

# 4 Types of Problem

What problems to solve now  
and what can wait

# Learning Session Outline

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

# Background - Lean / Toyota



Toyota Kamigo  
Overhead



Kamigo  
Entrance



Taiichi  
Ohno



Precision & Machine  
Intensive

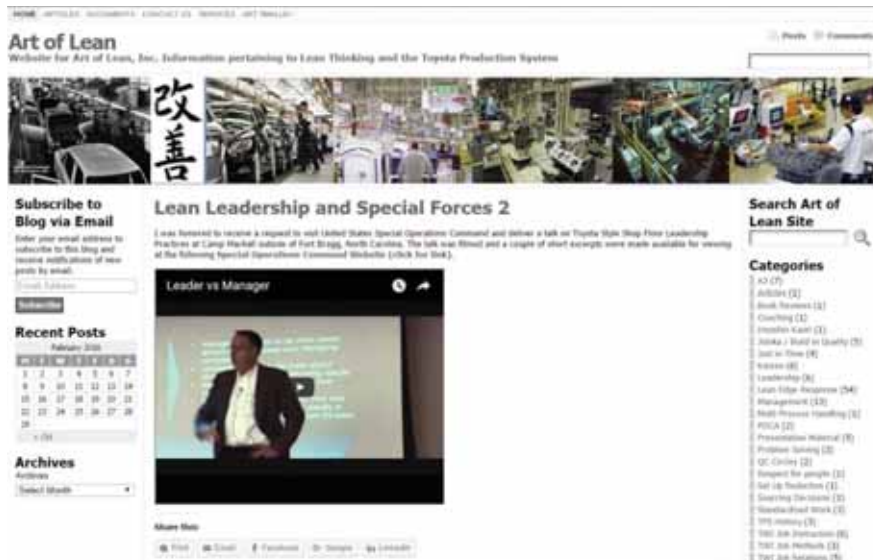
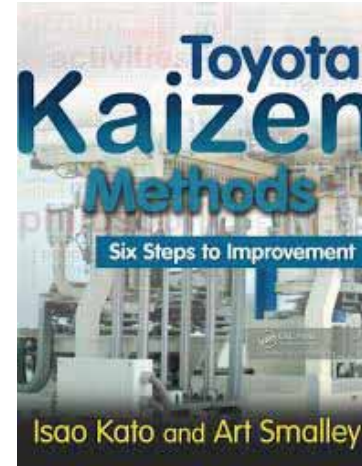
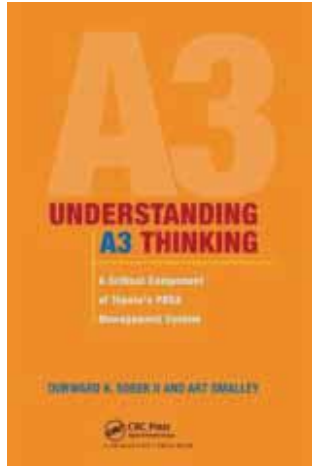


Lower Volume &  
Higher Mix



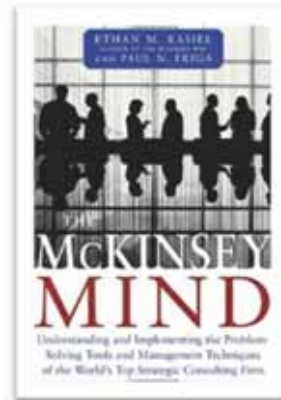
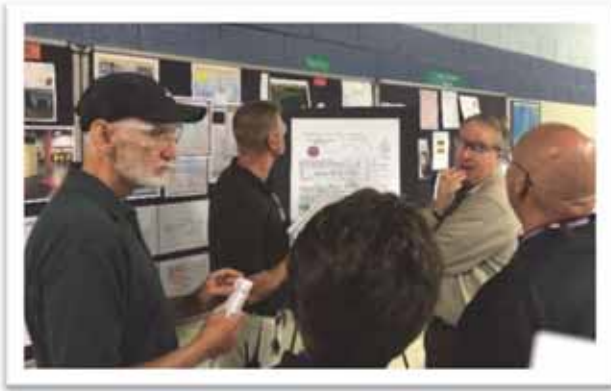
High Volume &  
Lower Mix

# Other Background - Work



[www.artoflean.com](http://www.artoflean.com)

# Other Background - Stuff



# TPS Development Timeline

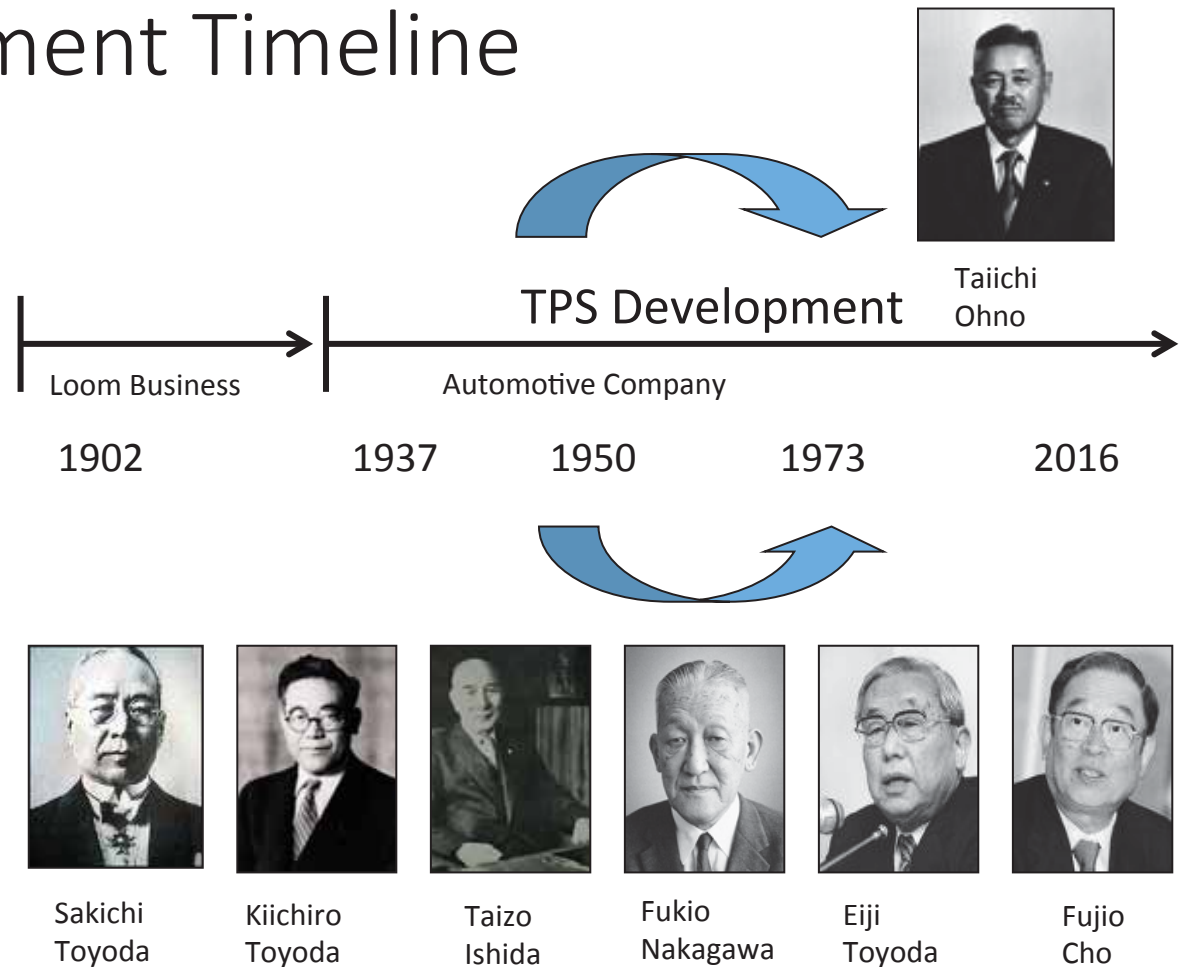
## Western Influences:

Mass Production & moving conveyor lines

Scientific Principles Of Management

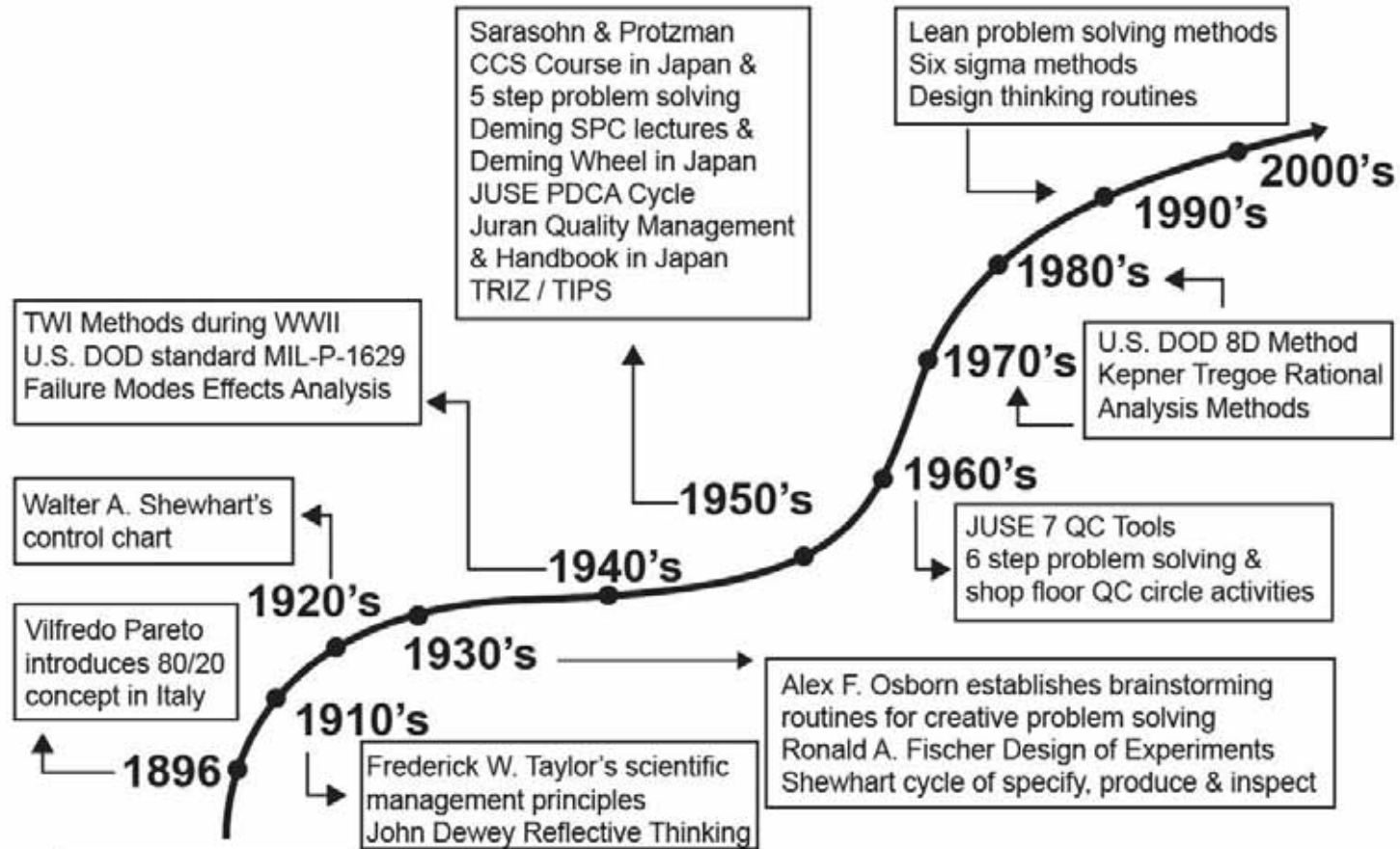
Standardization Of Parts

Many Others....



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

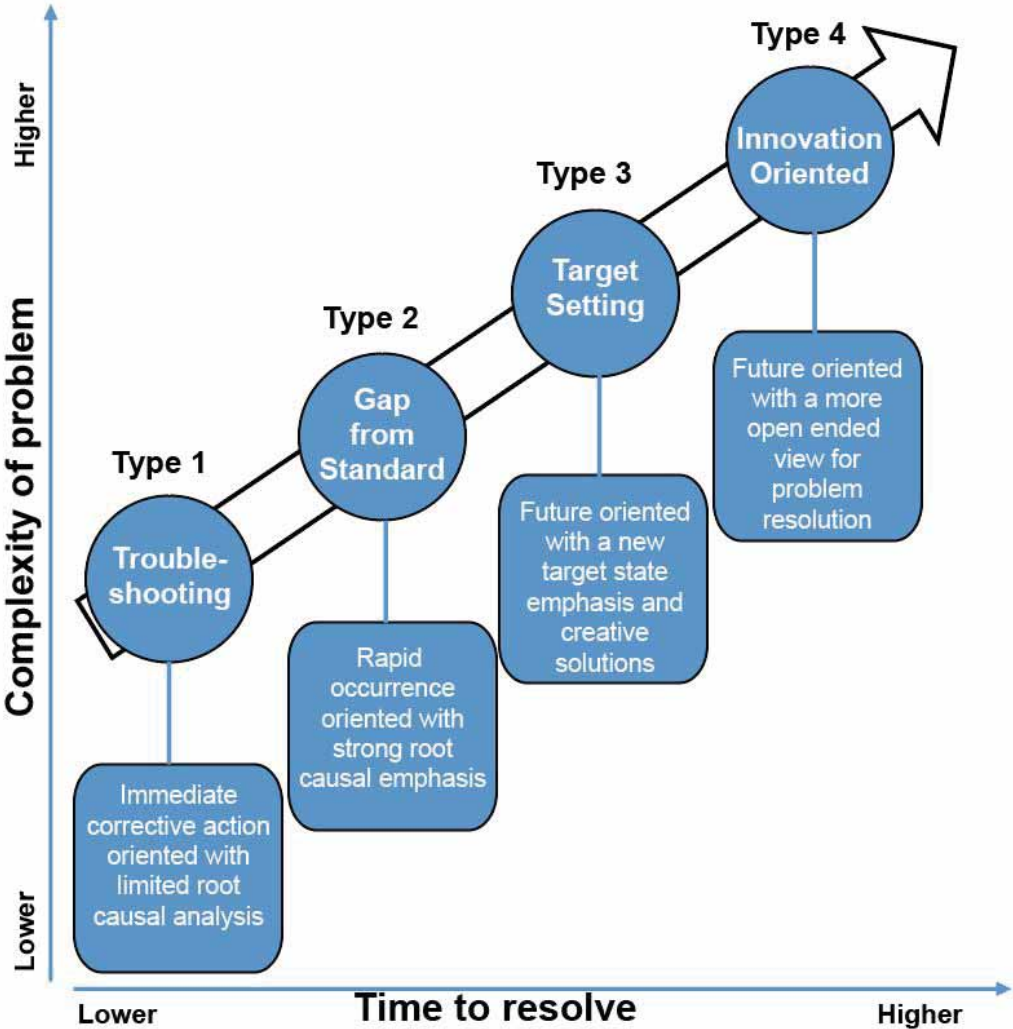
# 20<sup>th</sup> Century & Problem Solving



**General Inputs:**  
Scientific Method &  
Critical Thinking Routines



# 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

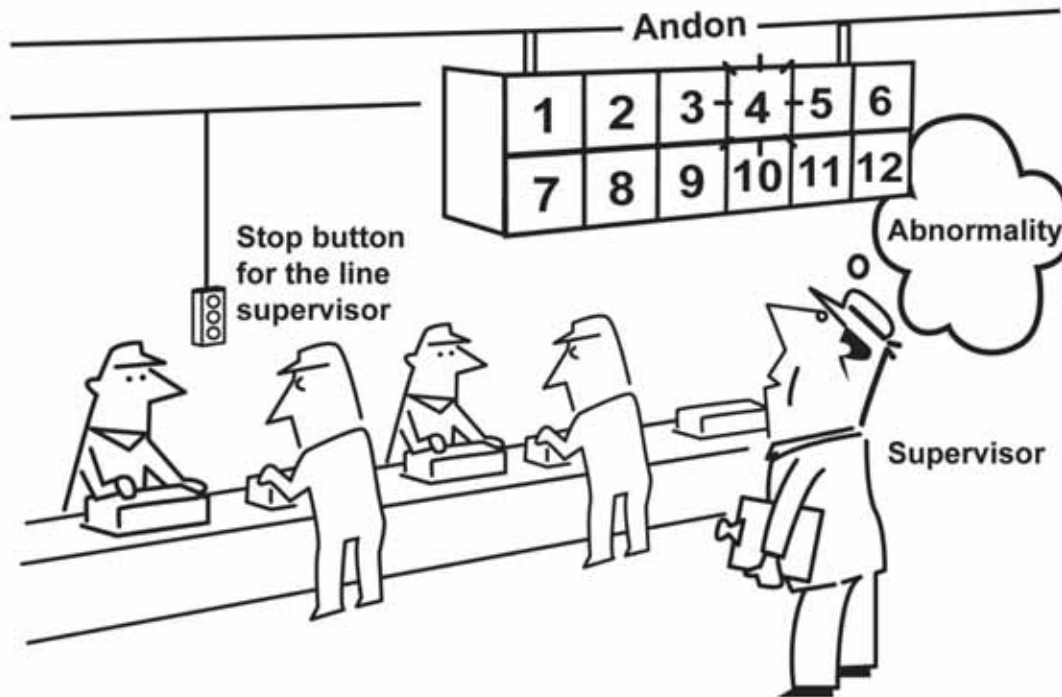
## Kaoru Ishikawa



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.

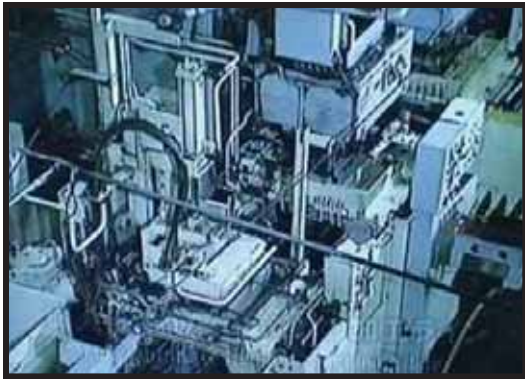
**Professor Emeritus  
University of Tokyo**

# Type 1 – Troubleshooting



**Condition Based Triggers  
Either Human or Machine**

# 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 releases only 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	Cumulative	Problem/Causes	Sign-off	
	Plan / Actual	Plan / Actual			
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## Rapid Problem Solving

- Concern
- Cause
- Countermeasure
- Check

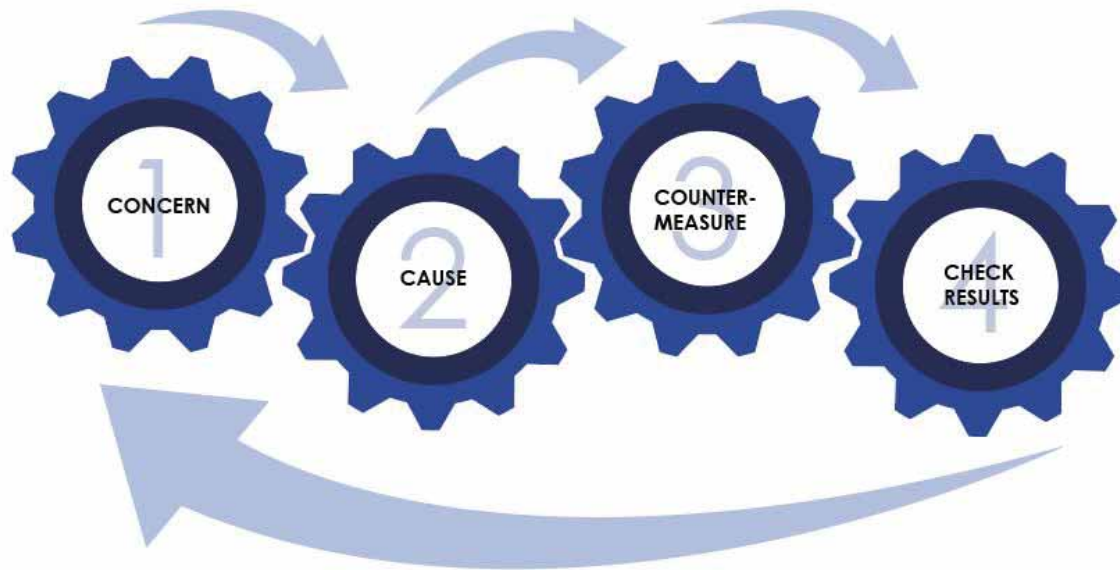


## Troubleshooting



**Time & Quantity Based Triggers  
Reviewed Hourly By Supervisor**

# 4 C's Thinking



Minimal Documentation Involved

Mainly Discussion, Thinking, Rapid Action & Follow Up

# 5 Why is the Ideal

**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.”

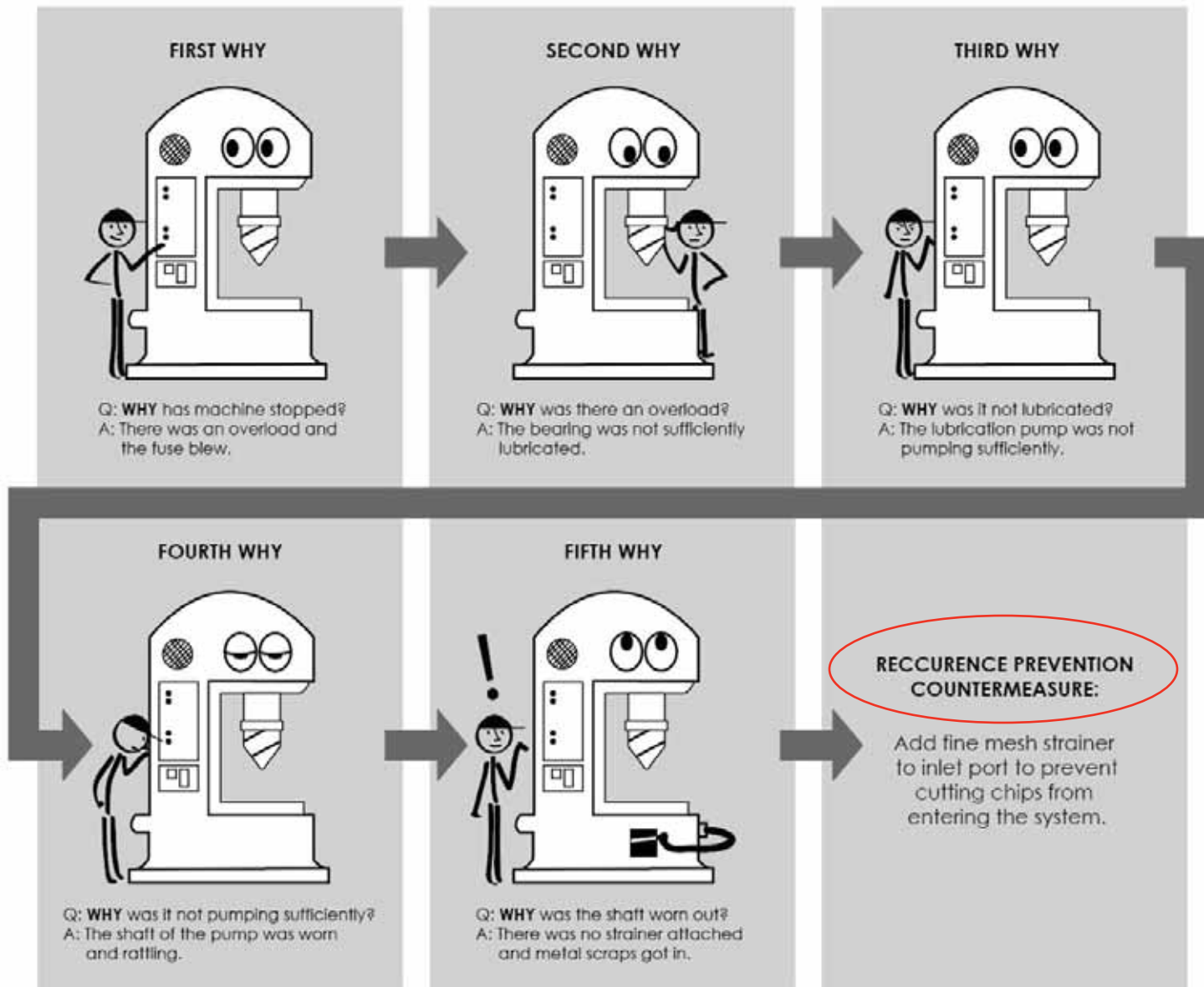
4) “Why was there insufficient lubrication draw from the pump?”

“Because the pump shaft was worn and rattling.”

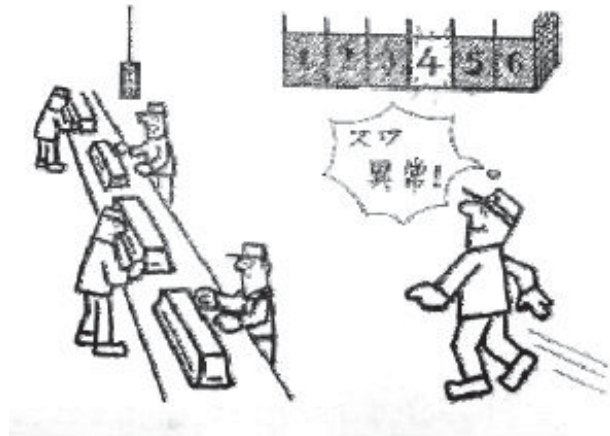
5) “Why was the pump shaft worn?”

“Because there was no strainer on the lubrication device inlet port, and small metal cutting chips entered the system causing damage.”

# Key Point is the Countermeasure!



# Toyota Supervisor Image



監督者はオールマイティである



Rapid response to problems and abnormal conditions by production

-Team Member

-Team Leader

-Group Leader

-Manager

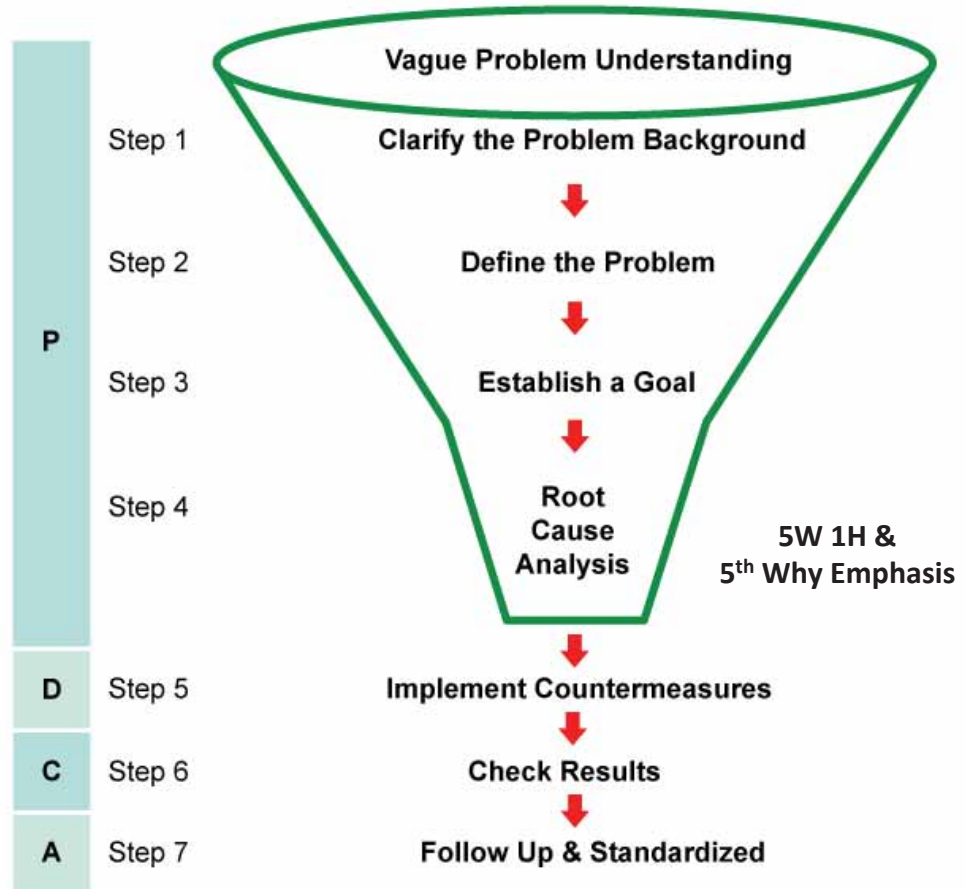
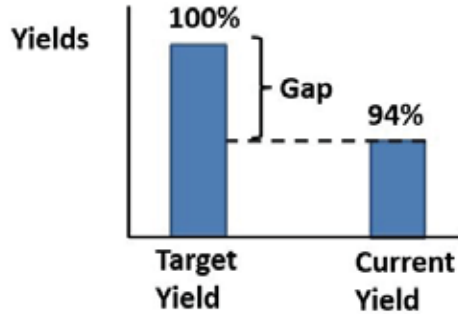
-Plant Manager

“Almighty” Supervisor Image

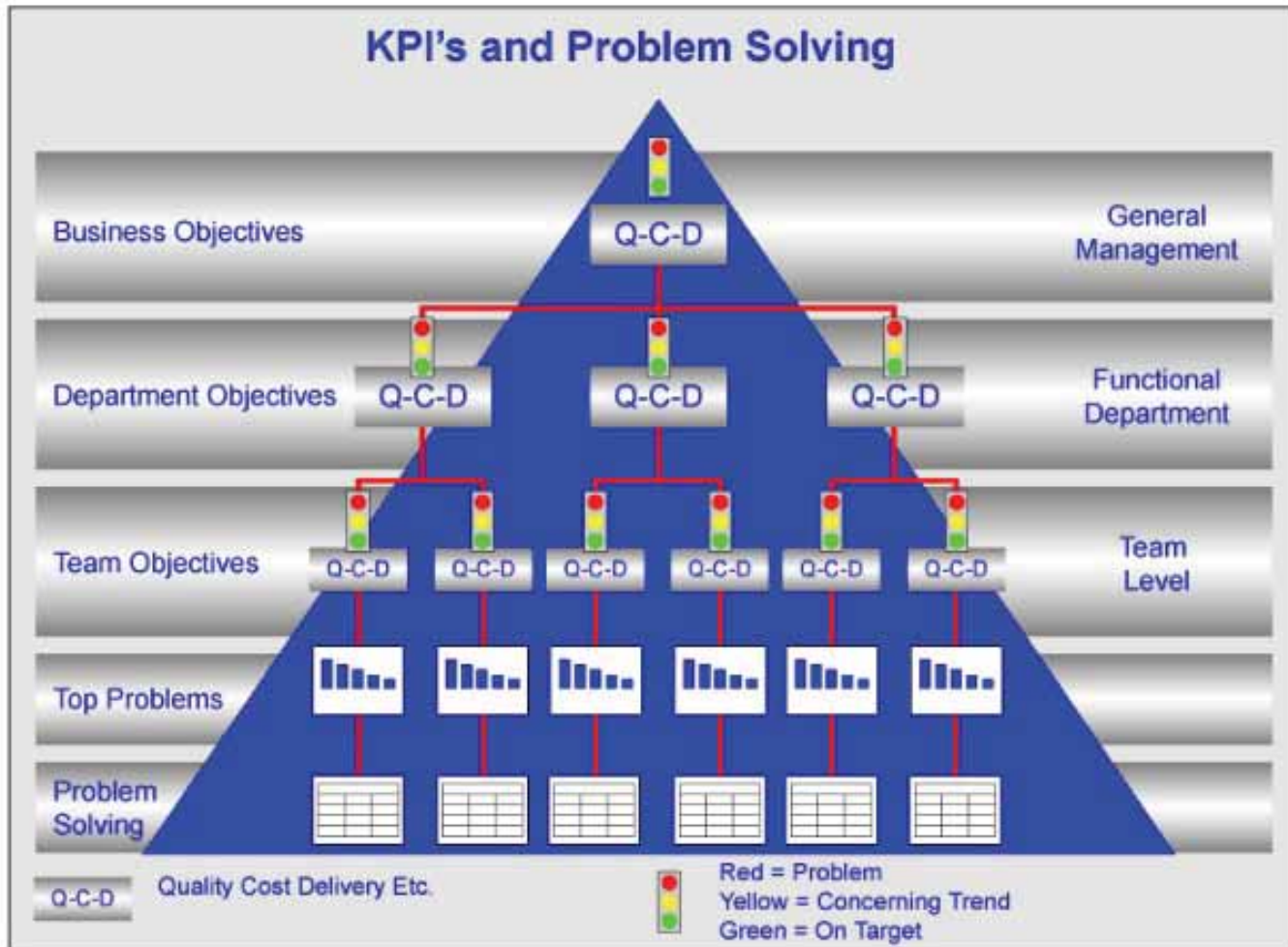
1. Safety
2. Job Ability
3. Leadership
4. Kaizen Skills
5. Technical Knowledge
6. Human Relations



# Type 2 – Gap from Standard



# KPI's & Problem Solving



# Shop Floor Management Board

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# Problem Investigation

TPS

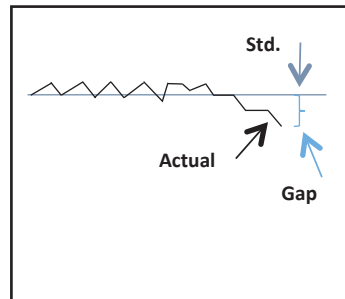
TPS



**A. Immediate abnormality signal**



**B. Go to actual machine and see status**

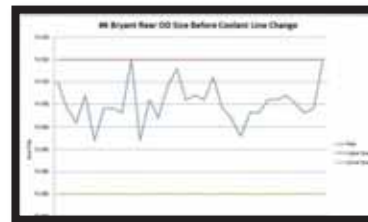


**C. Ascertain actual problem situation**

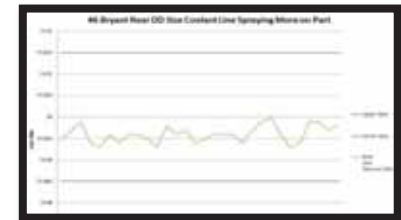
TPS

## D. Coaching 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



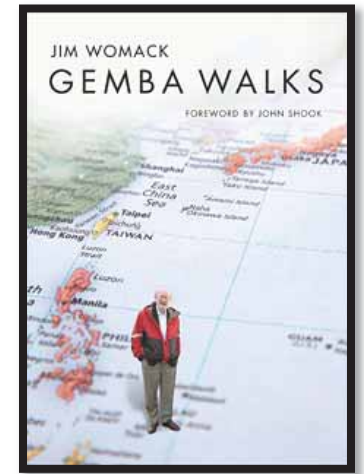
Cpk 1.15



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
- Genpo 現法 Actual Method
- Genin 現因 Actual Cause

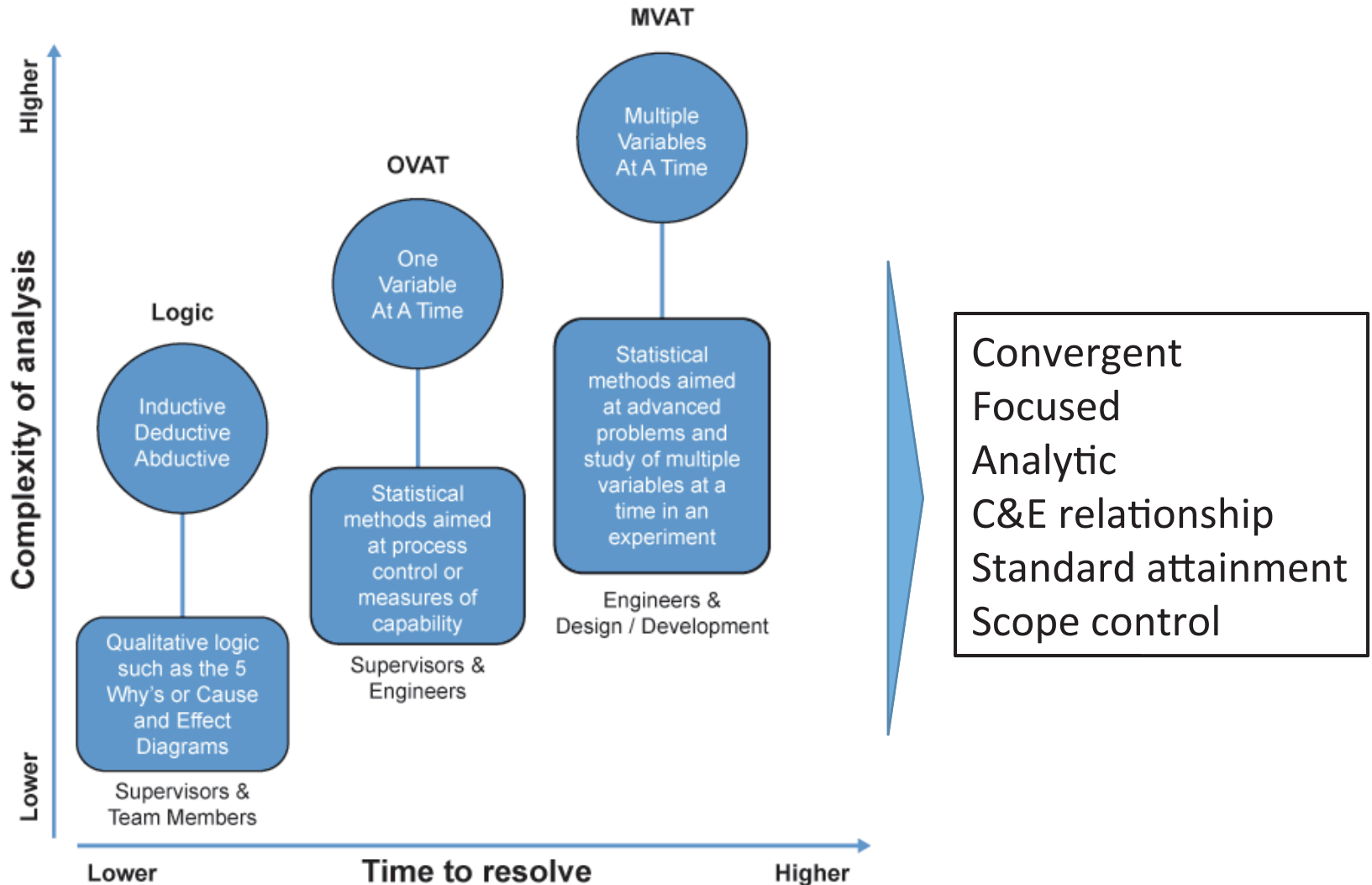


現地現物  
Genchi Genbutsu - "Go and See"

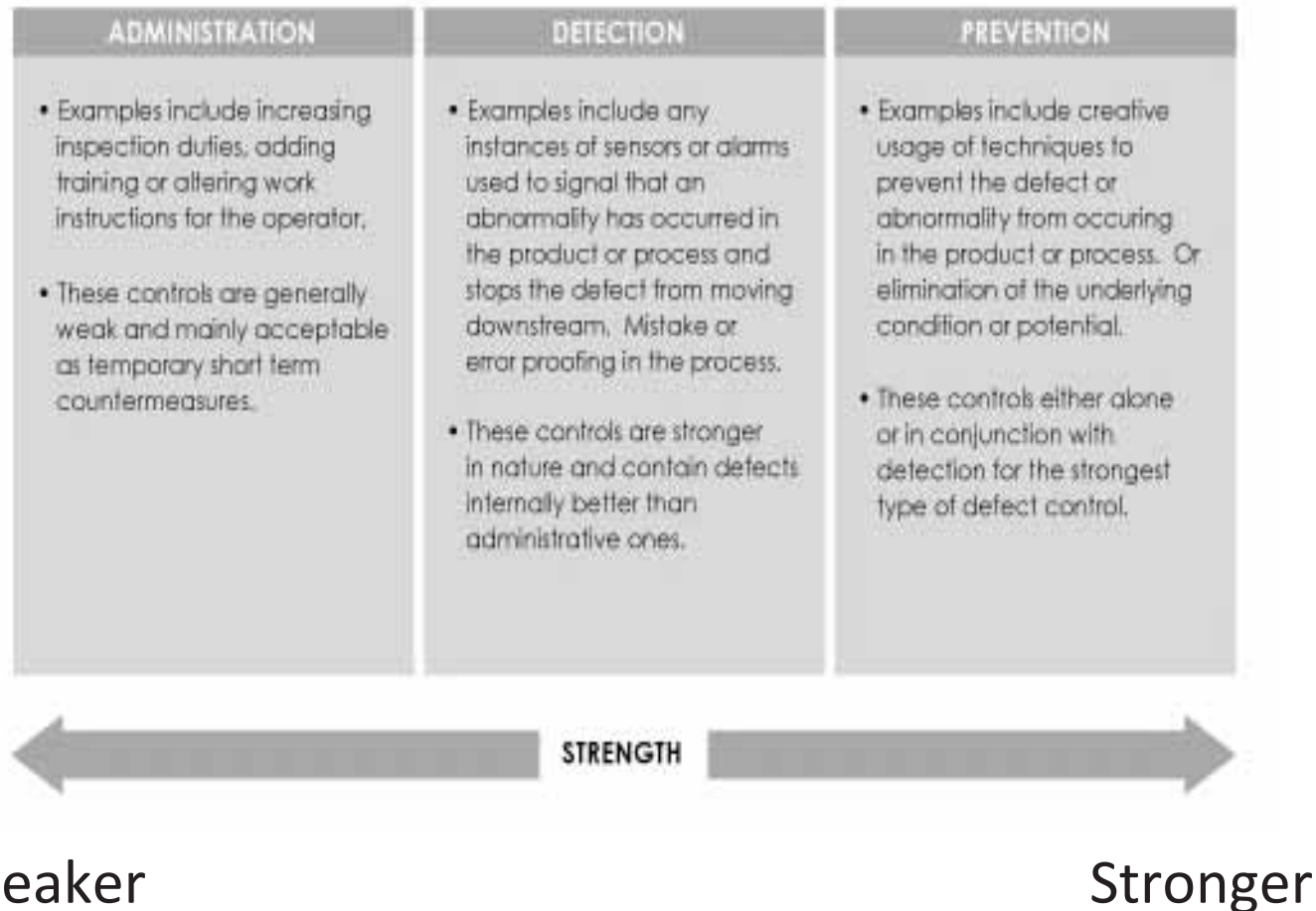
# Dig Deeper! Plain English

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?	1 <sup>st</sup> cause	2 <sup>nd</sup> cause	3 <sup>rd</sup> cause	4 <sup>th</sup> cause	5 <sup>th</sup> cause
How / How much	Non-conformance issue	Dimensional variation	Above standard allowed	Comparison to actual standard	Gap from actual standard: e.g., .001 mm

# Type 2 – Analysis Types

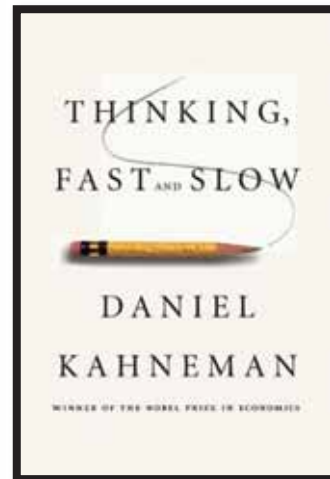
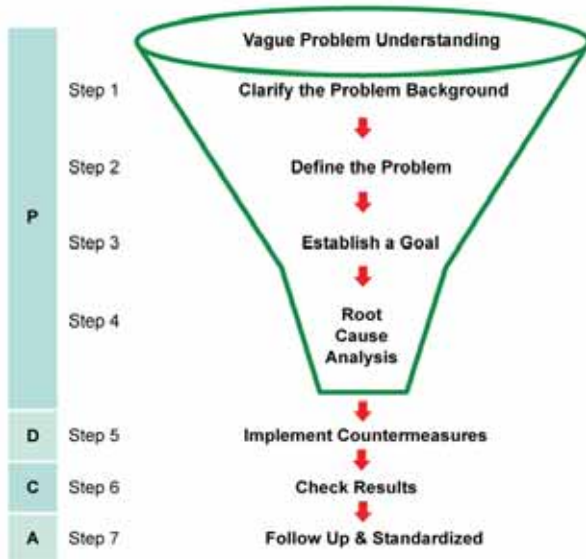


# Type 2 – Countermeasure Types





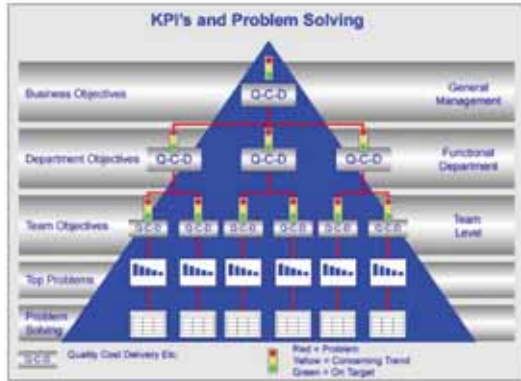
# Type 2 Summary



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 real cause...an analogy is thinking slow.

# Type 3 – Target State



Acceptable (Current State) Situation

(Future) Ideal Situation

GAP

Normal Status

GAP

Current Situation

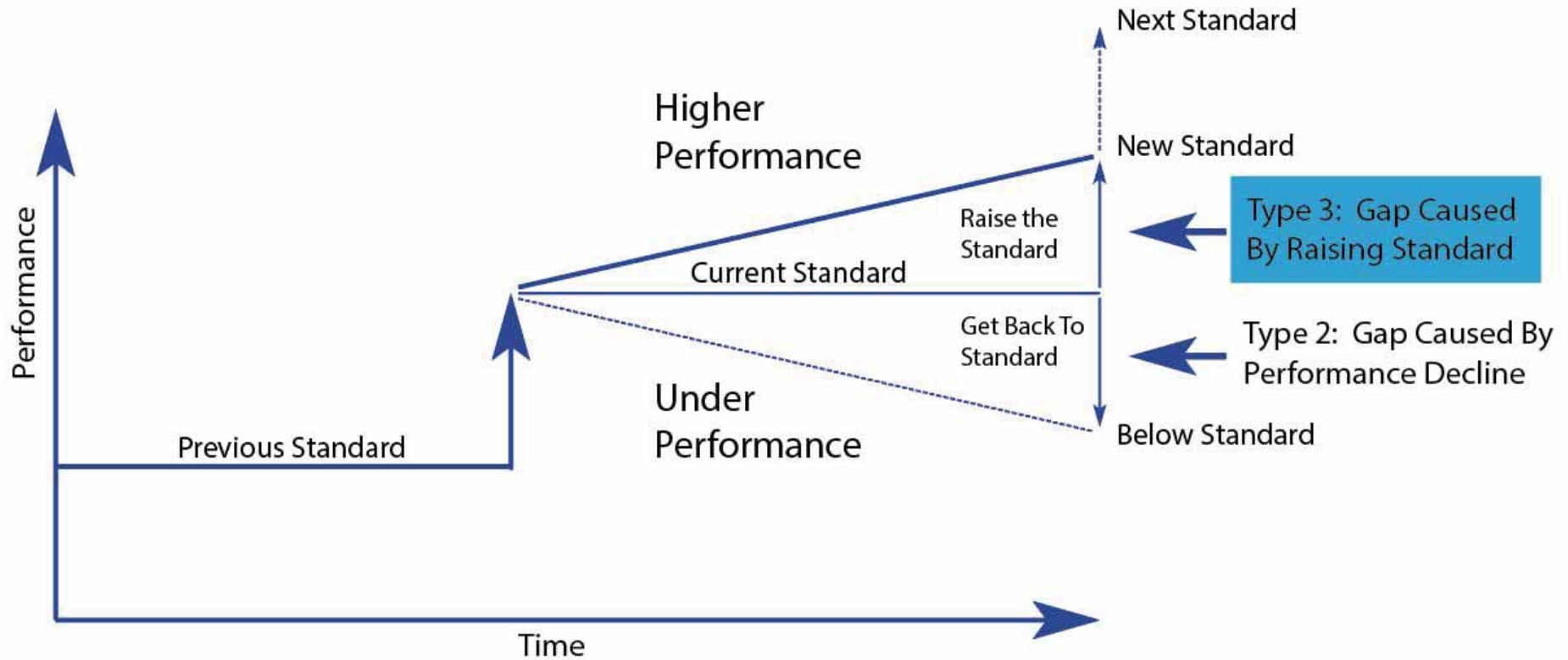
Type 2 - "Gap from Standard"

Kaizen Methods  
改善方法

Type 3 -  
"Target State"

問題解決  
Problem Solving

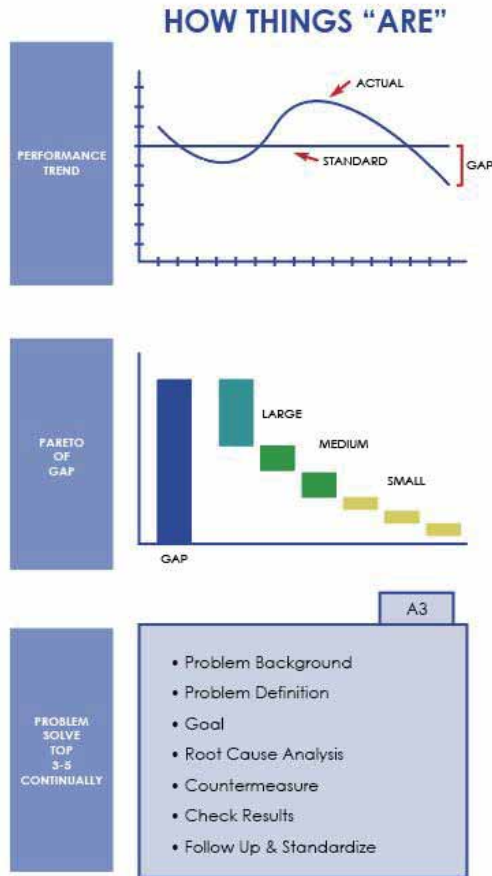
# Type 3 – Raise the Bar



# Target State Concept

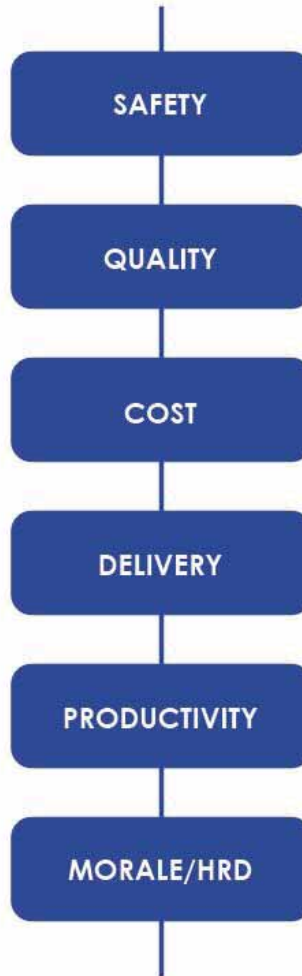
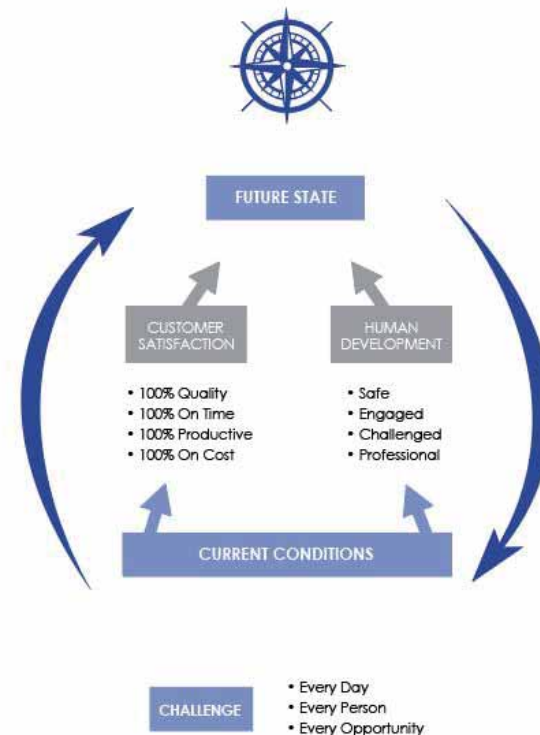
## KEY PERFORMANCE INDICATORS

### Type 2 Problems & Gap From Standard



### Type 3 Problems & Target State Setting

#### HOW THINGS "SHOULD BE"



# You Can Target State Anything!

- Products
- Processes
- Services
- Sports
- Metrics



But you have to think  
and not just copy...

# Two Types of Thinking

## TWO KINDS OF THINKING

### Critical Thinking

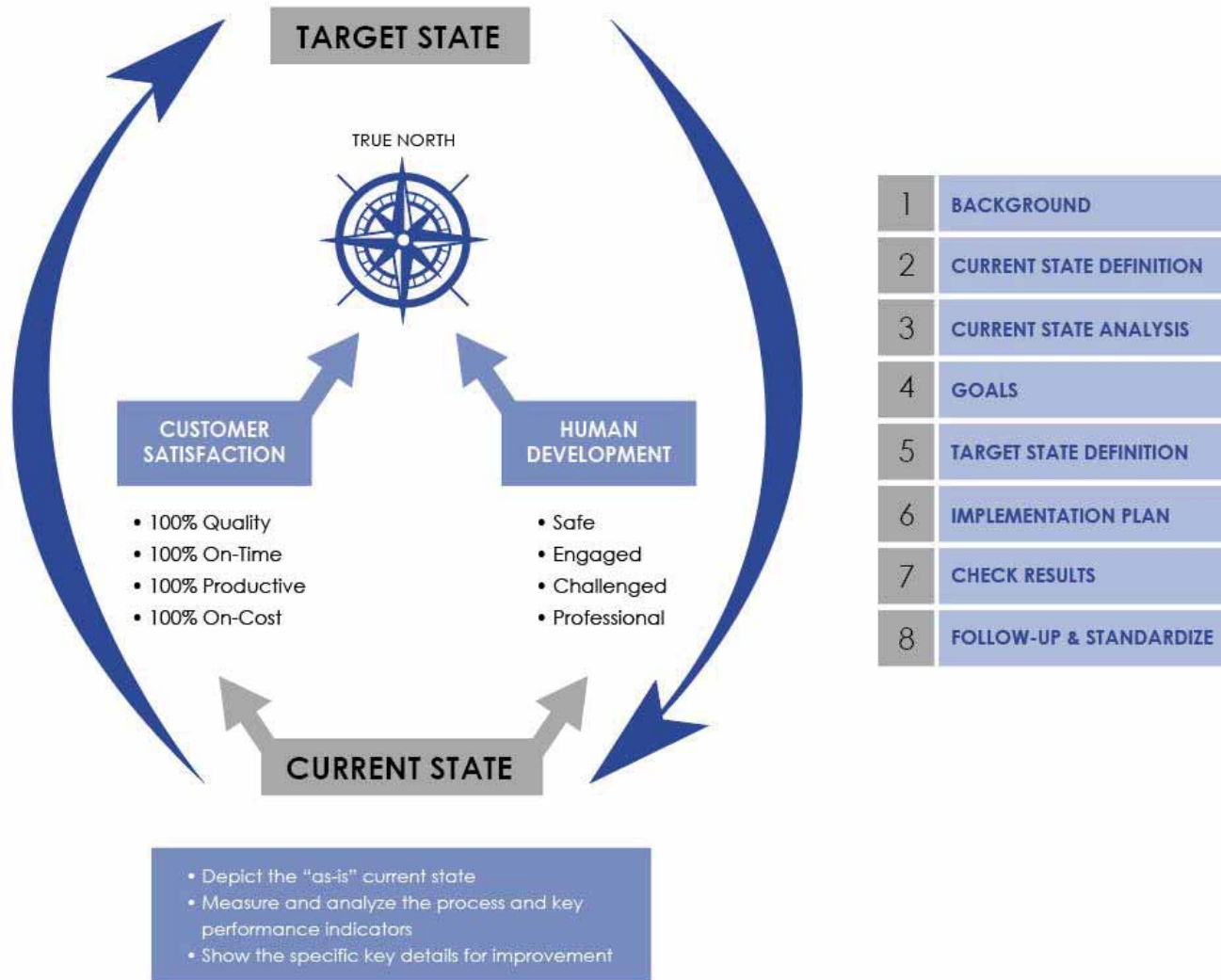
- analytic
- convergent
- vertical
- probability
- judgment
- focused
- objective
- answer
- left brain
- verbal
- linear
- reasoning
- yes but



### Creative Thinking

- generative
- divergent
- lateral
- possibility
- suspended judgment
- diffuse
- subjective
- an answer
- right brain
- visual
- associative
- richness, novelty
- yes and

# Target State Improvement Steps



# Process Example SMED Example



Dedicated Press  
Part A



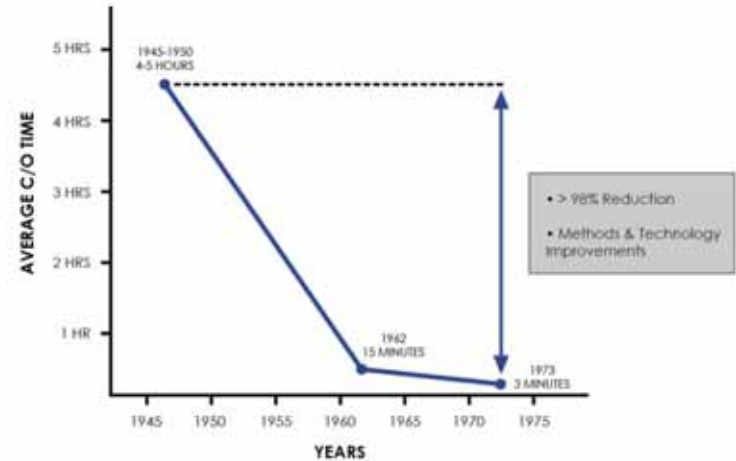
Dedicated Press  
Part B



Dedicated Press  
Part C

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

TOYOTA'S SET UP REDUCTION TIMELINE



Flexible Press  
Parts A, B, & C

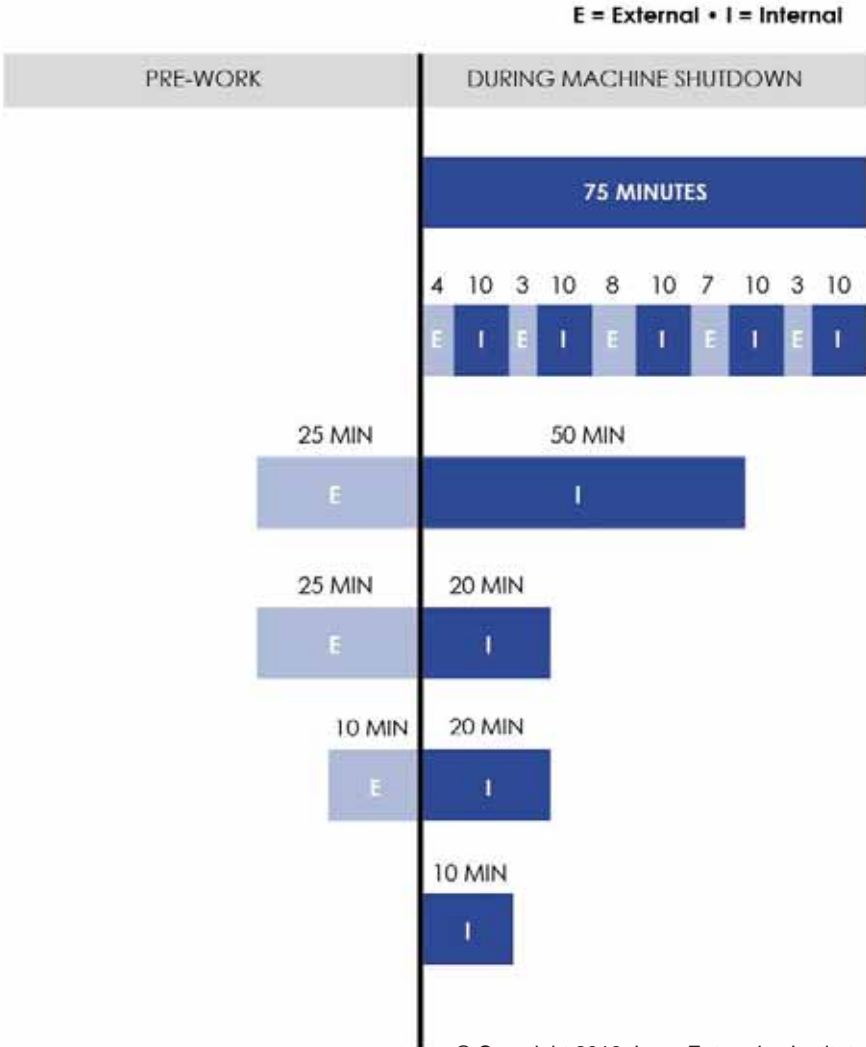
1 Flexible Machine  
Change Over Flexibility  
90% Utilization  
Run more JIT style



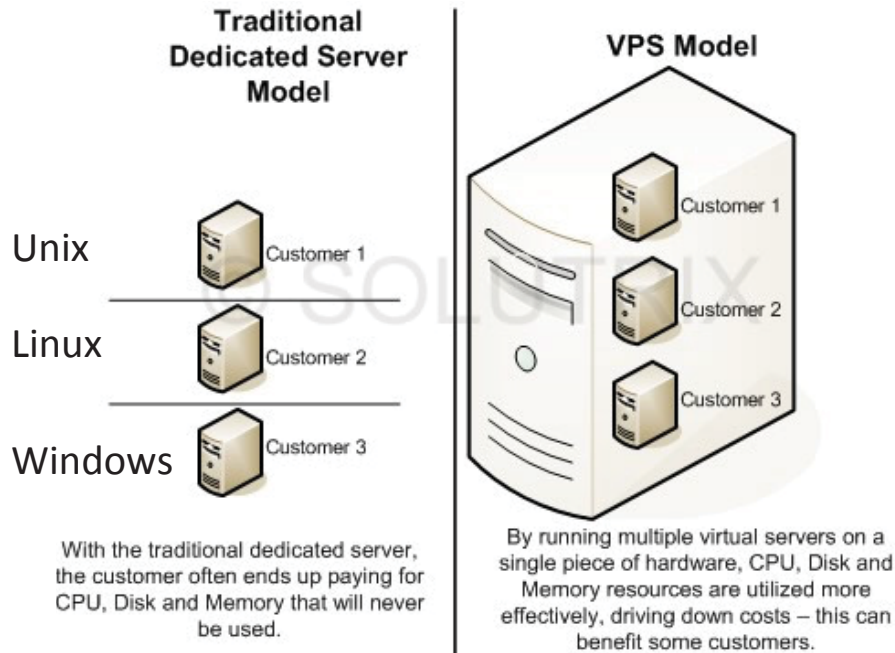
# Set Up Reduction

## 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



# Software Example



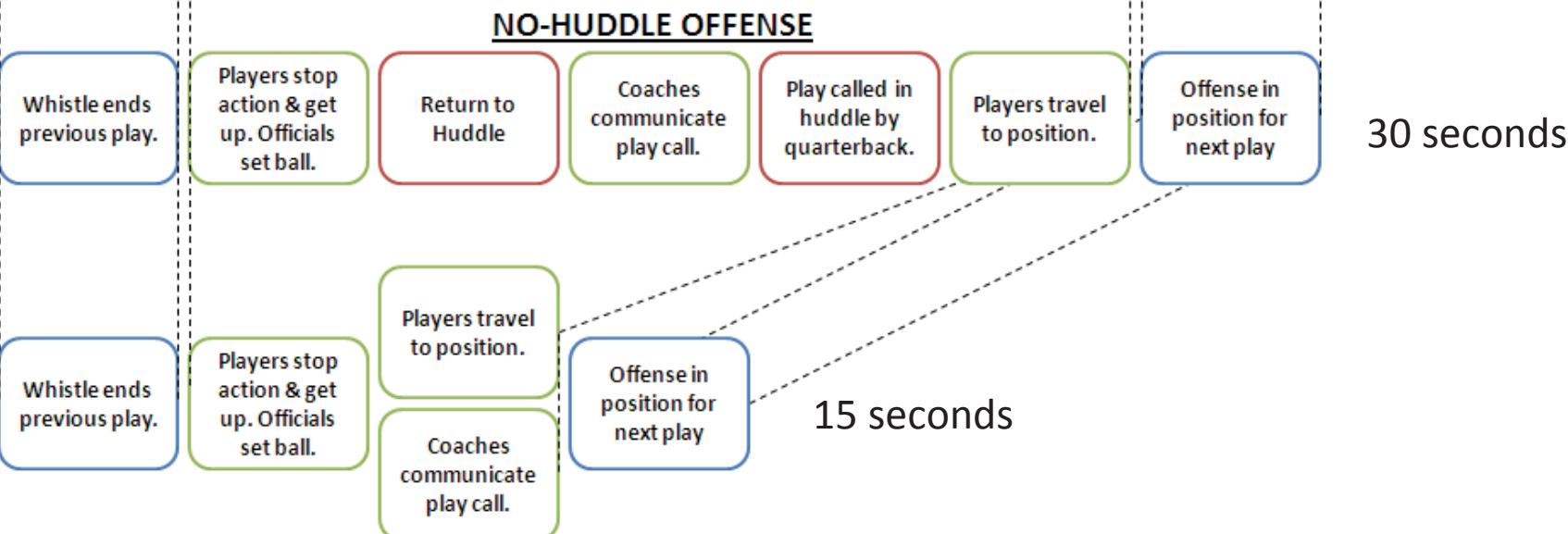
Same basic principle as SMED in die exchange...

Key here is not the time change over but the software ability to act as multiple server types...

3 Dedicated Servers  
Each 30% utilized  
No flexibility  
Wasted resources

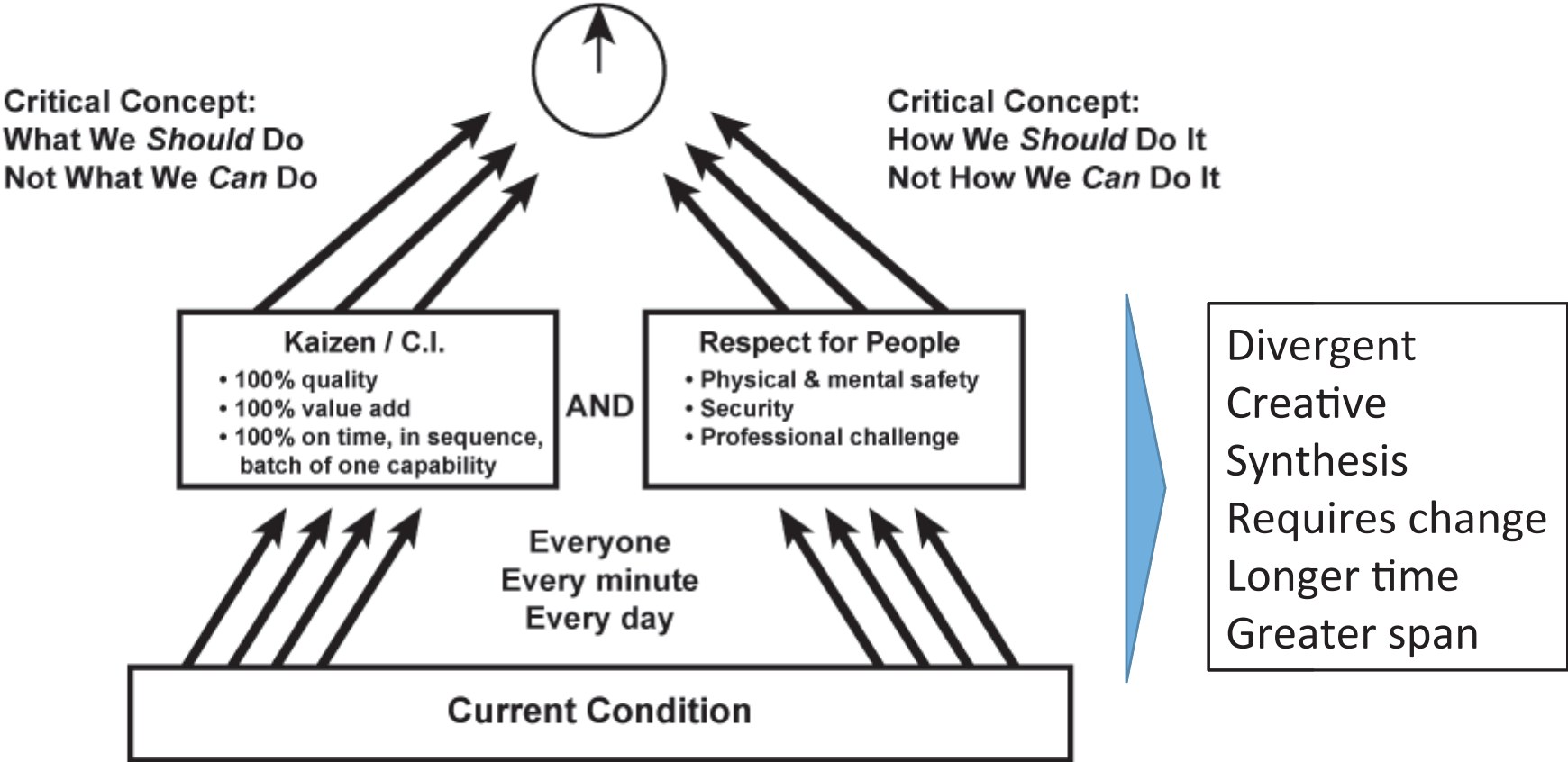
1 Virtual Server  
Now 90% utilized  
Flexibility  
Less waste

# Sports Example



# Type 3 – Target State Summary

*Arubeki Sugata / Ideal State*

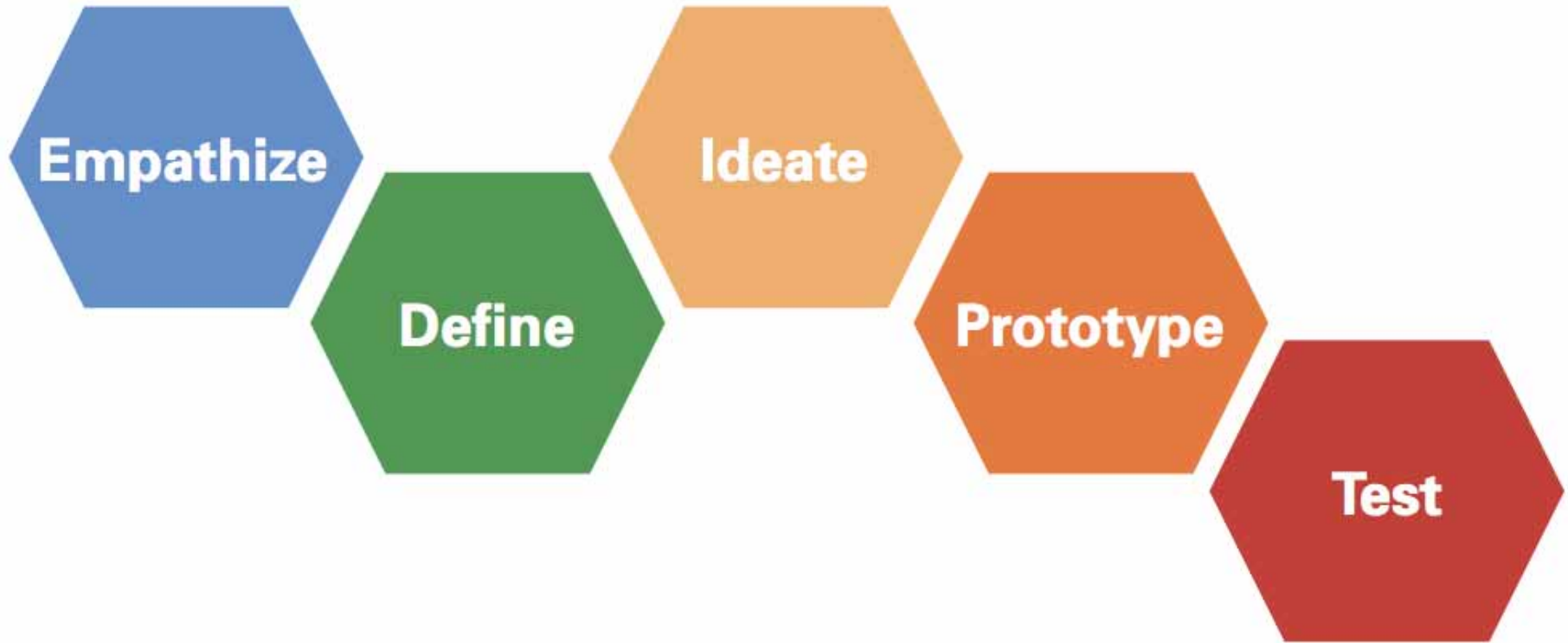


# Type 4 – Vision / Innovation

		How you?	
<b>CONFIGURATION</b>	<b>Profit Model</b>	Make money	Gillette, Hilti
	<b>Network</b>	Connect with others to create value	UPS, GSK, Toshiba
	<b>Structure</b>	Align your talent and assets	Mc Do, Fabindia
	<b>Process</b>	Use Superior methods to do your work	Zara Ikea
<b>OFFERING</b>	<b>Product Performance</b>	Employ distinguish features and functionality	Dyson, Mars, Inuit
	<b>Product System</b>	Create complementary products and services	Microsoft, Scion
<b>EXPERIENCE</b>	<b>Service</b>	Support and enhance the value of your offering	Zappos, Car Glass, Sysco
	<b>Channel</b>	Deliver your offering to your customers and users	Nespresso Amazon
	<b>Brand</b>	Represent your offering and business	Intel, Virgin
	<b>Customer Engagement</b>	Foster interaction	Apple Foursquare

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

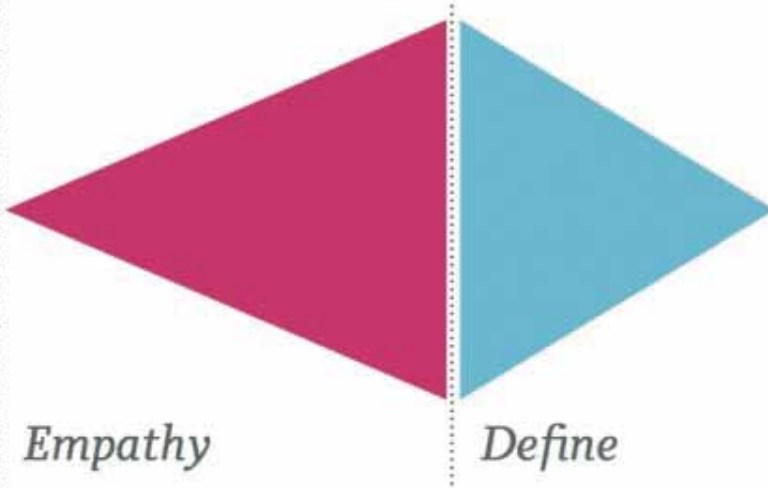
# Design Thinking



# Three Phases

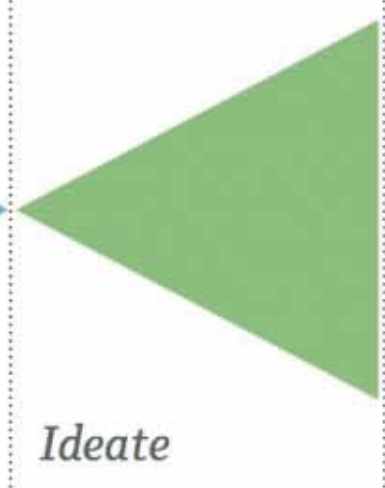
## Understand

Understanding ends in **Insight**.



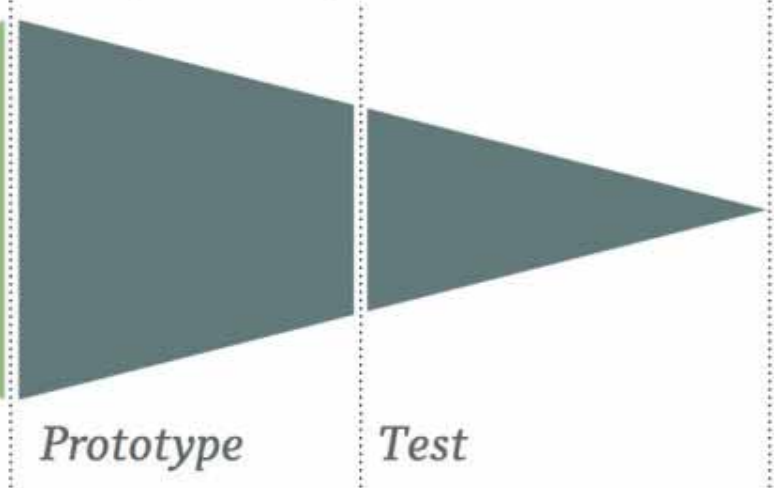
## Create

Creation ends in **ideas**.



## Deliver

Delivery ends in **reality**.



Extreme  
Empathy

Extreme  
Experimentation

# Toyota Motto & Precepts



The **“Spirit of Being Studious and Creative”** has been deeply embedded in the Toyota Way in all areas of operations — ever since the concept was very first introduced by Sakichi Toyoda, the founder of Toyoda Automatic Loom Works, Ltd. It is the fundamental concept behind "Good Thinking, Good Products," the slogan adorning Toyota factories around the globe. It was born from the Toyota Creative Ideas and Suggestions System (TCISS), which encourages employees to suggest improvements at work.

**Good Thinking, Good Products**



# 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 to be modernized. Toyoda took the idea 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.

# Washer Process Innovation



Entry View

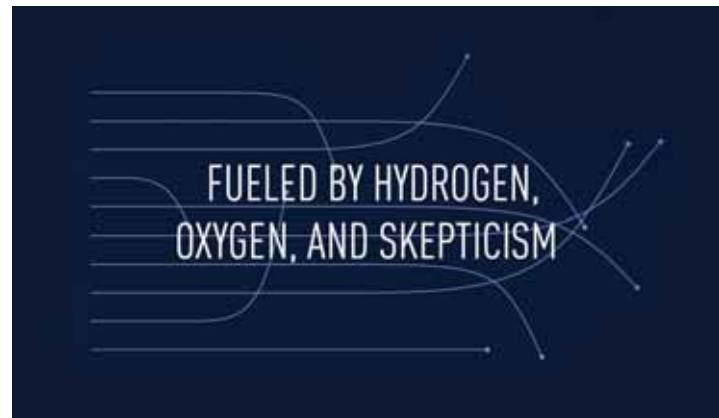


Front View

# Employee Improvement Idea

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

# Prius, Lexus, & Mirai



# 5 Why Example Revisited

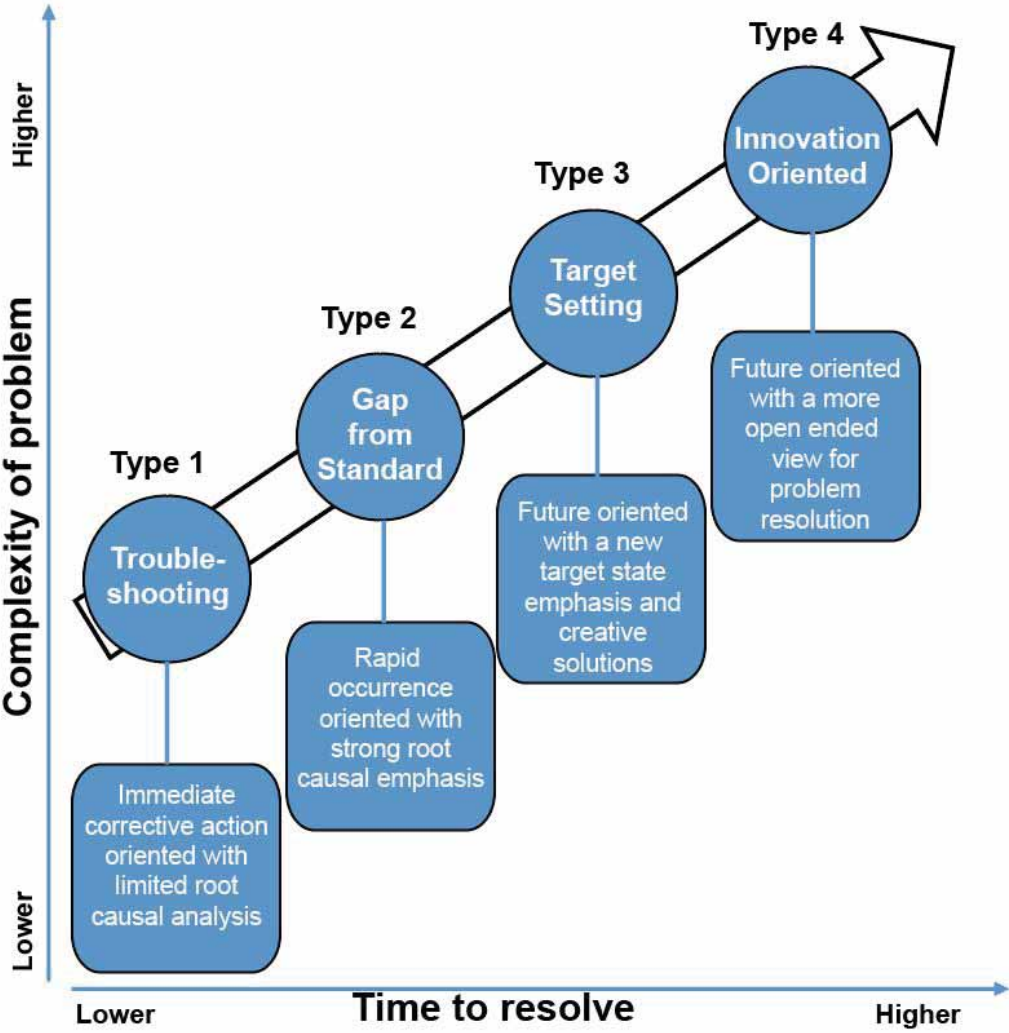
**Situation: A machine tool has stopped working halting production.**

- 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.”

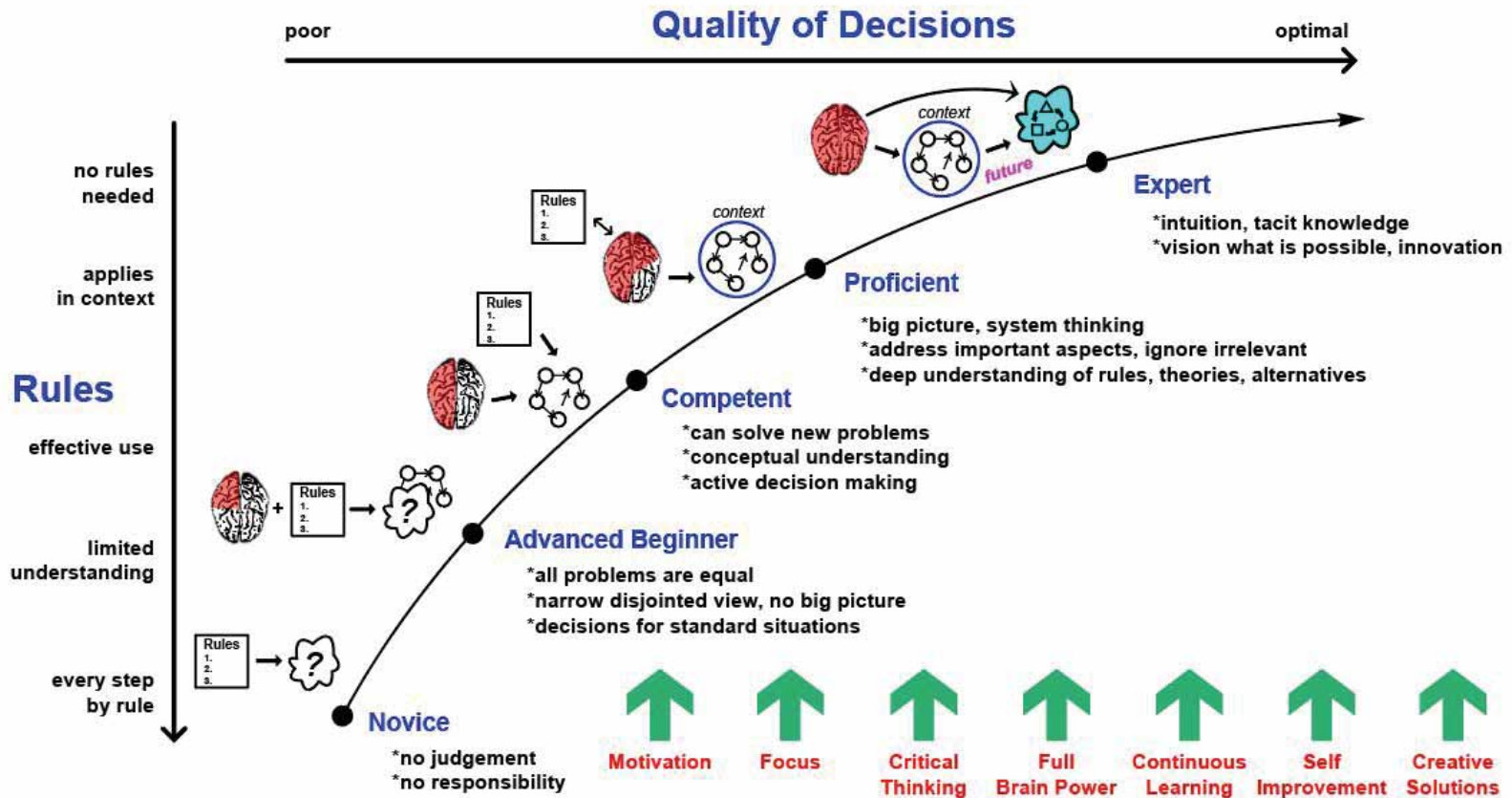
# 5 Why Revisited

- Type 1 - Troubleshoot cutting chips by daily cleaning and maintenance of the machine.
- Type 2 – Put the strainer on the inlet port in the previous example for recurrence prevention.
- Type 3 – Evacuate the cutting chip(s) better by breaking the cutting chips via tool breaker, with better coolant systems, chip breakers, and better tooling conditions. Also improve machine guards and tank covers.
- Type 4 – Tooling innovation, chip formation optimization, cutting condition innovation, washer process innovation, and upstream die casting optimization.

# 4 Types of Problem Situations



# Genesis of An Expert





# Summary

- Benkei & 7 QC Tools expert analogy
- Be careful of experts who only know one way
- Learning by doing is key for all four types
- Reflection after doing is key as well
- You can't just "think" your way to improvement
- Problem solving, innovation and improvement require perspiration
- Necessity is the mother of every invention...
- ...Not some kooky consulting problem solving framework - including mine!

# Appendix

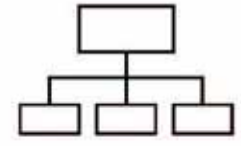
1 PURPOSE



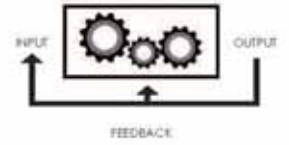
2 ENVIRONMENT



3 STRUCTURE



4 SYSTEMS/TOOLS



5 COMMUNICATIONS



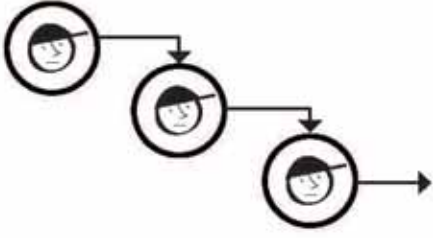
6 THINKING PATTERNS



7 BEHAVIORS & ACTIONS

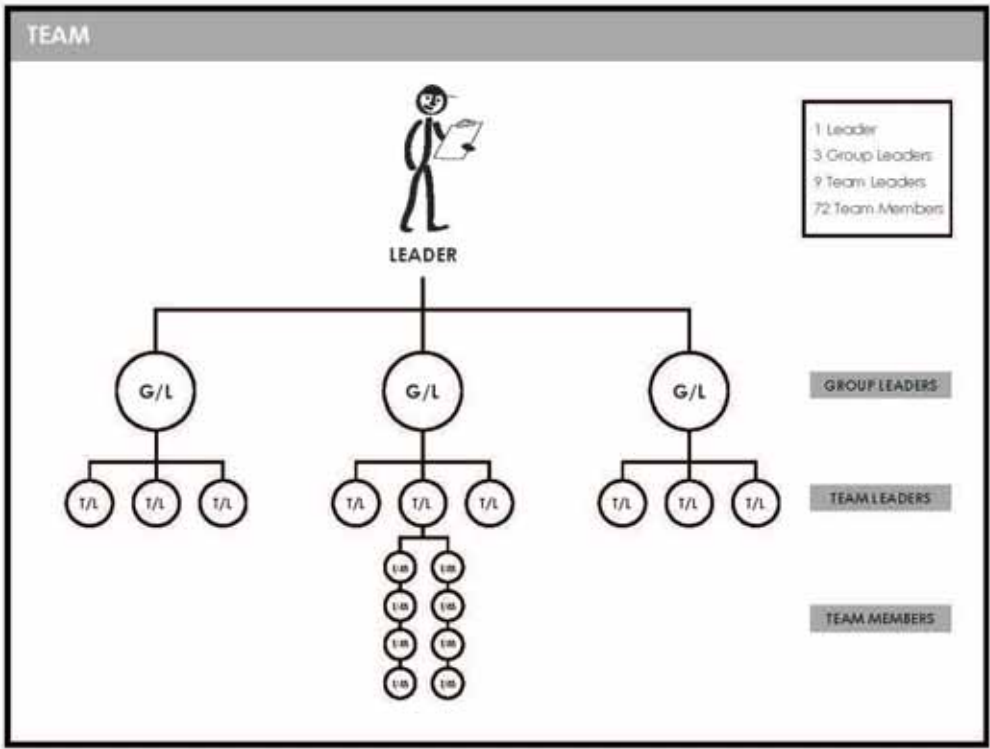


LEADERSHIP WORKS THROUGH LEVELS



LEADERS OBTAIN RESULTS THROUGH PEOPLE & PROCESSES

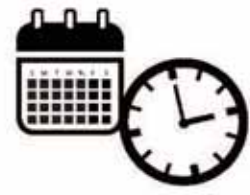
- METRICS
- ATTITUDES
- RELATIONSHIPS



10 RESOURCES & SUPPORT



9 TIME FRAME



8 PROCEDURES & STANDARDS

