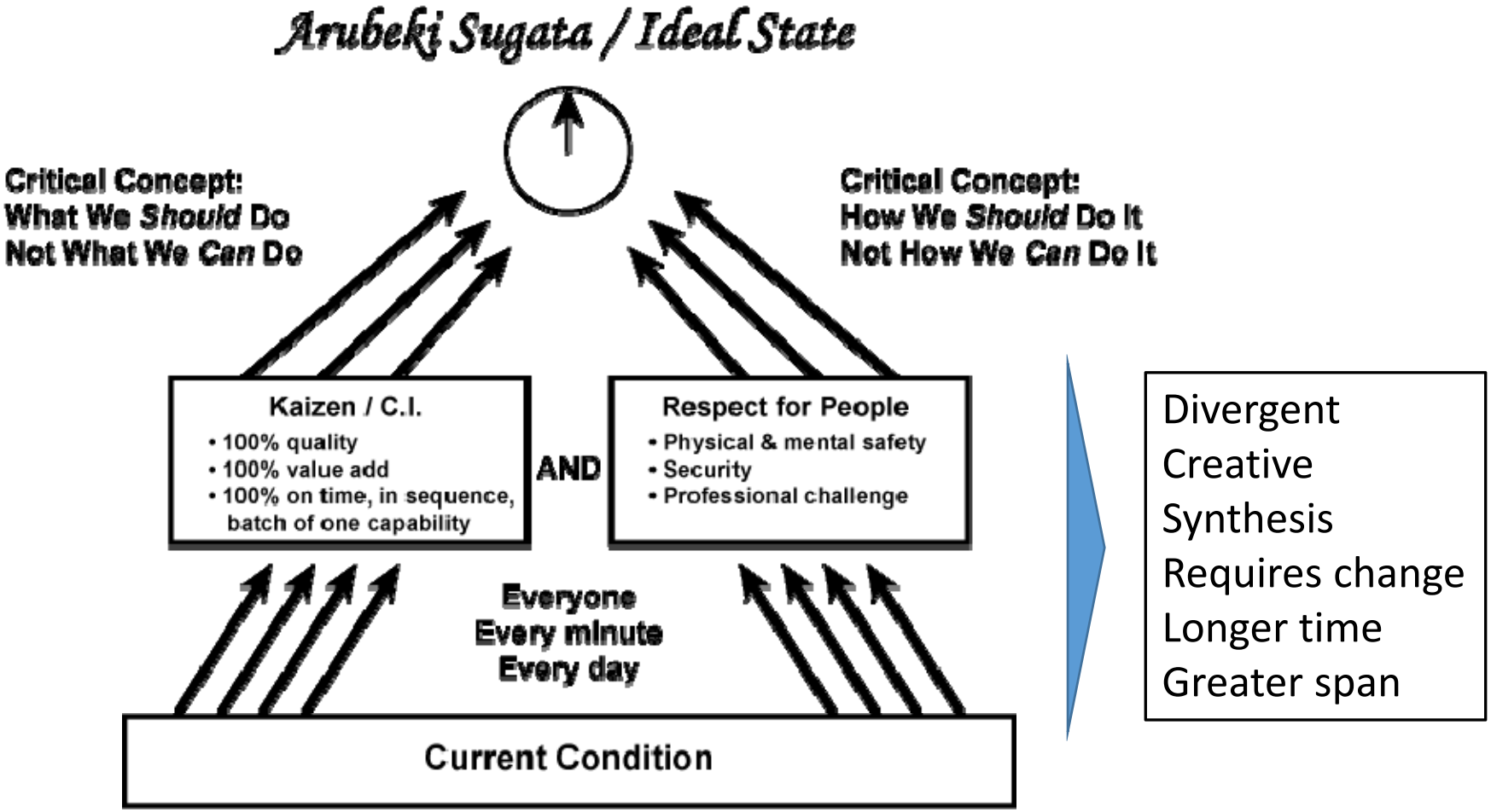


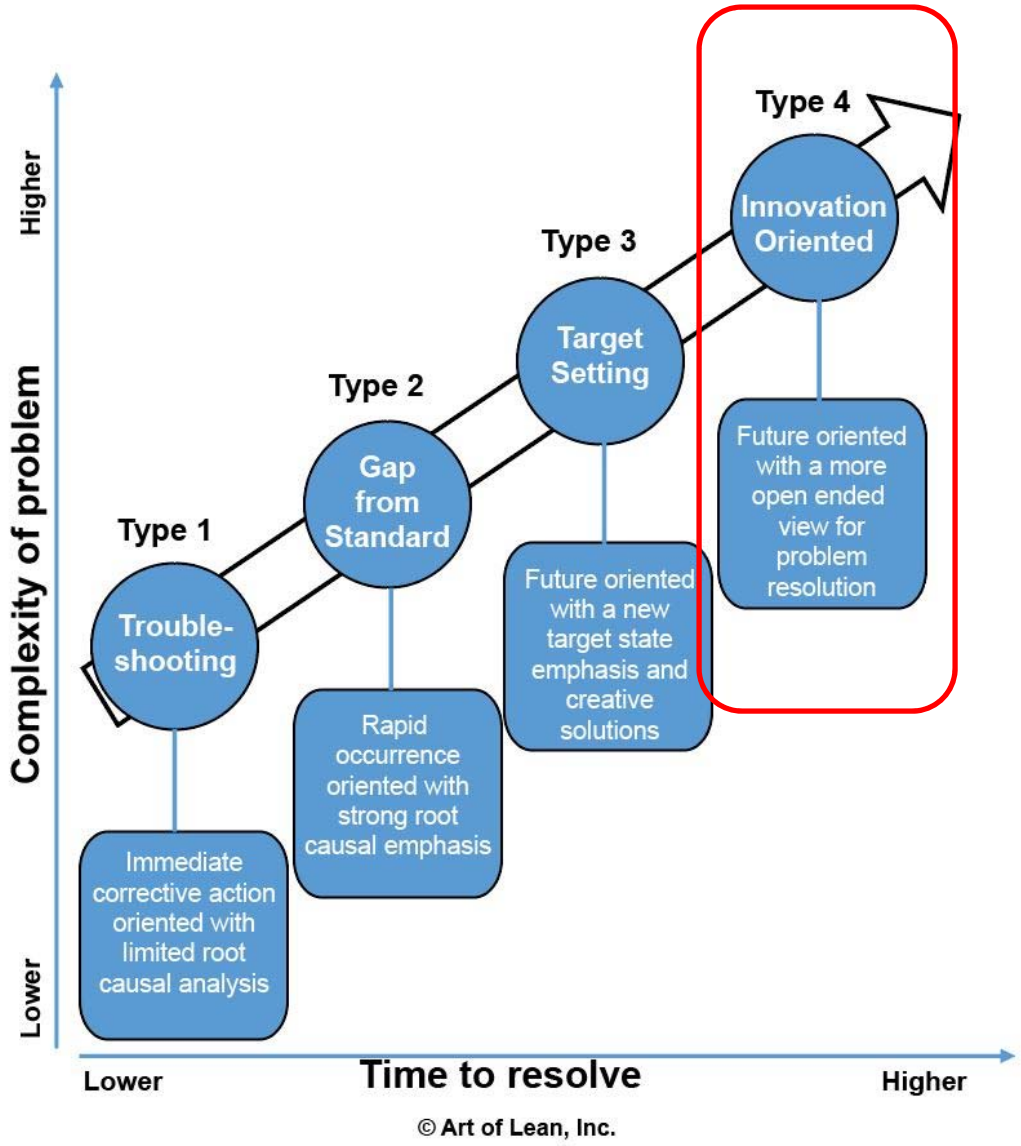
Type 3 Summary

- Type 1 & 2 Problem Solving: Defense
- Type 3 & 4 Problem Solving: Offense
- Type 3 Key Success Factors
  - Challenge, Courage, & Creativity
  - Openness to exploration
  - PDCA Loop iteration
  - Rapid experimentation
  - Learning by doing
- Good luck on your improvement journey!

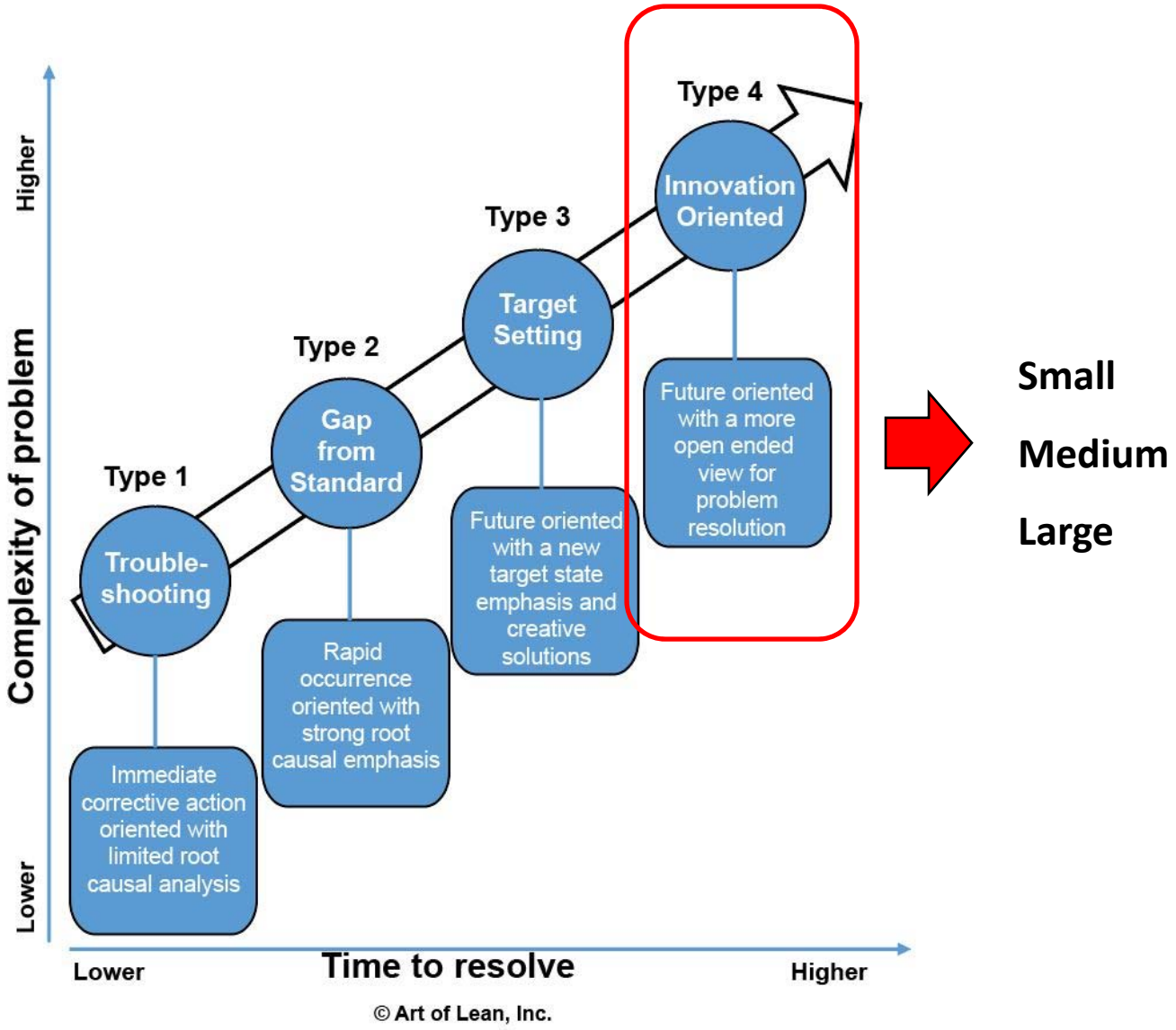
Type 3 – Target State Summary



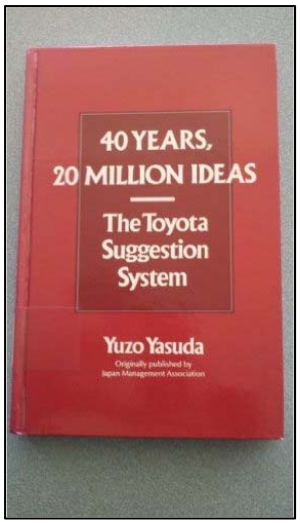
4 Types of Problem Situations



4 Types of Problem Situations



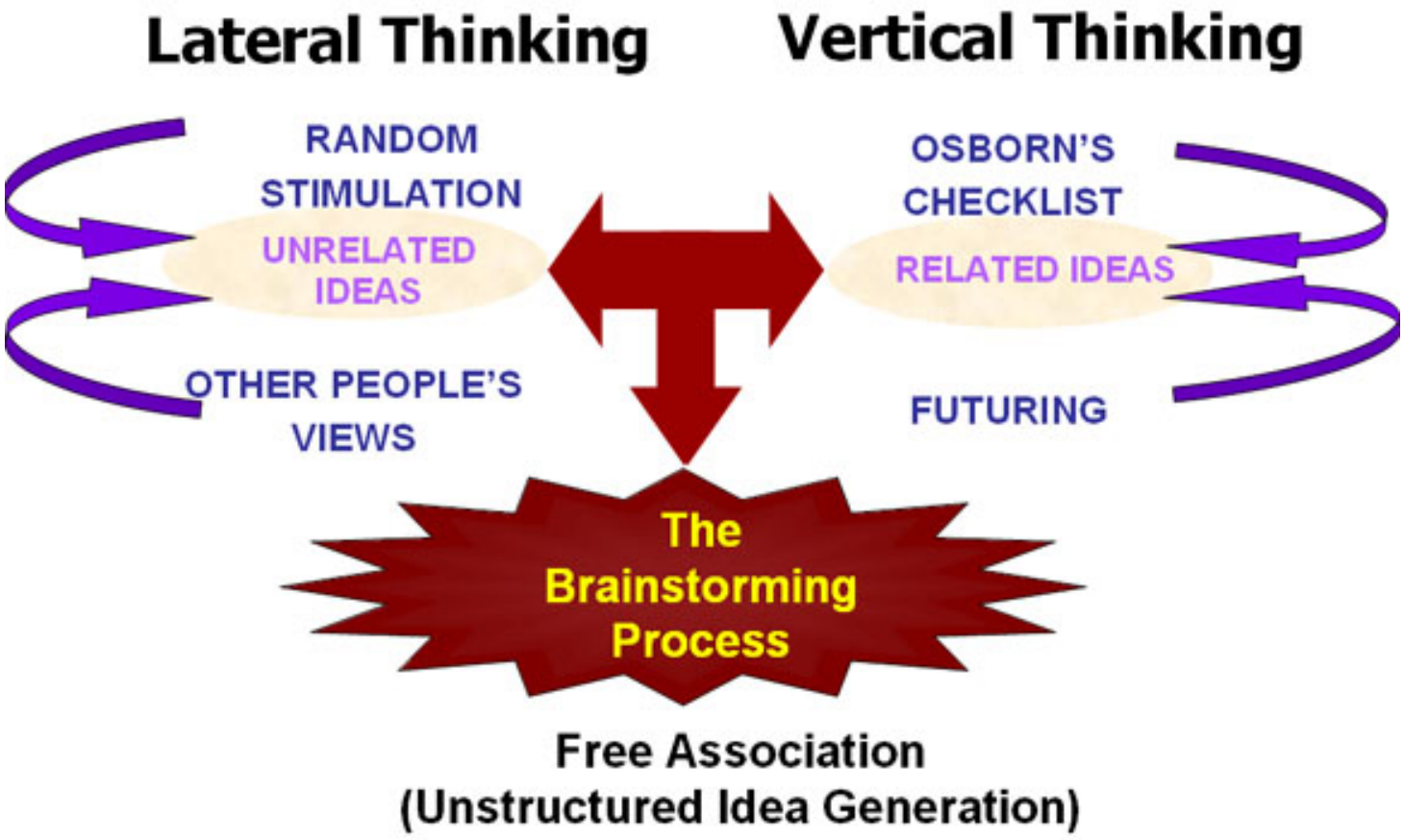
Toyota Suggestion System 1951



The system was introduced by Managing Director Eiji Toyoda in 1951 when it became clear during the post Second World War economic recovery that Toyota's production facilities needed improvement. Toyoda took the idea of TCISS (the creative ideas suggestion system) from a Ford Motor Company plant which he had visited in July 1950.

Although the TCISS offered incentives to employees, the real value of the system was that it provided motivation to employees by focusing on their skills and creativity. The TCISS systemized the practices that had been customary since the time of Toyota Motor Corporation founder Kiichiro Toyoda: respecting opinions from production and sales and conducting spontaneous on-site inspections while simultaneously inviting suggestions for improvements.

Lateral and Vertical Thinking



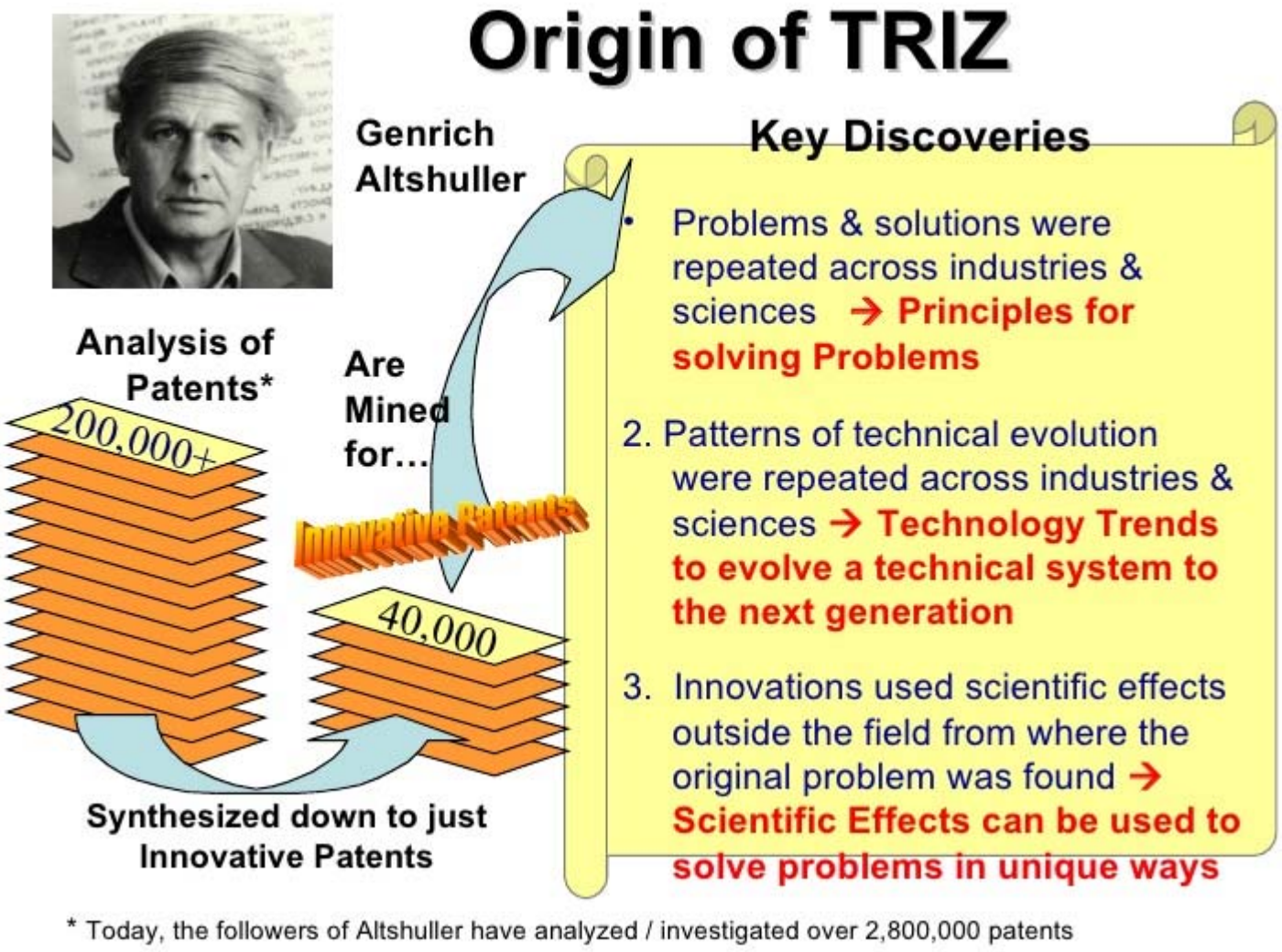
Brainstorming

Brainstorming is a group creativity technique by which efforts are made to find a conclusion for a specific problem by gathering a list of ideas spontaneously contributed by its members. The term was popularized by Alex Faickney Osborn in the 1953 book Applied Imagination.

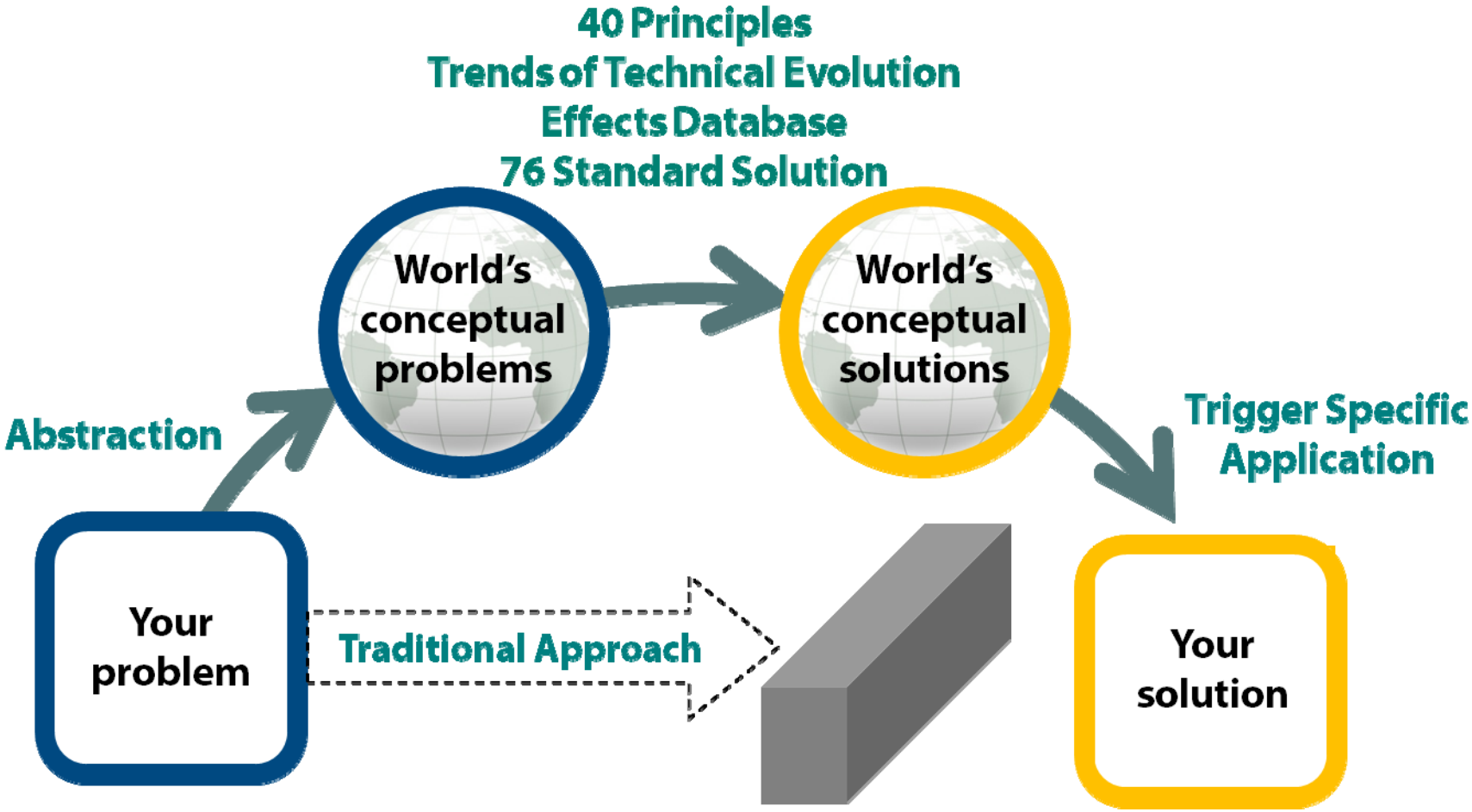
Four Rules:

1) Seek quantity
2) Suspect judgement
3) Free association / wild ideas
4) Combine and improve ideas

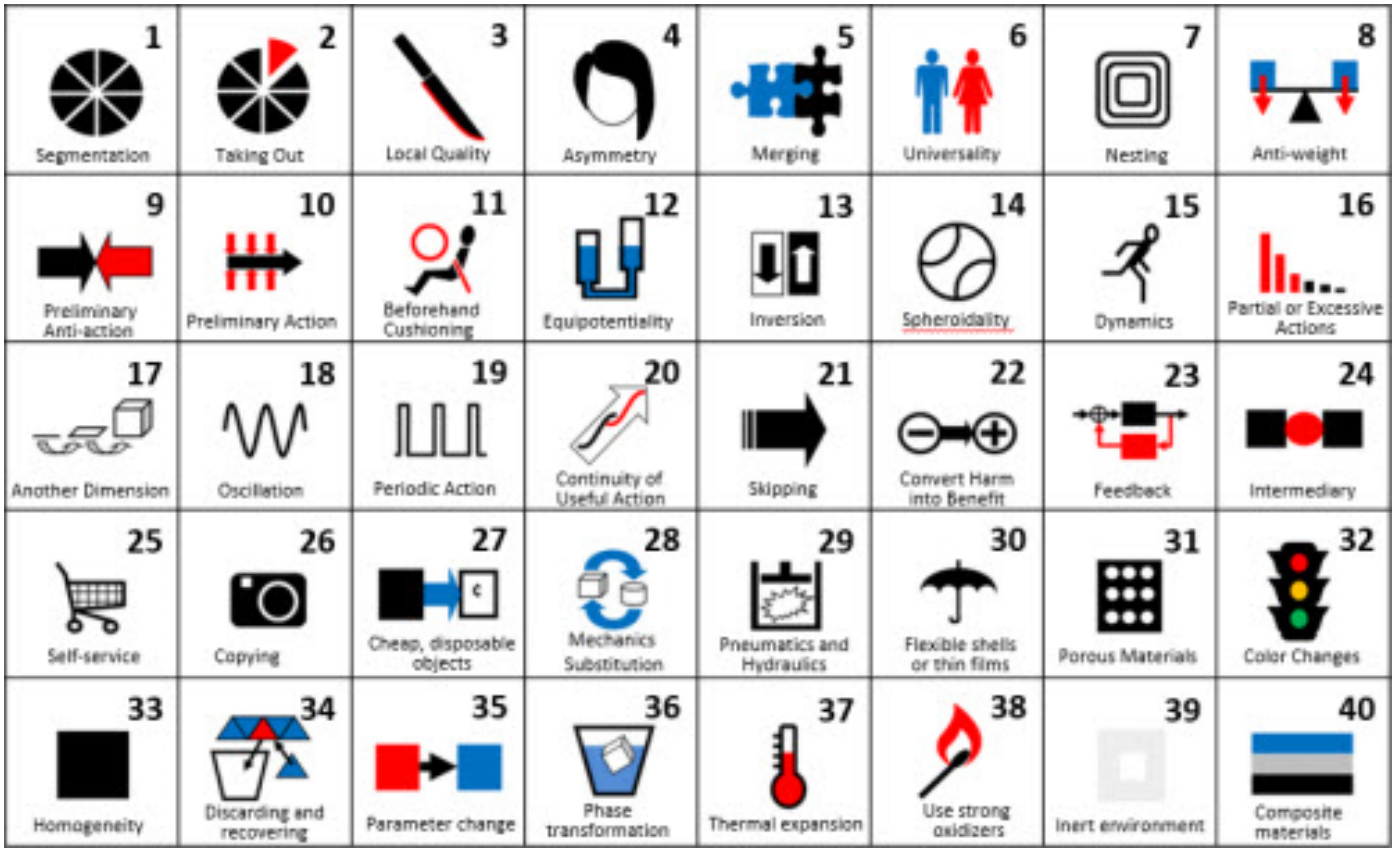
TRIZ / TIPS


Origin of TRIZ
Genrich Altshuller
Key Discoveries
• Problems & solutions were repeated across industries & sciences → Principles for solving Problems
2. Patterns of technical evolution were repeated across industries & sciences → Technology Trends to evolve a technical system to the next generation
3. Innovations used scientific effects outside the field from where the original problem was found → Scientific Effects can be used to solve problems in unique ways
Analysis of Patents*
Are Mined for…
200,000+
Innovative Patents
40,000
Synthesized down to just Innovative Patents
* Today, the followers of Altshuller have analyzed / investigated over 2,800,000 patents

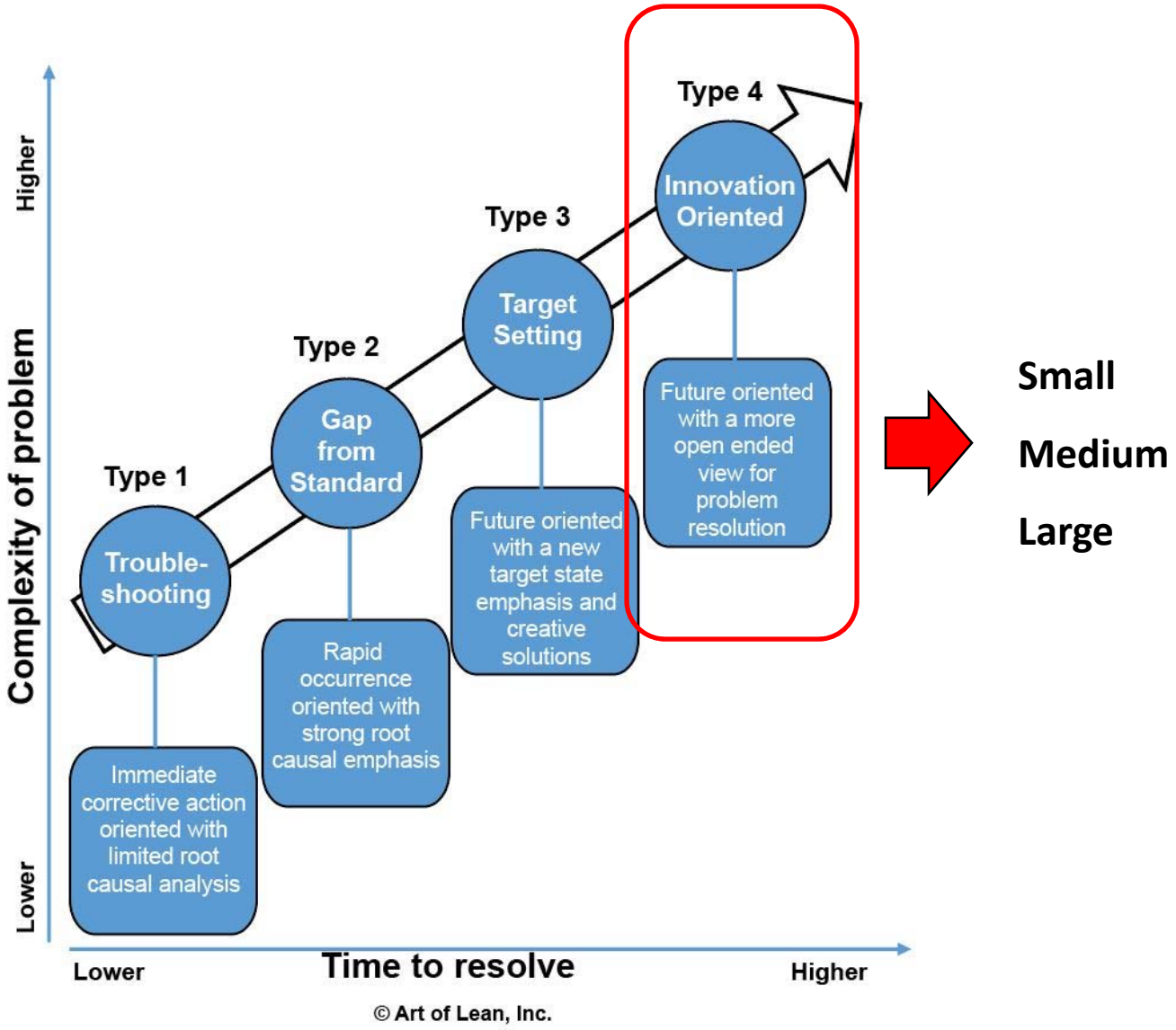
TRIZ / TIPS


40 Principles
Trends of Technical Evolution
Effects Database
76 Standard Solution
World's conceptual problems
World's conceptual solutions
Abstraction
Trigger Specific Application
Your problem
Traditional Approach
Your solution

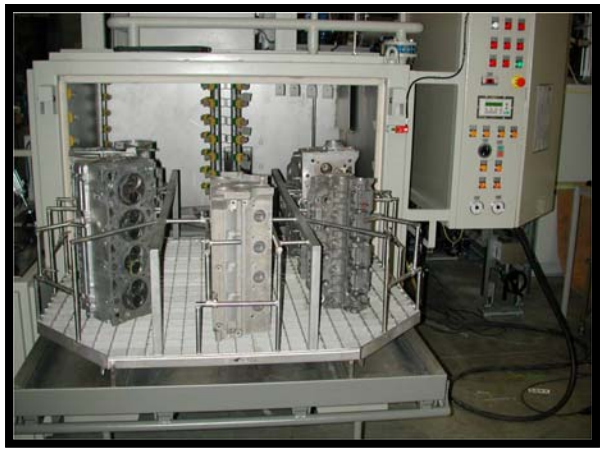
TRIZ / TIPS


1 Segmentation
2 Taking Out
3 Local Quality
4 Asymmetry
5 Merging
6 Universality
7 Nesting
8 Anti-weight
9 Preliminary Anti-action
10 Preliminary Action
11 Beforehand Cushioning
12 Equipotentiality
13 Inversion
14 Spheroidality
15 Dynamics
16 Partial or Excessive Actions
17 Another Dimension
18 Oscillation
19 Periodic Action
20 Continuity of Useful Action
21 Skipping
22 Convert Harm into Benefit
23 Feedback
24 Intermediary
25 Self-service
26 Copying
27 Cheap, disposable objects
28 Mechanics Substitution
29 Pneumatics and Hydraulics
30 Flexible shells or thin films
31 Porous Materials
32 Color Changes
33 Homogeneity
34 Discarding and recovering
35 Parameter change
36 Phase transformation
37 Thermal expansion
38 Use strong oxidizers
39 Inert environment
40 Composite materials

4 Types of Problem Situations



Washer Process Innovation



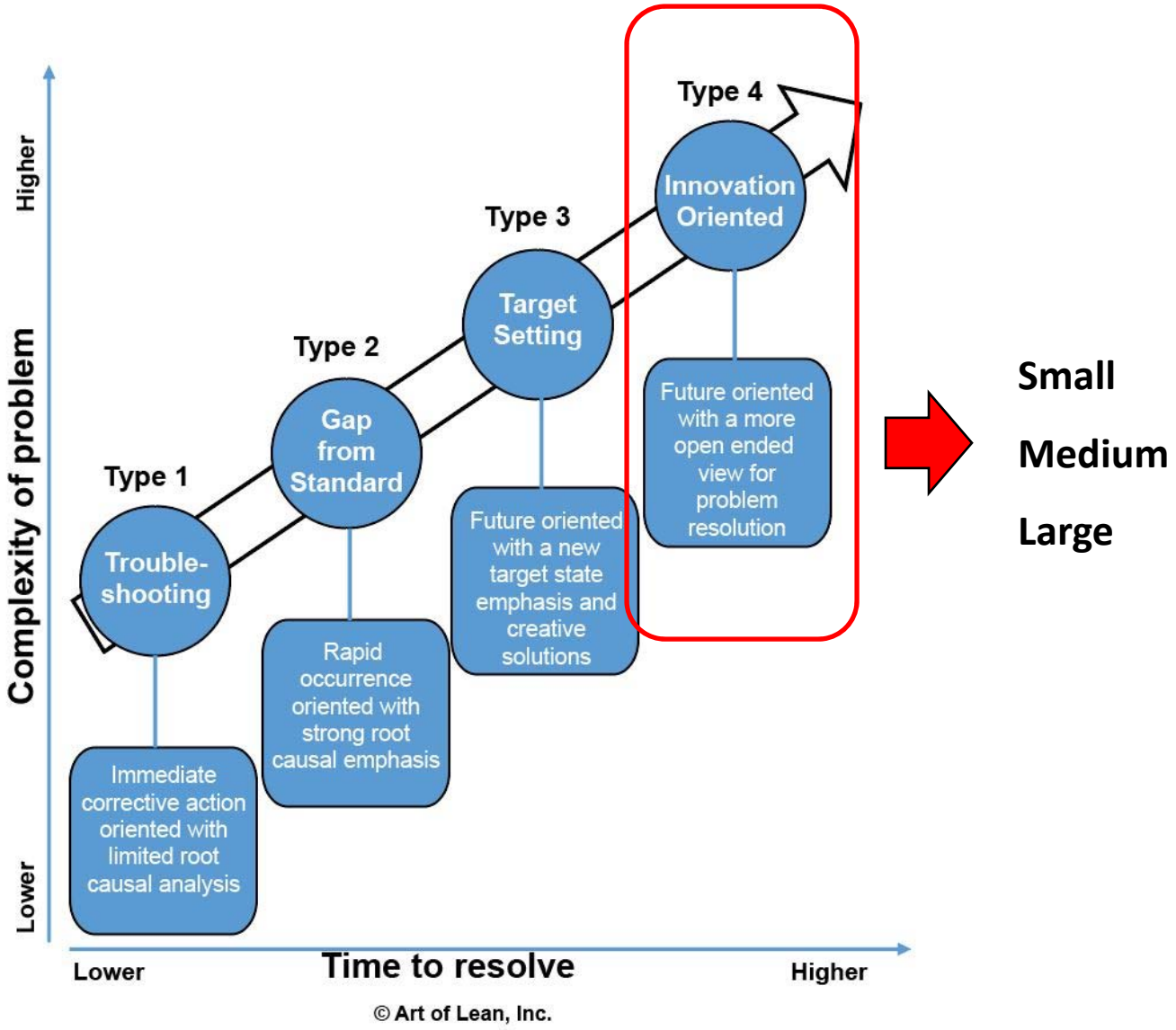
Entry View

Front View

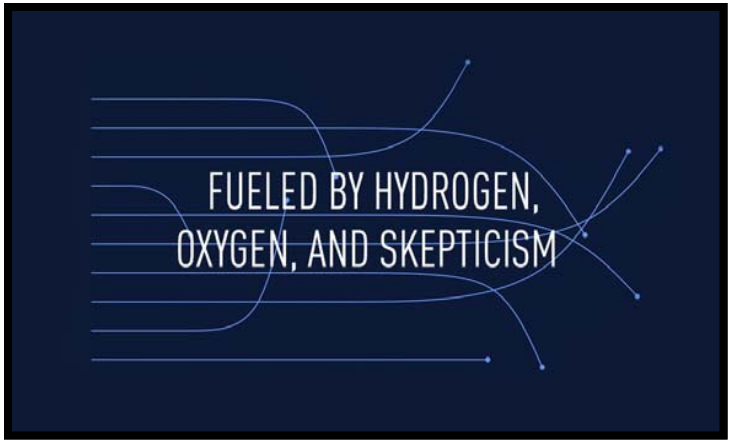
Employee Improvement Idea

- “It occurred to me that the thought of putting the cylinder head through a large box shaped industrial washer was inherently a bad idea…blasting it from the outside with dozens of high pressure nozzles only pushed some cutting chips, dirt, and contaminants father into the holes and ports, etc.”
- “It also occurred to me that just dunking the cylinder head into a series of 55 gallon sized dunk tanks via a robotic arm would work better. Plunging action into the tank with an agitator style of motion would drop the chips and contaminants out with less time, energy, cost, maintenance, and higher end quality…”

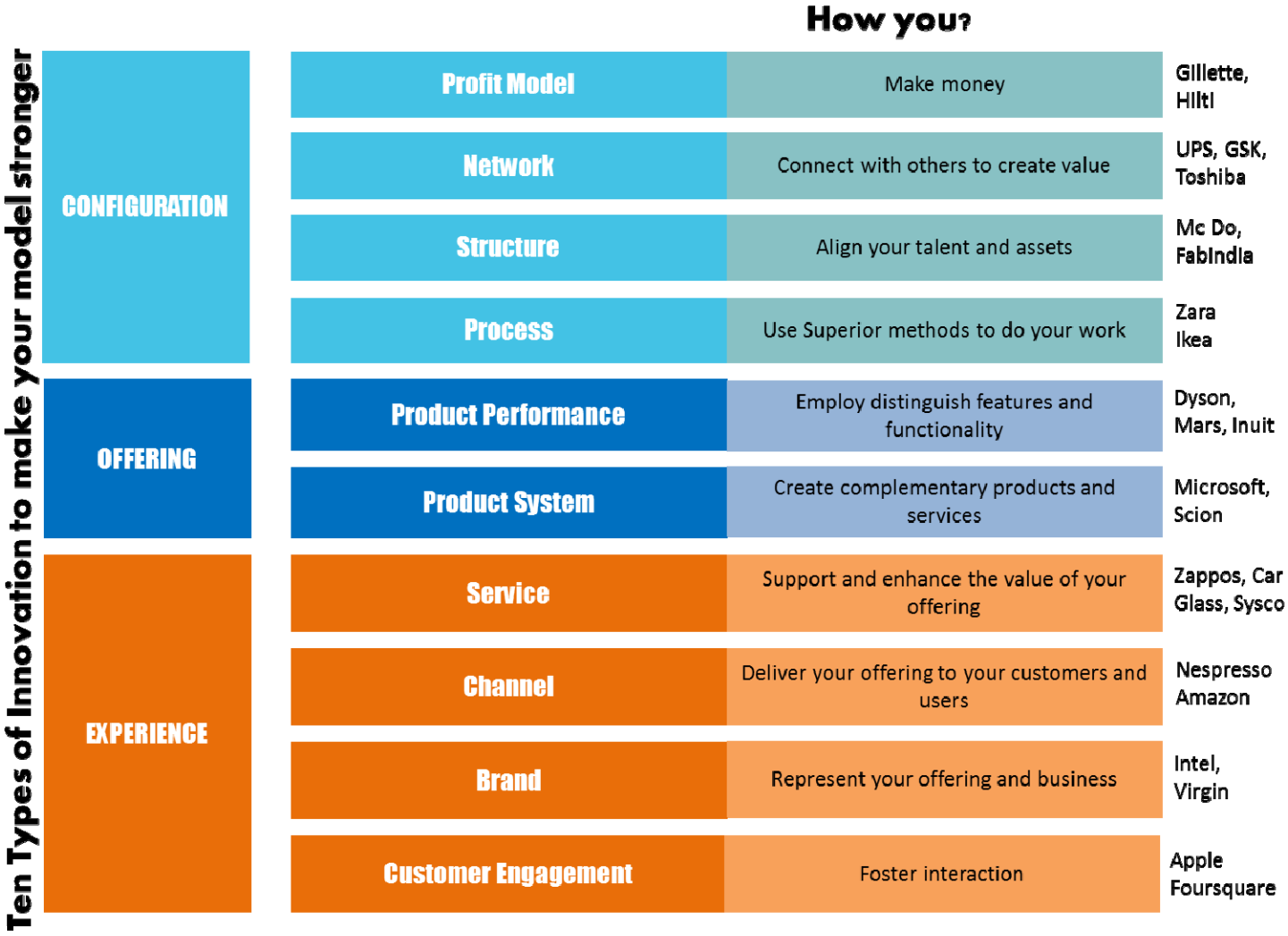
4 Types of Problem Situations



Prius, Lexus, & Mirai

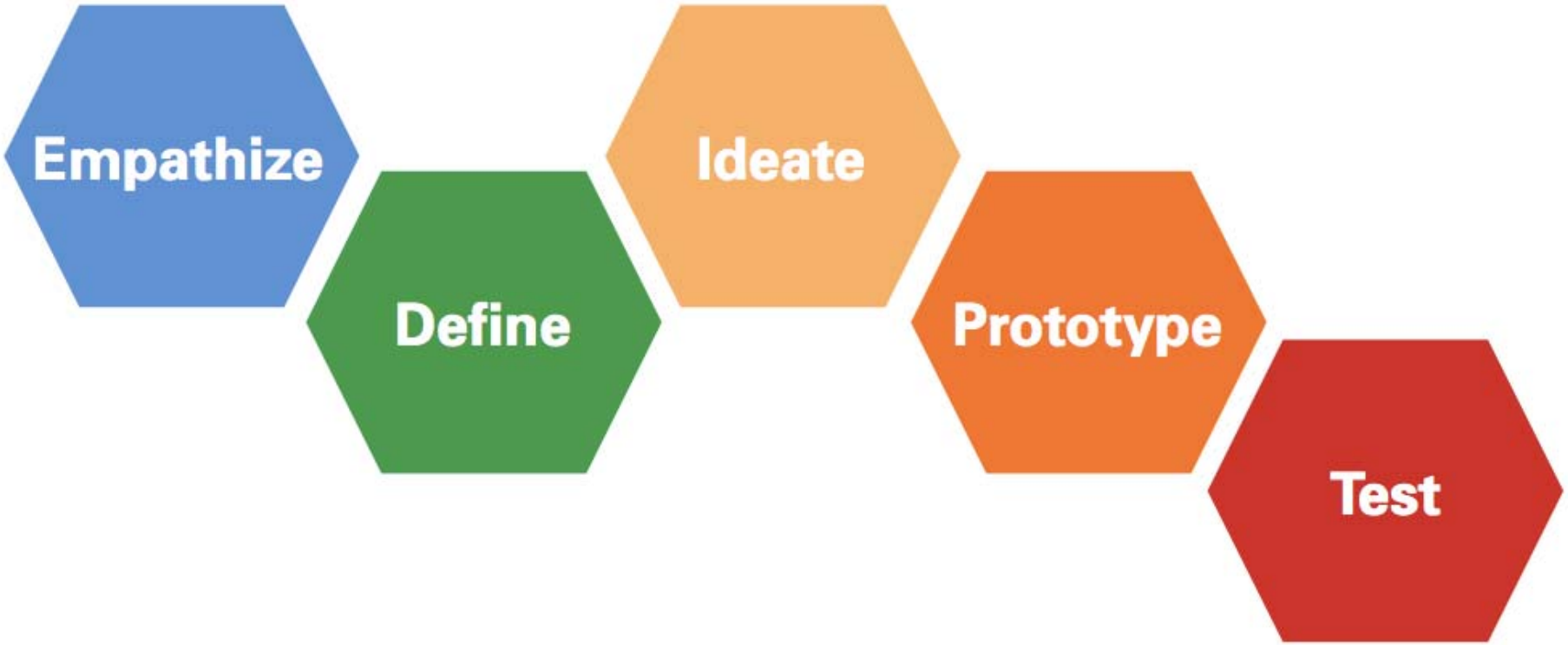


Type 4 – Vision / Innovation



Doblin: 10 Types of Innovation: The Discipline of Building Breakthroughs

Design Thinking

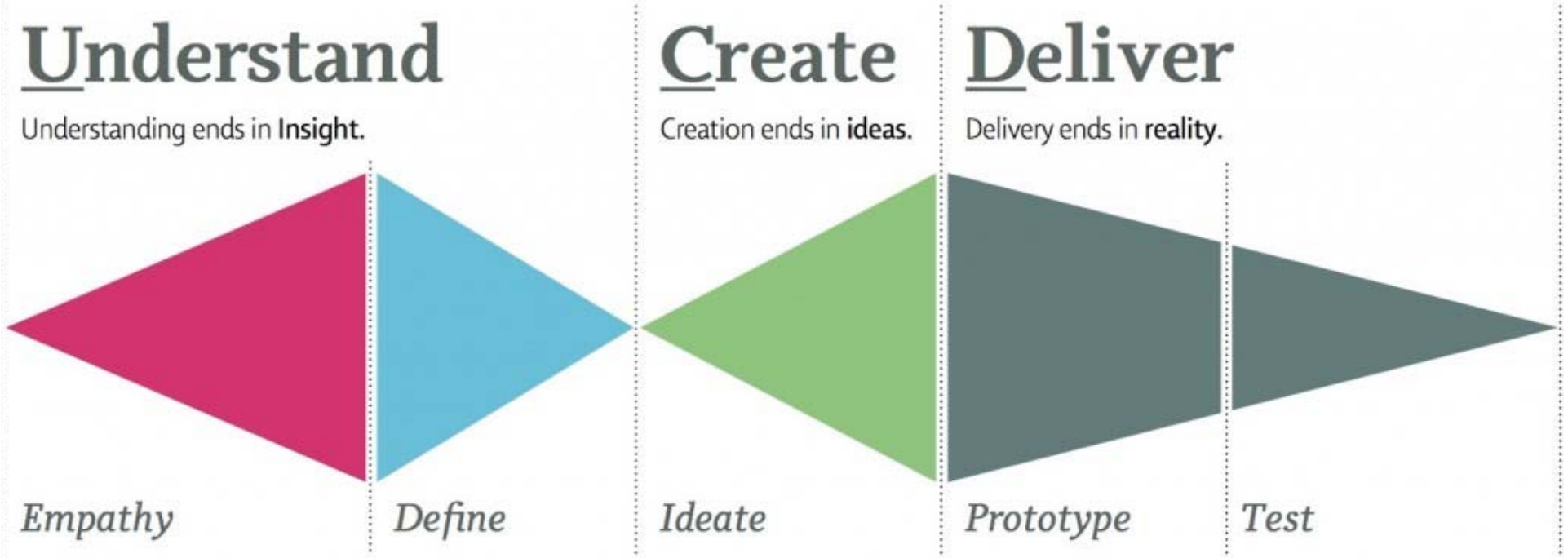


d.
HASSO PLATTNER
Institute of Design at Stanford

Three Phases of Design Thinking

Extreme Empathy

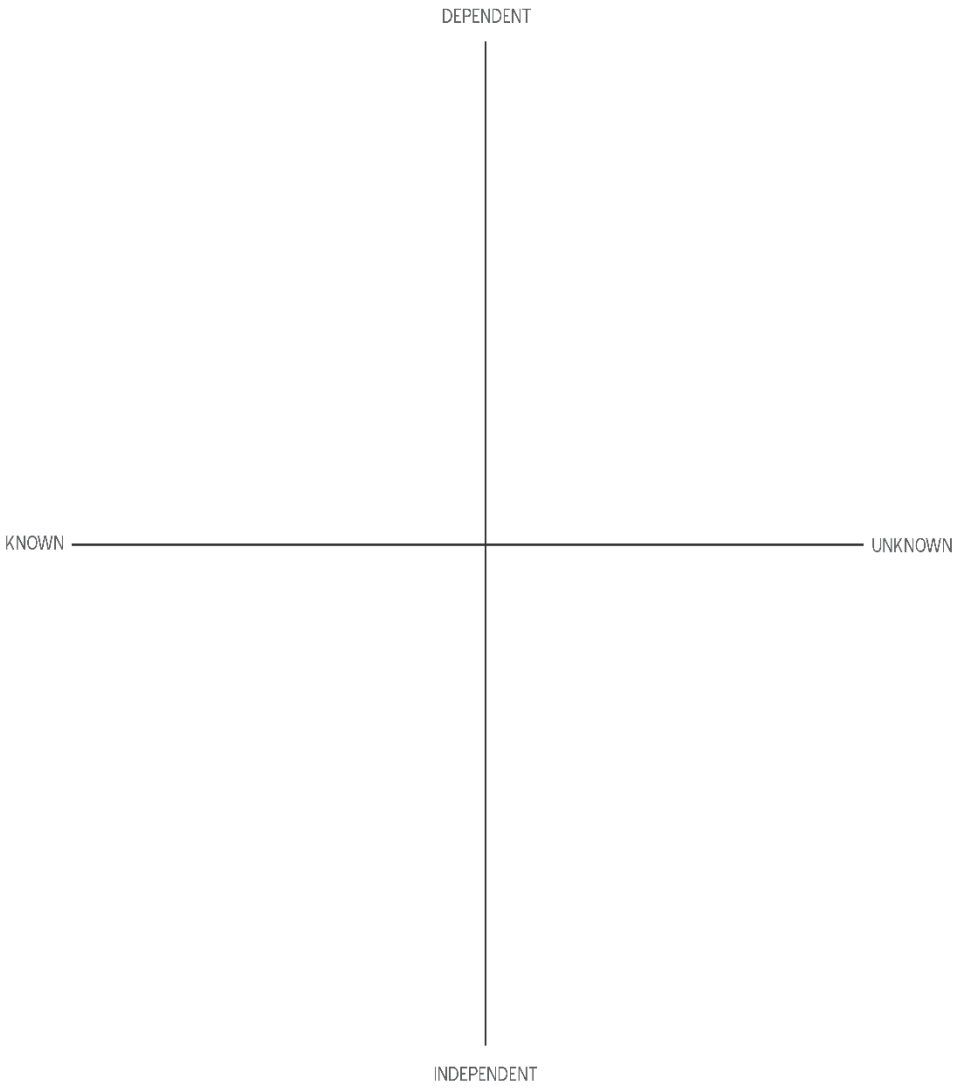
Extreme Experimentation



Lean Learning Loops

winning aspiration | playing space | business challenge | winning solution

What Must Be True?



1. GUESS

What are the riskiest elements of our solution – the potential barriers to success?

2. TEST

What simple, fast, and frugal experiment can we run to test our "what must be true" beliefs... our conditions for success?

What minimally viable prototype can we build to elicit actual customer behavior?

What measurable result can we use to gauge the validity of our hypothesis?

3. Learn

How well did our experiment work?

What key insights did we gain?

What will be our next iteration?

	Loop 1	Loop 2	Loop 3
Condition	what condition are we most worried might not be true?	what condition are we most worried might not be true?	what condition are we most worried might not be true?
Concern	why is it so worrisome?	why is it so worrisome?	why is it so worrisome?
Objective	what is it that we must learn?	what is it that we must learn?	what is it that we must learn?
Hypothesis	what is our testable belief? (i.e. "if we do X, Y will happen")	what is our testable belief? (i.e. "if we do X, Y will happen")	what is our testable belief? (i.e. "if we do X, Y will happen")
Prototype (MVP)	how will we test our hypothesis?	how will we test our hypothesis?	how will we test our hypothesis?
Impact	what target measure will be our standard of proof?	what target measure will be our standard of proof?	what target measure will be our standard of proof?
Results	what actually happened?	what actually happened?	what actually happened?
Explanation	what explains the results, if different from expected?	what explains the results, if different from expected?	what explains the results, if different from expected?
Insights	what was our biggest surprise? what new things did we learn?	what was our biggest surprise? what new things did we learn?	what was our biggest surprise? what new things did we learn?
Decision	what is our next iteration: kill, pivot, or persevere?	what is our next iteration: kill, pivot, or persevere?	what is our next iteration: kill, pivot, or persevere?

5 Why Example Revisited

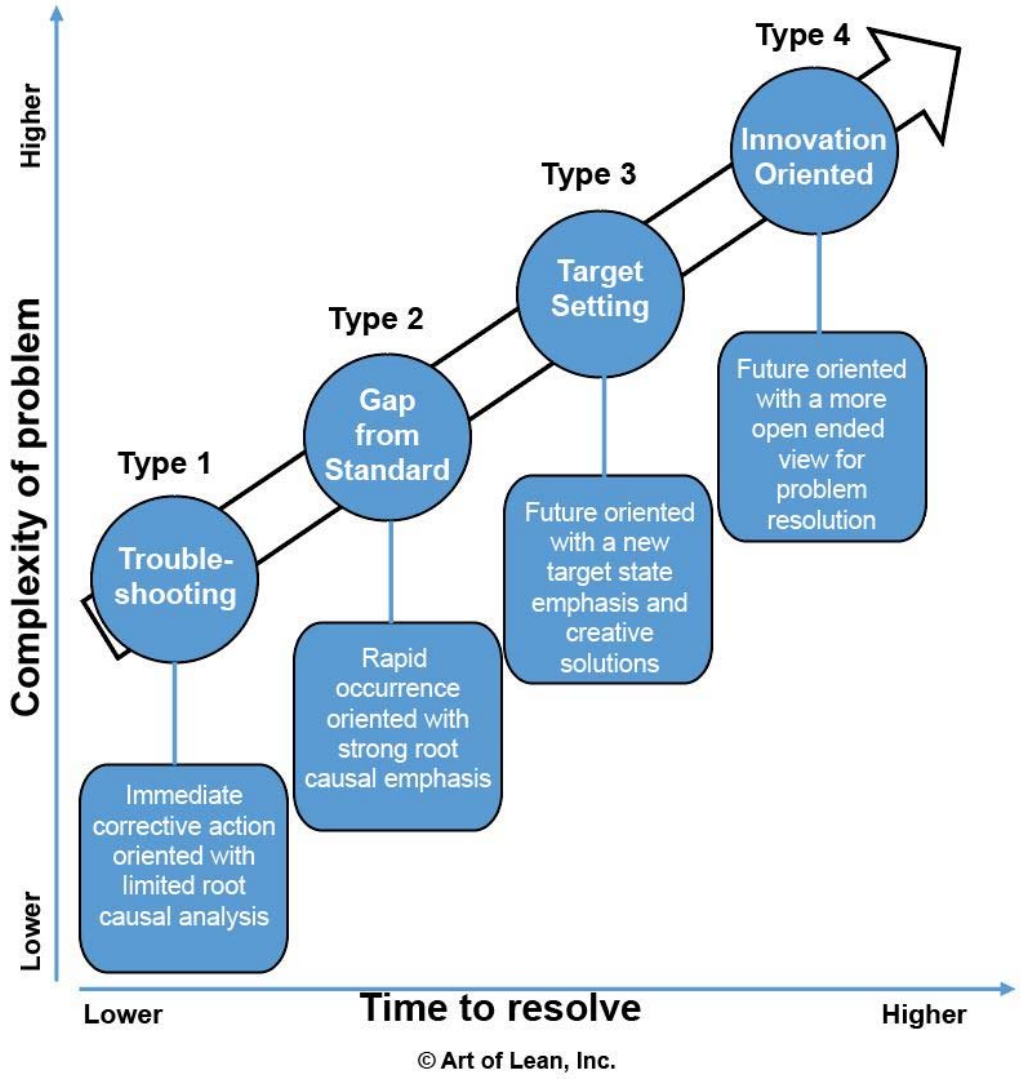
Situation: A machine tool has stopped working halting production.

1) "Why did the machine stop working?"
   - "Because the machine overloaded blowing the fuse in the control panel."
2) "Why did the overload condition result?"
   - "Because there was insufficient lubrication to the spindle bearing."
3) "Why was there insufficient spindle bearing lubrication?"
   - "Because there was insufficient lubrication drawn up by the pump."
4) "Why was there insufficient lubrication draw by the pump?"
   - "Because the pump shaft was worn and rattling."
5) "Why was the pump shaft worn?"
   - "Because there was no strainer on the lubrication device inlet port, and small metal cutting chips entered the system causing damage."

5 Why Revisited

- Type 1 - Troubleshoot cutting chips by daily cleaning and maintenance of the machine for immediate relief.
- Type 2 – Put the strainer on the inlet port in the previous example for recurrence prevention.
- Type 3 – Evacuate the cutting chip better by breaking the cutting chips smaller, with better coolant systems, chip breakers, and better tooling conditions. Also improve machine guards and tank covers for a more creative solution.
- Type 4 – Tooling innovation, chip formation optimization, cutting condition innovation, washer process redesign, and upstream die casting optimization for process innovation. Material and product innovation are also possible angles.

4 Types of Problem Situations



4 Types & Benkei Analogy

Benkei

Kaoru Ishikawa

The term "7 QC tools" is named after the seven tools of Musashibo Benkei the famous warrior monk. Benkei owned seven weapons which he used to win all his battles. Similarly from my own experience you will find that you will be able to solve 95% of the problems you face if you properly use the 7 QC tools.

Professor Emeritus
University of Tokyo

Baka / バカ / 馬鹿

馬鹿の一つ覚え
[ばかのひとつおぼえ,
baka no hitotsu-oboe

A fool remembers only one thing

A fool knows only one way of doing things

Session Summary

- Benkei versus Baka analogy and be careful of experts who only know one way
- Each type has a different cadence and focal point
- Learning by doing is key for all four types
- Reflection after doing is key as well. However you can’t just “think” your way to improvement
- Problem solving, innovation and improvement require perspiration and willingness to fail more than once

Appendix