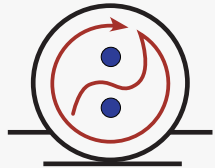


15<sup>th</sup> Annual Northeast Lean Conference

# Four types of problems

**Art Smalley**  
President



ART of Lean



# Short Introduction

## Work Experience Related

Toyota Motor Corp. Japan  
Director Donnelly Corporation  
McKinsey & Company  
Art of Lean, Inc.

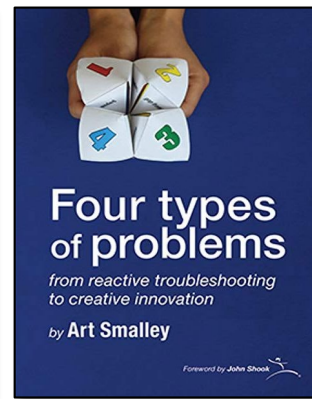
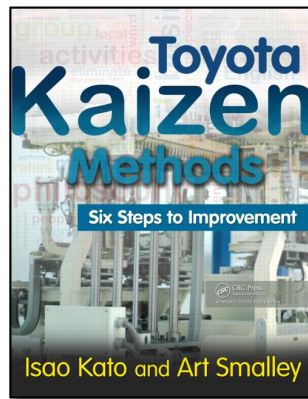
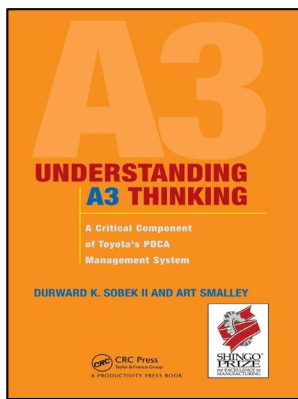
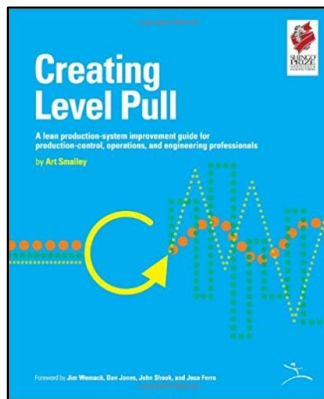


## Home / Family Related

Wife & 3 Daughters  
Cypress, California

## Hobby Related

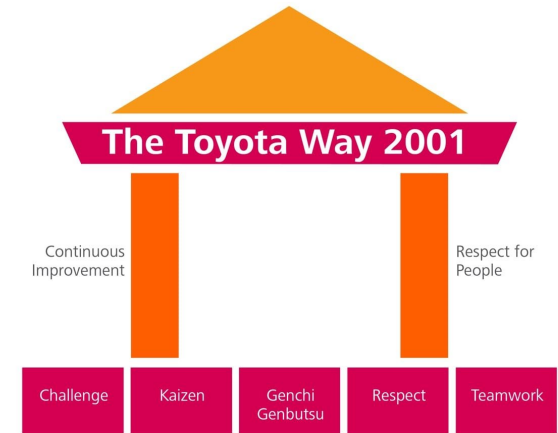
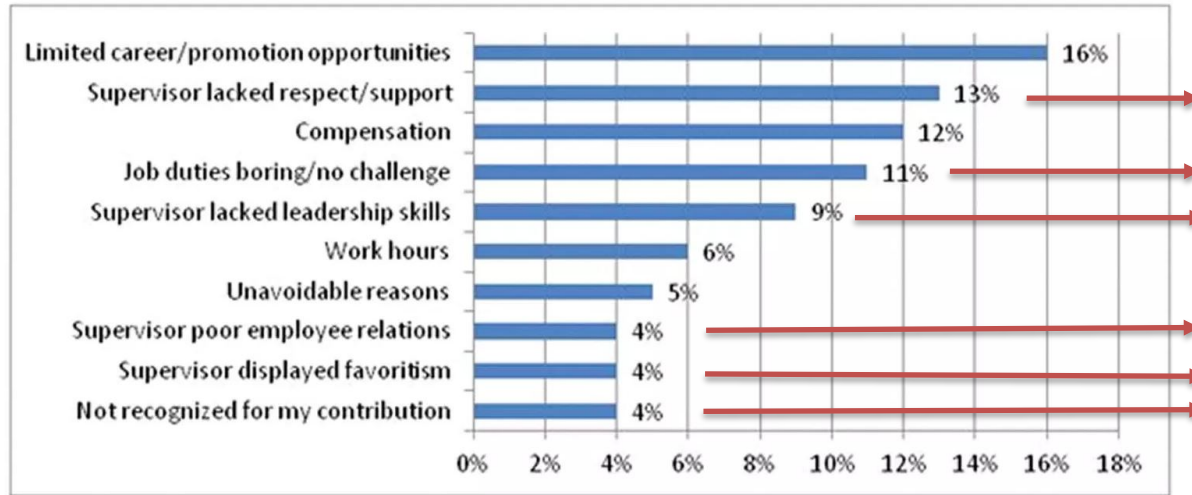
Photography  
Woodworking  
Reading  
Judo / Jiujutsu / Kali



- LEI Transformation Framework
- What are the 4 Types?
- Why propose 4 Types? Why not just one?
- What type of situation does each one best address?

# Why People Leave Jobs

Ask employers why people quit a company and 9 out of 10 will tell you it's about the money. Ask employees the same question and you'll get a whole different story. PricewaterhouseCoopers (PwC) discovered this when they asked 19,000+ people their reasons for leaving as a part of exit interviews they conducted for clients. The top 10 reasons why employees quit? Check out the responses below.



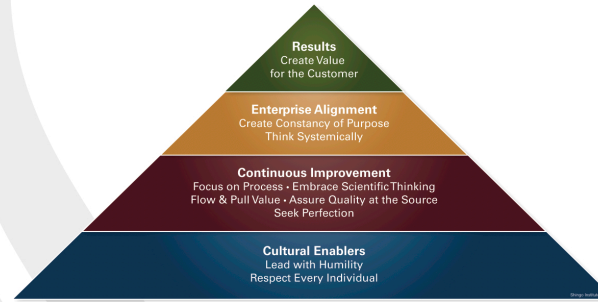


# Shingo Model

THE SHINGO MODEL™



THE GUIDING PRINCIPLES™



THREE INSIGHTS OF ENTERPRISE EXCELLENCE™

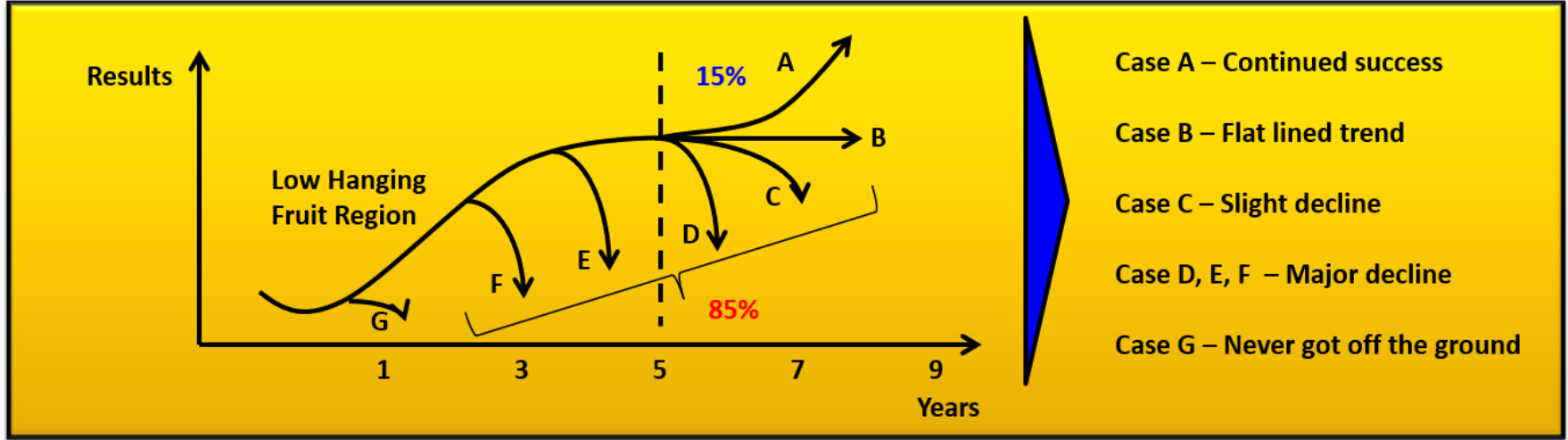
1. Ideal Results Require Ideal Behavior
2. Beliefs and Systems Drive Behavior
3. Principles Inform Ideal Behavior



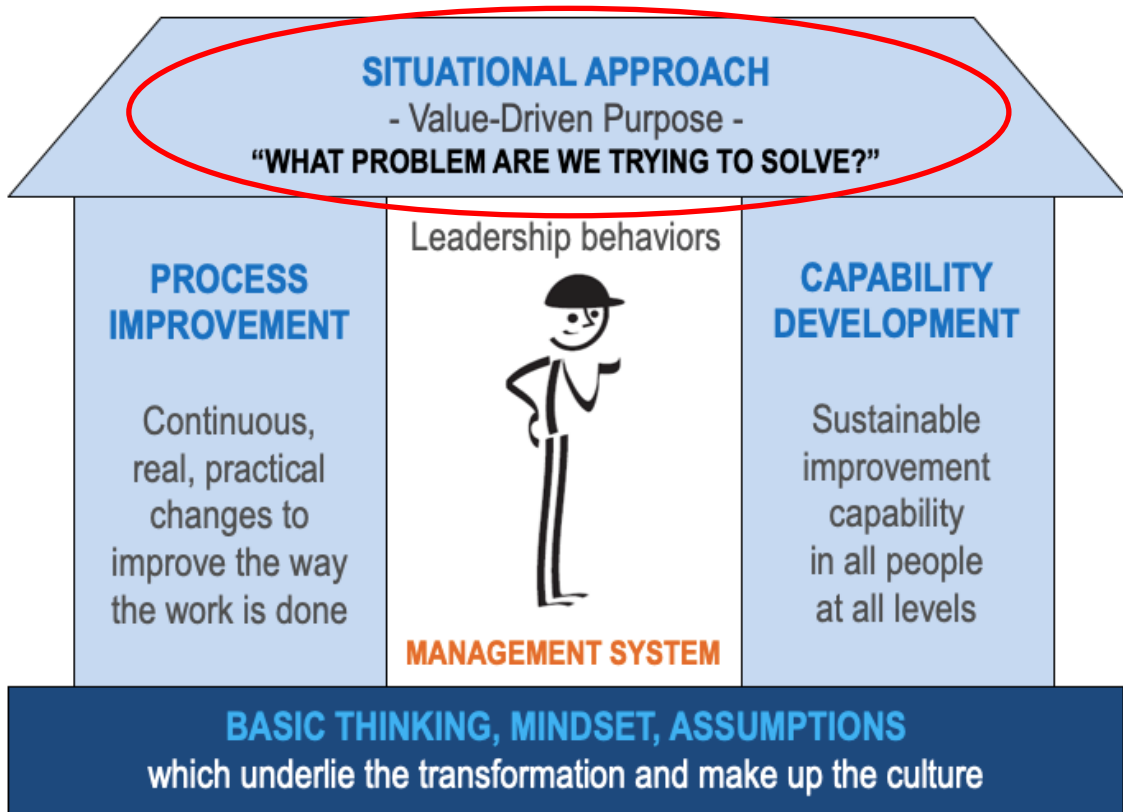
HOME OF THE SHINGO PRIZE

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# Lean Transformation Reality?



# LEI Transformation Framework



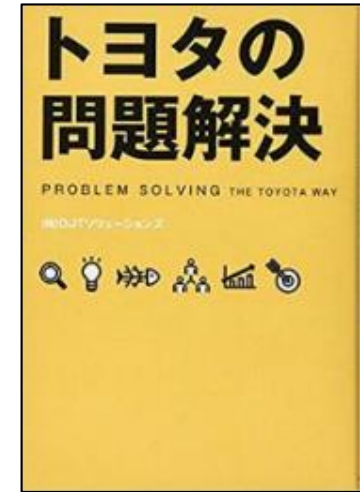
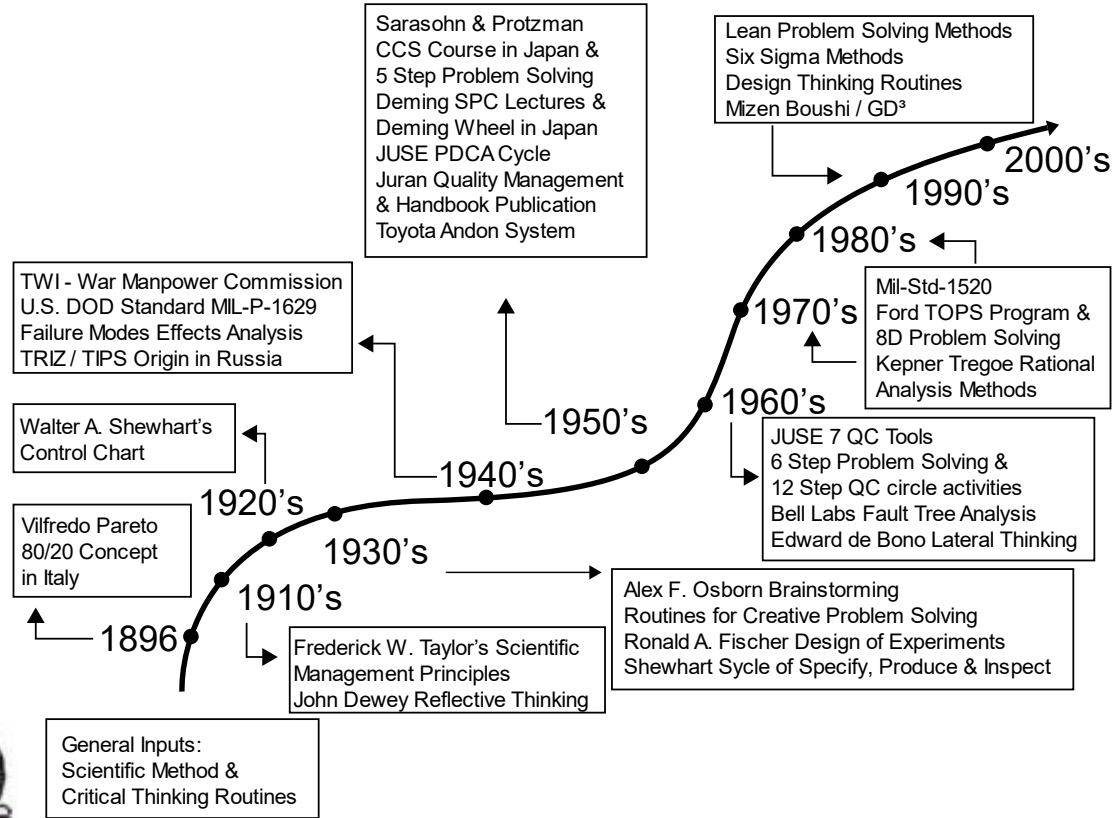
Not just: What lean tool can I use?

Nor: How many kaizen events do I conduct?

Nor: Now much training do I need to schedule?

**What problem are you trying to solve and how will you go about it???**

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



# 4 Types of Problems

## Why 4 Types??

Just Do It!!

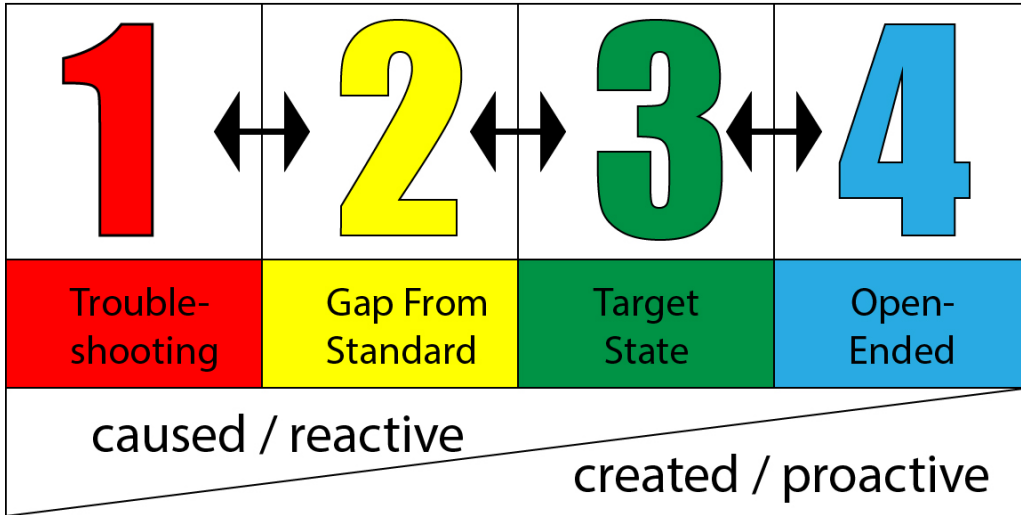
Kaizen Events!!

PDCA!! Kata!!

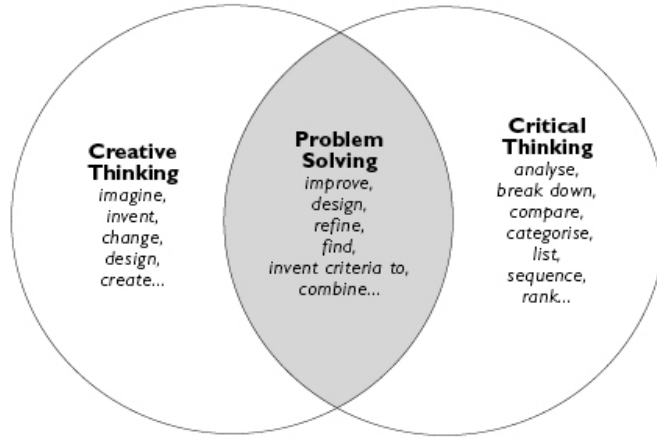
Six-Sigma DMAIC!!

Scientific Method!!

Design Thinking!!



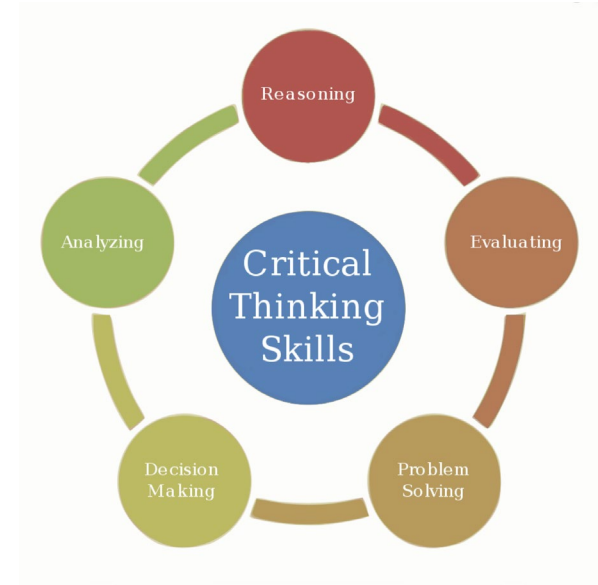
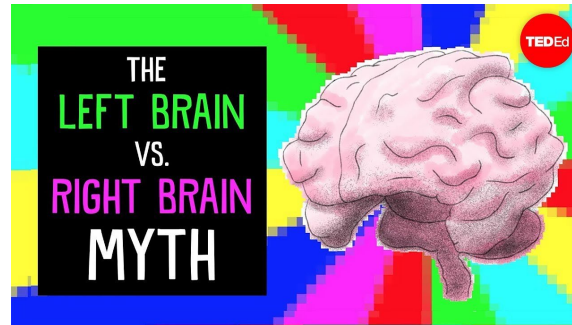
# External Consideration Factors



Dr Edward de Bono's  
**Six Thinking Hats®**

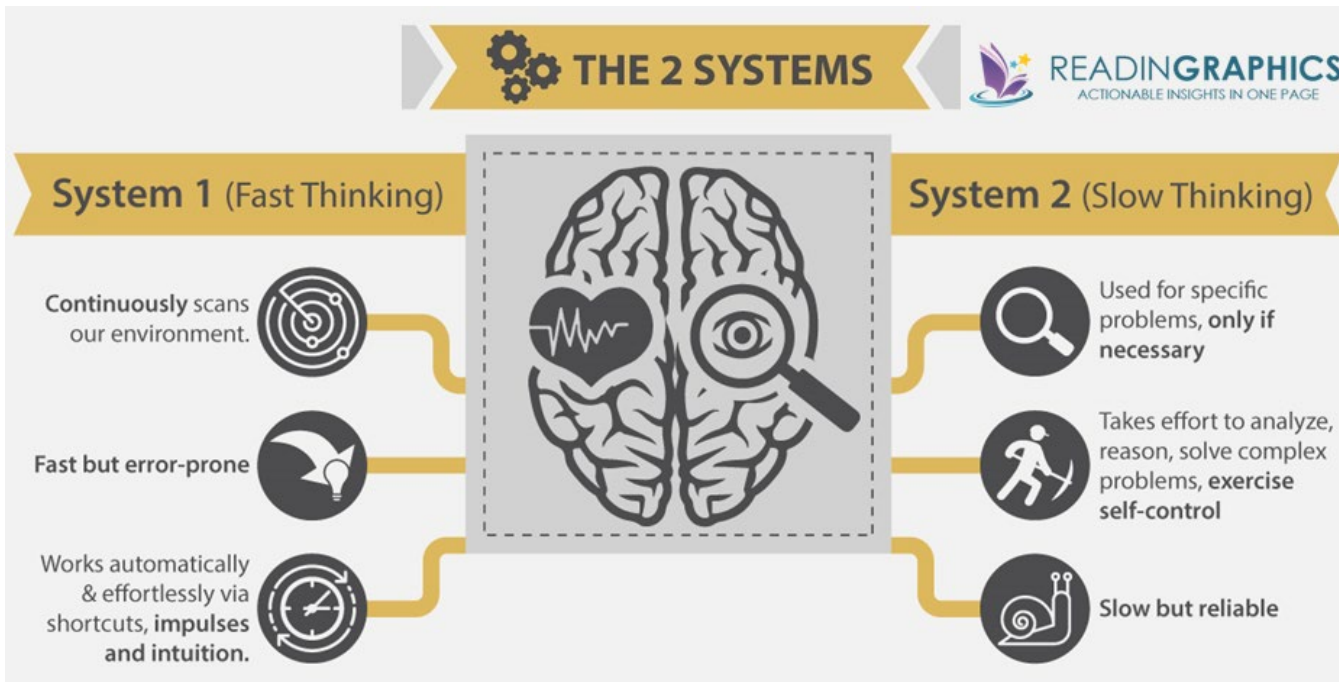
 <b>Red Hat</b> intuition, hunches, & feelings	 <b>White Hat</b> information available & needed, facts and data
 <b>Yellow Hat</b> benefits, value & positive aspects	 <b>Black Hat</b> caution, difficulties, risks & weaknesses
 <b>Green Hat</b> alternatives & creative ideas	 <b>Blue Hat</b> managing the thinking, focus, summary

For information on Deliberate Creative Thinking™ contact mindwerx International Pty Ltd on 1800 060 982  
 de Bono materials © McQuay Group www.mindwerx.com.au



# External Consideration Factors

Type 1



Types

2

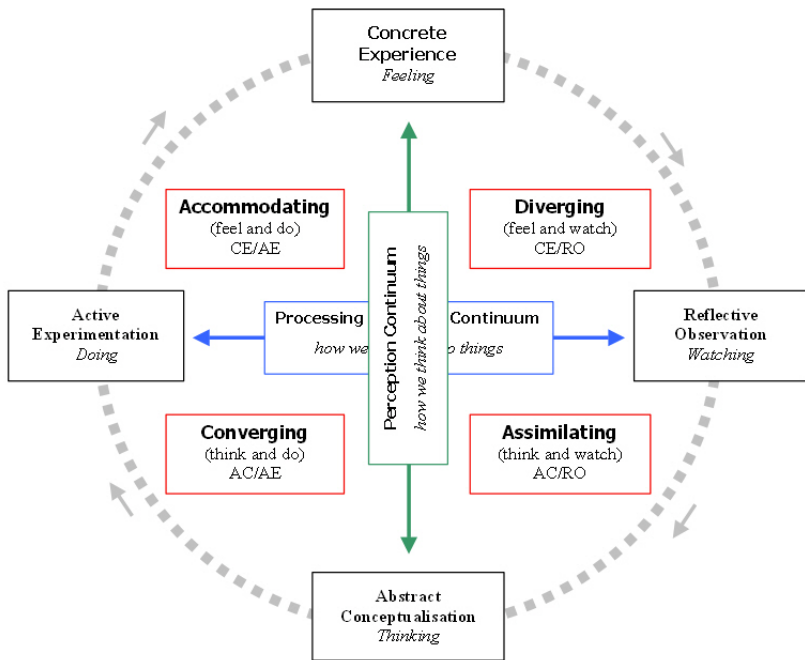
3

4



# External Consideration Factors

## Kolb Learning Styles

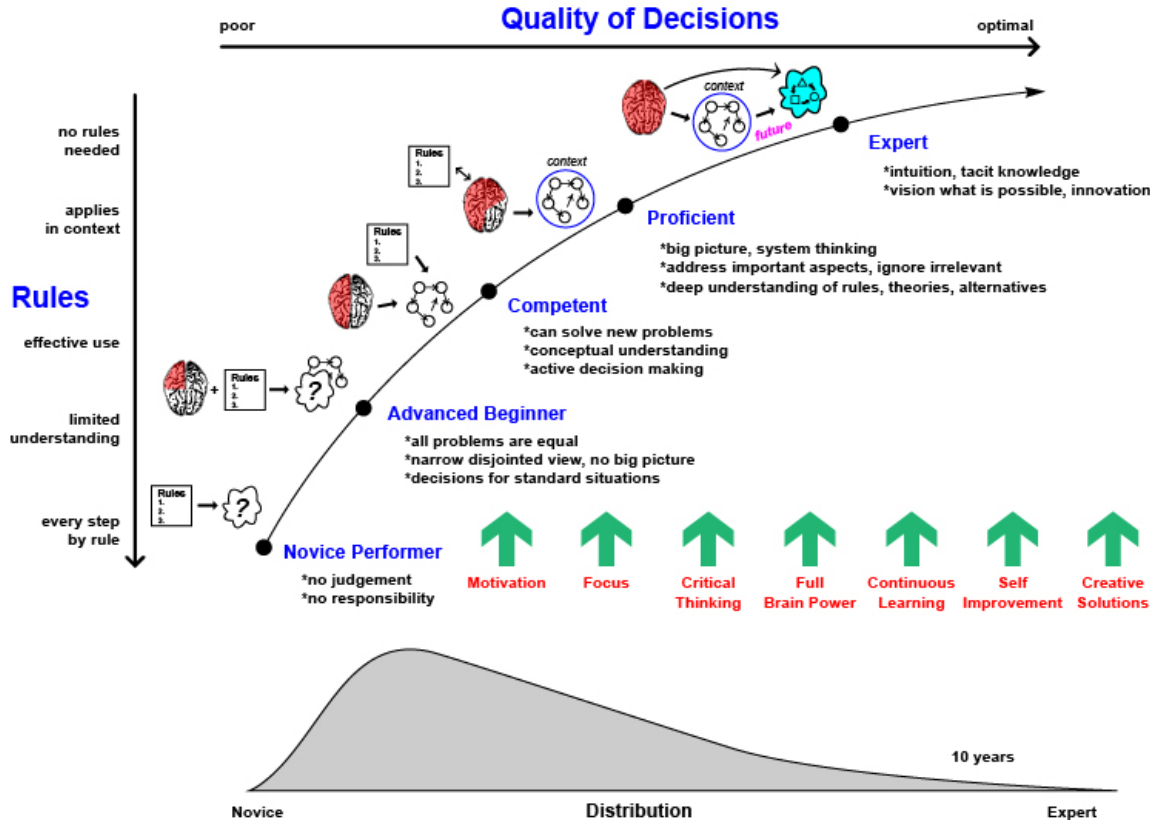


## Situational Leadership



# Dreyfuss Model














## Dreyfuss Model of Skill Acquisition



# Martial Arts Analogy



PROGRESSION OF GRADES (White belt to Black belt 5<sup>th</sup> Dan)

Kyu	Belts	Time Requirement	Kata required
9-Ku KYU	 WHITE WITH YELLOW STRIPE	4 months and/ or at the Sensei's discretion	SHIHO UKE, JUNI NO KATA
8-Hachi KYU	 YELLOW	4 months and/ or at the Sensei's discretion	HEIAN NIDAN
7-Shichi KYU	 ORANGE	4 months and/ or at the Sensei's discretion	HEIAN SANDAN, HIJI ATE GOHO
6-Roku KYU	 GREEN	4 months and/ or at the Sensei's discretion	HEIAN SHODAN
5-Go KYU	 BLUE	4 months and/ or at the Sensei's discretion	HEIAN YONDAN
4-Yon KYU	 PURPLE	4 months and/ or at the Sensei's discretion	HEIAN GODAN, JUROKU
3-San KYU	 BROWN	4 to 6 months and/ or at the Sensei's discretion	JITTE, ITOSU ROHAI SHODAN
2-Ni KYU	 BROWN 1 STRIPE	4 to 6 months and/ or at the Sensei's discretion	NAIHANCHIN SHODAN, MATSUMORA ROHAI
1-Ikkyu	 BROWN 2 STRIPES	6 months and/ or at the Sensei's discretion	BASSAI DAI, SHINSEI
SHODAN	 SHODAN 14 years old required	Minimum 12 months and/ or at the Sensei's discretion	*BASSAI DAI, SEIENCHIN, Heian Shodan to Heian Godan, Juroku, Jitte, Itosu Rohai Shodan, Naihanchi Shodan, Matsumora Rohai, Shinsei
NIDAN	 NIDAN 17 years old required	Minimum 24 months and/ or at the Sensei's discretion	*KOSOKUN-DAI, SEIPAI, MATSUKAZE, Heian Shodan to Heian Godan, Juroku, Jitte, Itosu Rohai Shodan, Naihanchi Shodan, Matsumora Rohai, Shinsei, Bassai Dai, Seienchin, Jion
SANDAN	 SANDAN 21 years old required	Minimum 36 months and/ or at the Sensei's discretion	*CHINTO, NIPAPO, KURURUNFA, KOSOKUNSHO Heian Shodan to Heian Godan, Juroku, Jitte, Itosu Rohai Shodan, Naihanchi Shodan, Matsumora Rohai, Shinsei, Bassai Dai, Seienchin, Jion, Kosokun Dai, Seipai, Matsukaze
YONDAN	 YONDAN 26 years old required	Minimum 48 months and/ or at the Sensei's discretion	*GOJUSHIHO, SHISOCHIN, NIPAPO, SEISAN Heian Shodan to Heian Godan, Juroku, Jitte, Itosu Rohai Shodan, Naihanchi Shodan to Sandan, Matsumora Rohai, Shinsei, Bassai Dai, Seienchin, Jion, Kosokun Dai, Seipai, Matsukaze, Chinto, Kururunfa, Kosokunsho
GODAN	 GODAN 32 years old required	Minimum 60 months and/ or at the Sensei's discretion	*SUPARINPEI, UNSHU, Heian Shodan to Heian Godan, Juroku, Jitte, Itosu Rohai Shodan, Naihanchi Shodan to Sandan, Matsumora Rohai, Shinsei, Bassai Dai, Seienchin, Jion, Kosokun Dai, Seipai, Matsukaze, Seisan, Kosokunsho

\*From Shodan to Godan, the katas printed in Blue color are mandatory and those in Red color, are the Free (Toku) kata that candidates can choose from.

Beginner

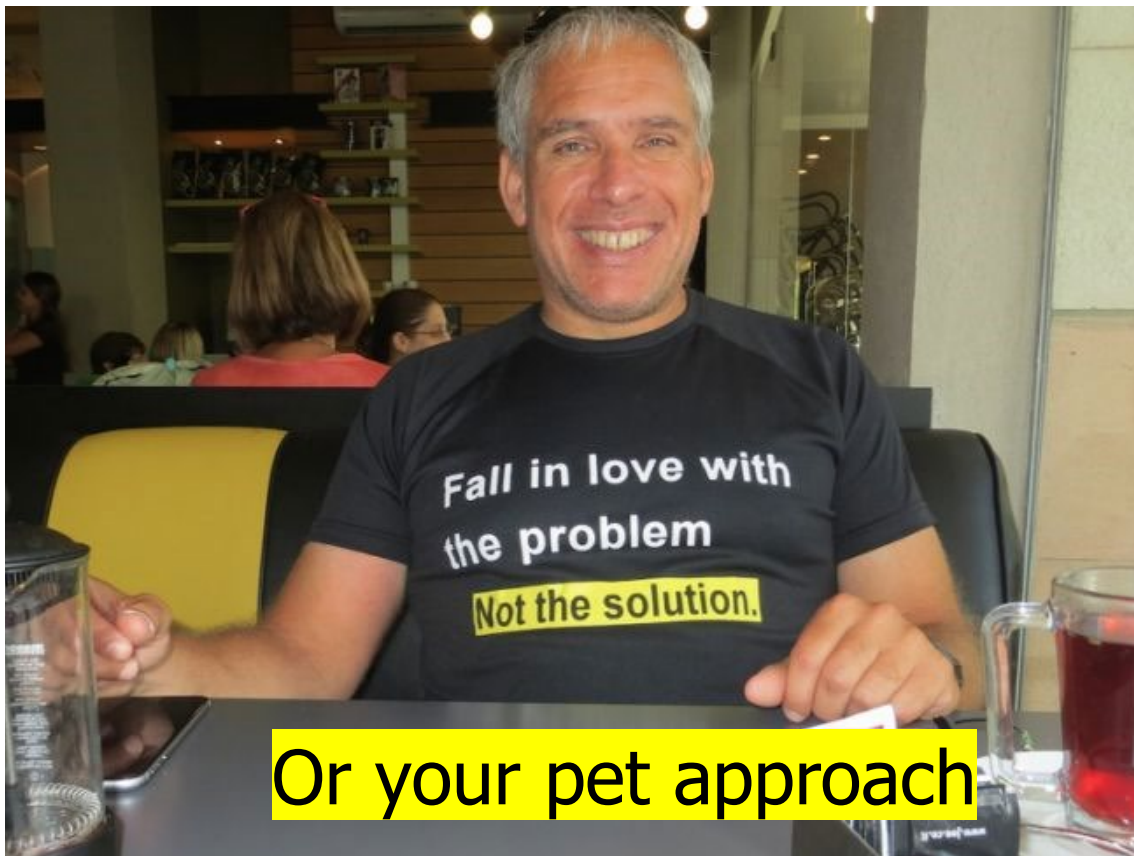
Advanced



All models are wrong,  
but some are useful.

George E. P. Box

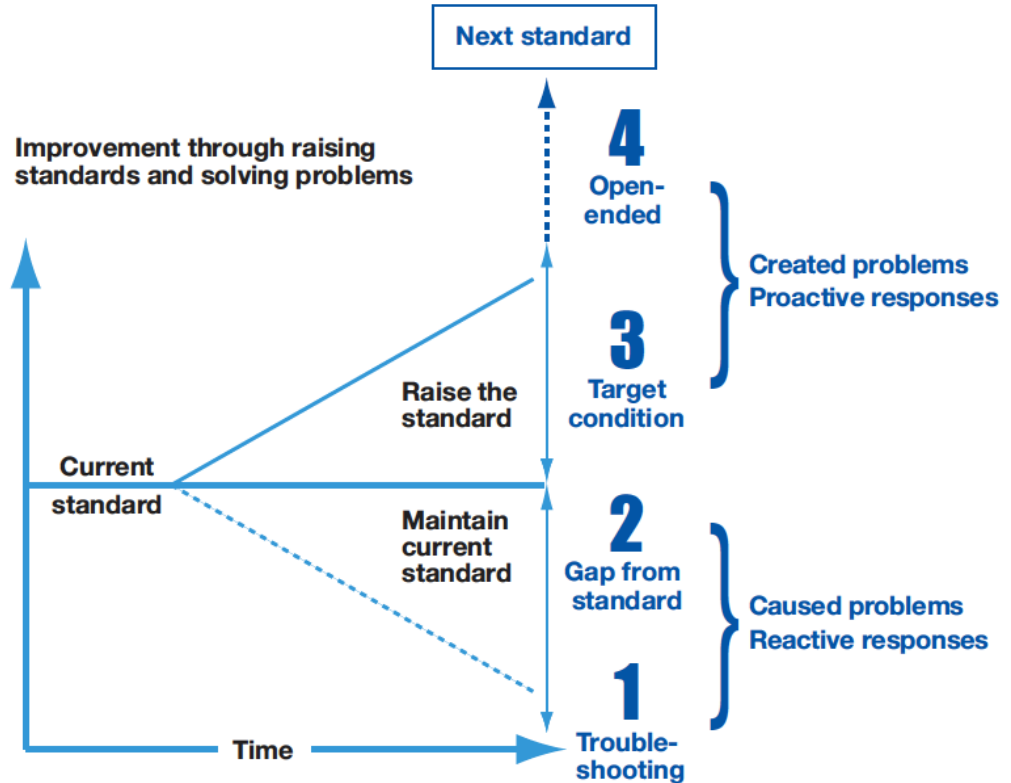
quotefancy



**Uri Levine**  
**Co-Founder Waze**

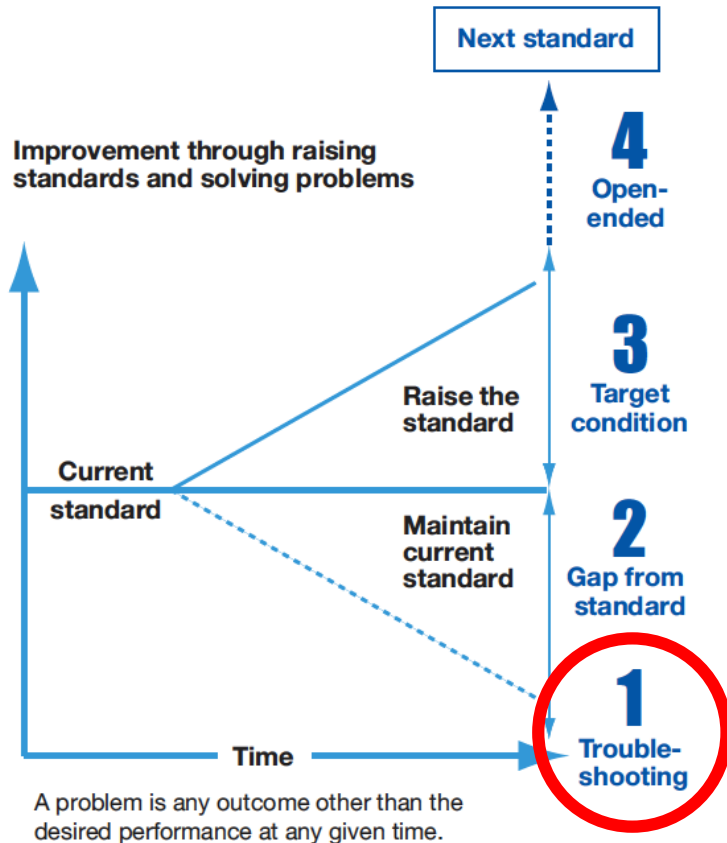


# Toyota Historical Viewpoint



A problem is any outcome other than the desired performance at any given time.

# 4 Types of Problems

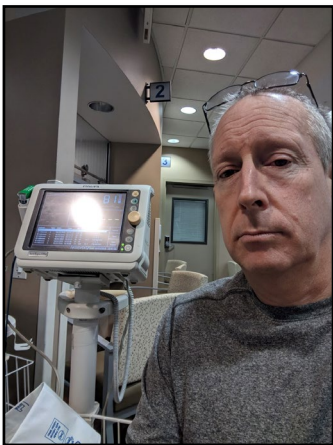


## Type 1 Problem Approach

- Concept of fixing problems now
- First responder mentality
- Protect the customer
- Engage the workforce RFP
- Makes for a better day
- Displaying courage, creativity, and the spirit of challenge



# Commonalities?



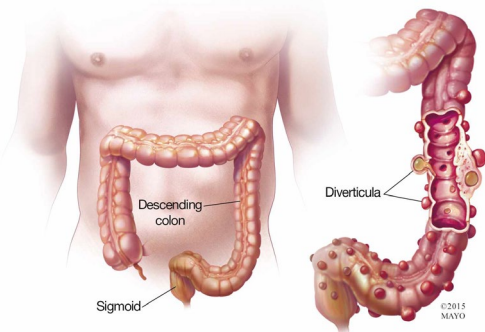
## Yahoo breaks its own record with new announcement that 1 billion accounts were hacked in 2013

What's known so far about the worst breach on record

## Marissa Mayer testimony: I don't know how Yahoo hack happened

By Nicolas Vega

November 8, 2017 | 11:20am | Updated



**YAHOO!**



**Details of the breach**

- Yahoo recently discovered a record-setting breach of 1 billion user accounts, compromising names, e-mail addresses, telephone numbers, dates of birth and passwords
- The incident, which occurred in August 2013, was discovered when, last month, law enforcement presented the company with data that according to a third-party belonged to Yahoo. A subsequent investigation confirmed this claim

**From bad to worse**

- In September the beleaguered firm announced that a state-sponsored actor hacked 500 million accounts in late 2014, the largest known breach until Yahoo broke its own record with yesterday's disclosure
- Though the 2013 and 2014 incidents are likely unconnected, the 2014 state-sponsored actor is suspected in connection with a separate security issue in which Yahoo's source code was hacked and used to forge cookies, which provide a way into users' accounts without passwords

**Verizon: "we will evaluate"**

- The latest revelation casts more doubt on Verizon's planned acquisition of Yahoo, a \$4.83 billion deal finalized in July
- Verizon had already voiced concern in the aftermath of September's disclosure, noting that the 2014 hack could be a material event
- After news of the total figure surfaced, Verizon stated "we will evaluate the situation as Yahoo continues its investigation. We will review the impact of this new development before reaching any final conclusions"



Former Yahoo CEO Marissa Mayer waits to testify before the Senate Commerce Committee on Capitol Hill in Washington on Wednesday.

# Troubleshooting vs. Root Cause



Rupture of oxygen tank #2 in the service module.

Damaged to a valve in the #1 oxygen tank, causing it to lose oxygen rapidly.

Oxygen stores, water, electrical power, and use of the propulsion system were lost inside of 3 hours.

## Type 1 Focus

### How to get home safely?

- Primary navigation impaired in the damaged Service Module. Abort moon landing. Move to LEM.
- Decision to return to Earth using Lunar Module for thrust
- Internal environment fell to 39° F
- Lack of potable water and food
- Dangerous CO<sup>2</sup> build up
- Free return trajectory around moon using its gravity to return to earth
- Power up of command module from shut down state
- Manual vital burn adjustments

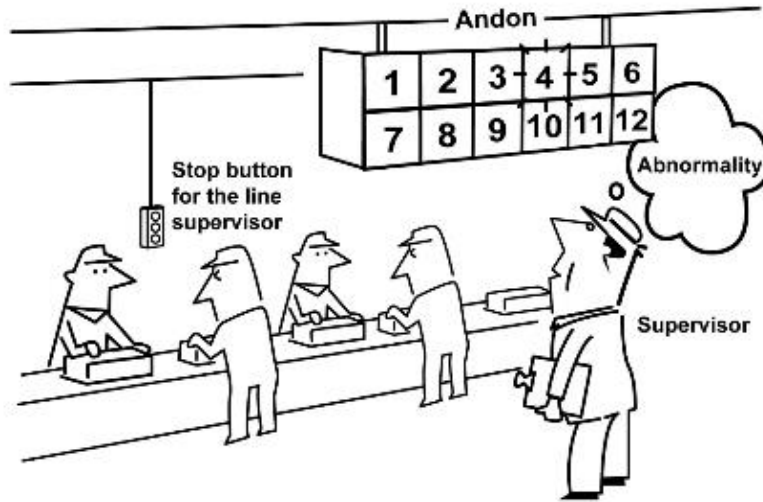
## Type 2 Focus

### Why did the tanks rupture?

- Oxygen tank dropped in assembly possibly causing some damage
- Tank drain tube misalignment factor
- Thermostat 28 volt vs. 65 volt design spec issue
- High tank temps 1000° F & wire insolation came off
- Two of the now-bare wires arced, caught fire, pressure rose, and the tank ruptured.

# Type 1 – Troubleshooting

## 異常処置 / Ijō Shochi



## Abnormality Management System

Condition based trigger

Time Constraint

Human based call for help

or

Machine based abnormality

**10,000 Andon calls – Not all are equal in terms of impact.  
What do you do as an organization?**

# Time & Quantity Trigger Based

Production Analysis Board

Line Fuel Line Cell			Team Leader Barb Smith			
Quantity Required 690			Takt Time 40 sec.			
Time	Plan	Actual	Plan	Actual	Problems/Causes	Sign-off
6-7	90	90	90	90		GL
7-8	90	88	180	178	tester failure	GL
8-9 <sup>10</sup>	90	90	270	268		GL
9 <sup>10</sup> -10 <sup>10</sup>	90	85	360	353	tester failure	GL
10 <sup>10</sup> -11 <sup>10</sup>	90	90	450	443		GL
11 <sup>40</sup> -12 <sup>40</sup>	90	90	540	533		GL
12 <sup>40</sup> -1 <sup>40</sup>	90	86	630	619	bad parts (valves)	GL

hourly      cumulative

Plan vs. Actual  
Time & quantity-based triggers

- Rapid Problem Solving
- Concern
  - Cause
  - Countermeasure
  - Check

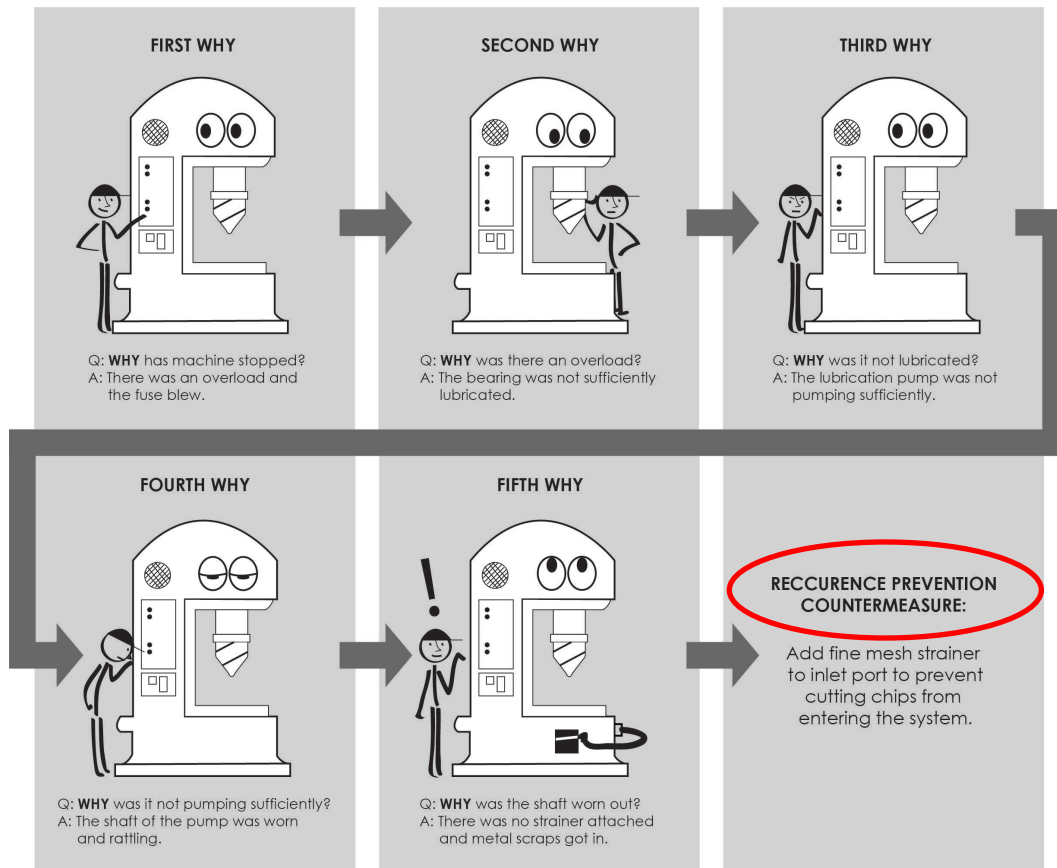


# Birth of the 5 Why's



## 3G's

- Go and See
- Get the Facts
- Grasp the Situation Details











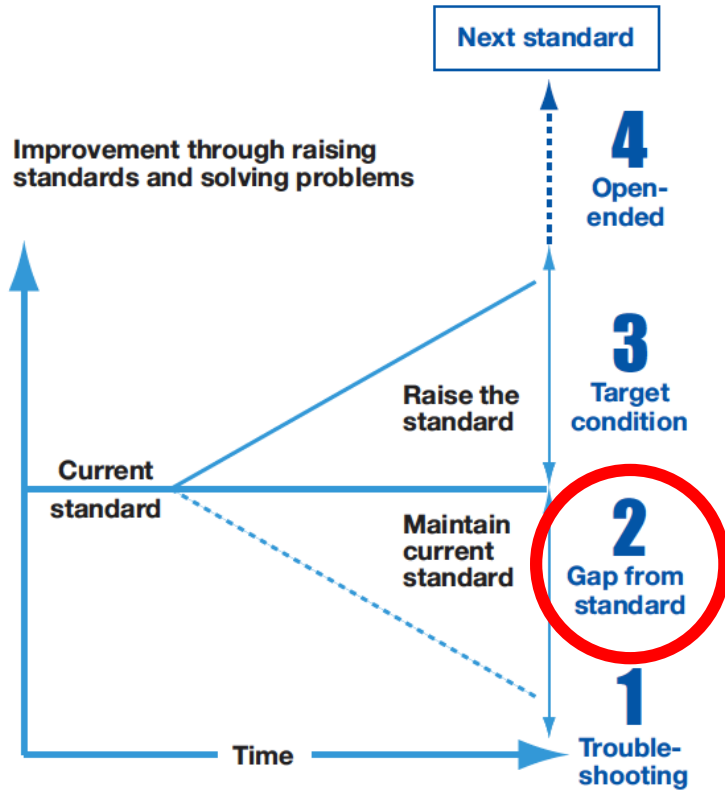
# Client Examples



## 4C Card

wipac PDCA Tracking Sheet						
Problem Identification		Actions Identified		Actions in place		Complete
No	Concern	Cause	Countermeasure	Resp	When	Status
6	Imports Damaged SS	SS wearing on container sides during transport	#1 shield material into Hoppers return to TS as WIP Issue SCAR to France! The best QM to France to Supply Curia	RB	11/20	<input type="checkbox"/>
				BE	12/1 12/11	<input type="checkbox"/>
	32 x 40 Pallets Require Top Board change ATP Robot	SCAR#1 - 1 x 3 software issues left need to change design	Arrange for Sample Pallet for test	SK	1/29	<input type="checkbox"/>

# 4 Types of Problems



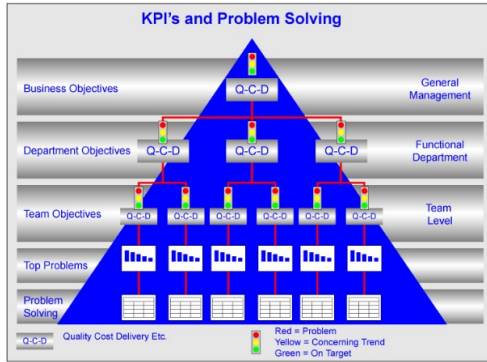
Some problems are severe, or recurring or hindering progress...troubleshooting alone won't solve these.

Convergent  
Deeper Dive / Detailed Analytic / Quantitative  
C&E Relationship (RCA)  
Types of Countermeasures  
System of Checks  
Standardized & Sustain

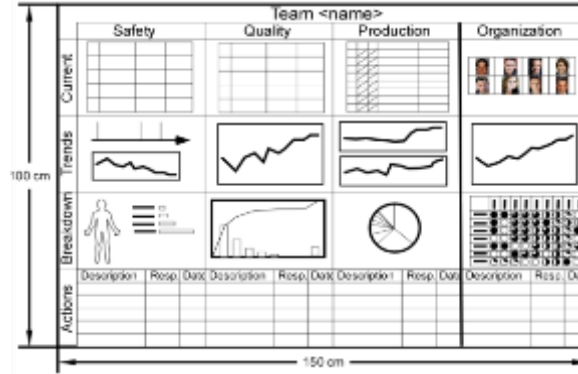
A problem is any outcome other than the desired performance at any given time.

# Type 2 – Gap from Standard

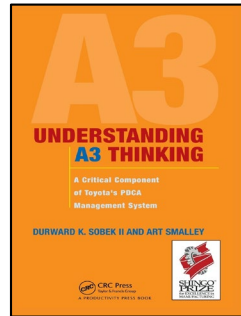
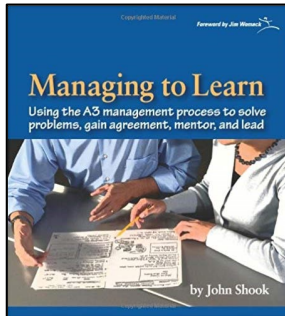
## Monthly



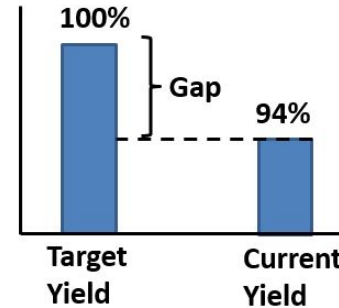
## Weekly



## Daily

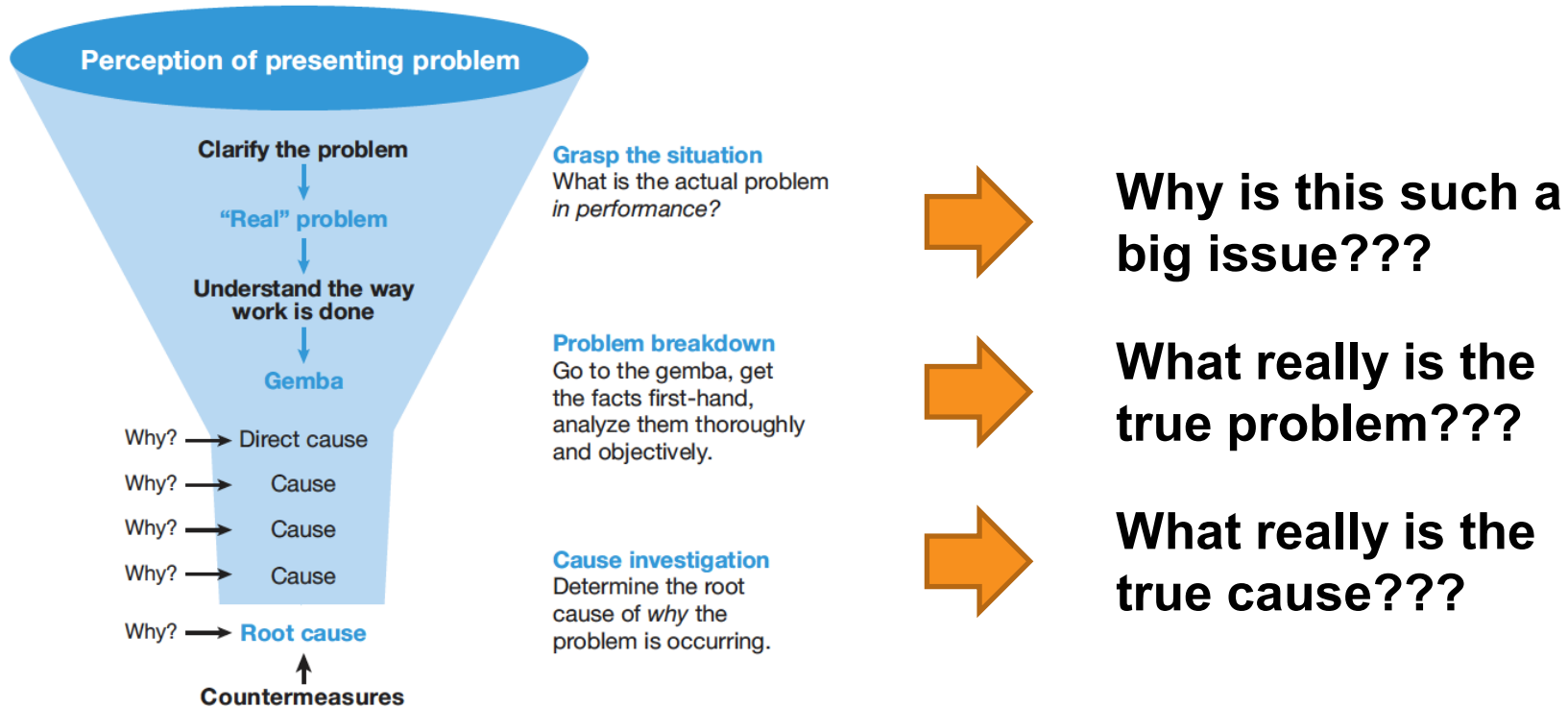


Yields



Why???

# Emphasis on Step by Step



## 7 Basic Steps of Type 2 Problem Solving

# Type 2 Example in A3 Format

## Example 1: Problem Solving A3 Report

Theme: Reducing Scrap in the Machine Shop

### Background

- Corporate Goals 2014**
  - Increase global market share
  - Improve quality and service
  - Increase corporate profits
- Manufacturing Goals 2014**
  - Reduce cost by 5%
  - Reduce scrap by 15%
  - Improve productivity by 7%
  - Improve HSE index by 10%

### Current Condition

Scrap by Department

Breakdown of Machine Shop Scrap Rates

Process	Milling	Turning	Drilling	Rough Grinding	Final Grinding
Scrap %	1.5	0.9	0.7	3.7	8.7
Scrap \$	40K	27K	23K	150K	460K
Status	▲	●	●	×	×

Legend: ● 0-1%, ▲ 1-2%, × >2%

### Goal Statement

By December 2014:

- Reduce scrap in rough grinding from 3.7% to less than 2%.
- Reduce scrap in final grinding from 8.7% to less than 2%.

### Root Cause Analysis

Issues by Defect Type

Undercut Shaft defect

```

graph LR
    Root[Undercut Shaft defect] --- Man[Man]
    Root --- Mater[Material]
    Root --- Meth[Method]
    Man --- Cont[Contaminates]
    Man --- Setup[Setup wheel setup]
    Man --- Off[Misaligned wheels]
    Mater --- Hard[Hardness]
    Mater --- Finish[Surface finish]
    Meth --- Grind[Grinding conditions]
    Meth --- Coat[Coated concentration]
    Meth --- Dress[Wheel dressing]
    
```

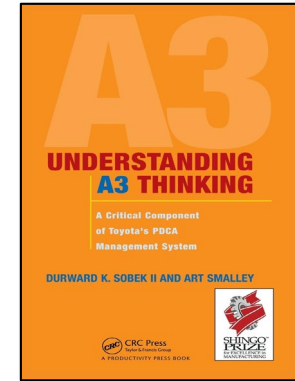
### Countermeasures

Suspected Cause	Action Item	Responsible	Due	Finding
1. Oil and contamination	Daily 5S & PM tasks	Tony (TL)	11/27	Conducting daily. No issues
2. Grinding wheel setup check	Grinding wheel setup check	Tony (TL)	11/24	Checked out okay.
3. Manual wheel function	Check wheel function	Tony (TL)	11/24	Checked out okay.
4. Spindle bearing loose	Spindle bearing check	Ed (Maint)	11/25	Loose bearing cap. Tightened.
5. Clamp & bracket damage	Clamp & bracket check	Ed (Maint)	11/25	Milling abnormal.
6. Grinding wheel balance	Grinding wheel check	Tony (TL)	11/26	Nothing abnormal.
7. Swapping part dimensions	Measure part dimensions	Janet (QC)	11/29	Within spec.
8. Poor material hardness	Measure hardness	Janet (QC)	11/29	Within spec.
9. Abnormal surface finish check	Surface finish check	Janet (QC)	11/29	Within spec.
10. Abnormal grinding conditions	Grinding condition check	Wag (Eng)	11/13	Nothing abnormal.
11. Coolant concentration	Measure concentration	John (Maint)	11/13	Contaminated tanks. Replaced.
12. Wheel dressing check	Check condition	Mar (Eng)	11/13	Nothing abnormal.

### Effect Confirmation

### Follow Up Actions

Investigation Item	Responsibility	Due	Status
1. Establish coolant check PM	Ops & Maintenance	11/15	Complete
2. Establish bearing check PM	Ops & Maintenance	11/15	Complete
3. Communicate findings to similar plants	Tom Eng Mgr	11/22	In progress
4. Discuss bearing issue with OEM	Tom Eng Mgr	11/20	Pending

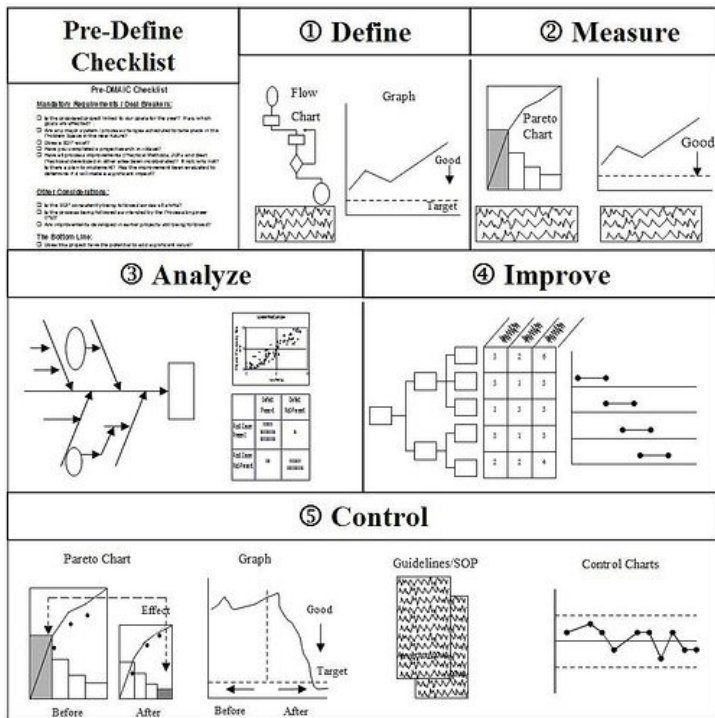


A3 is simply a tool for aiding the problem-solving process, showing your thinking, communicating and reporting progress

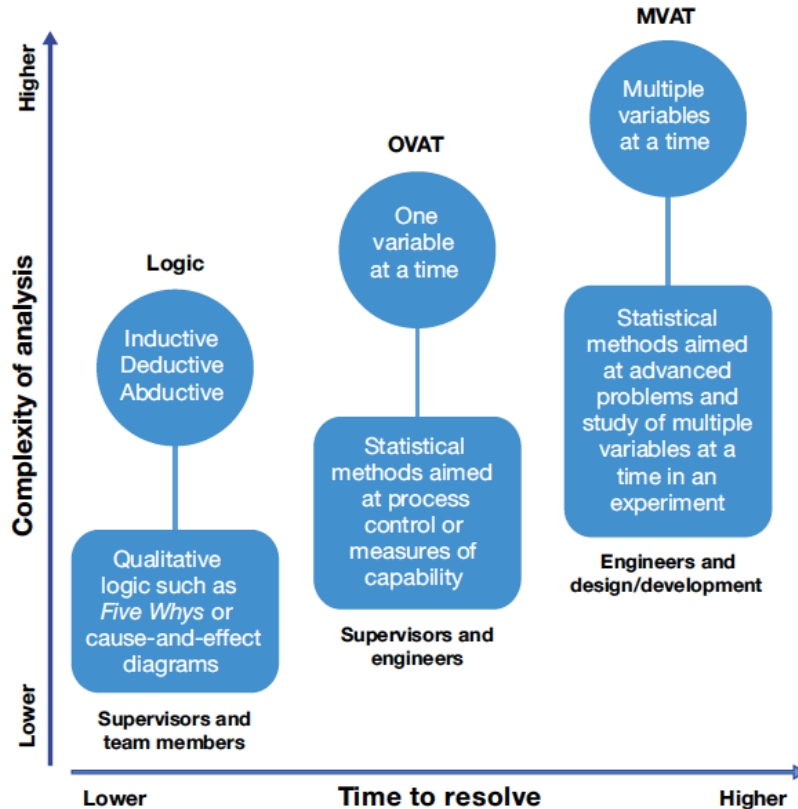


# Other Common Type 2 Examples

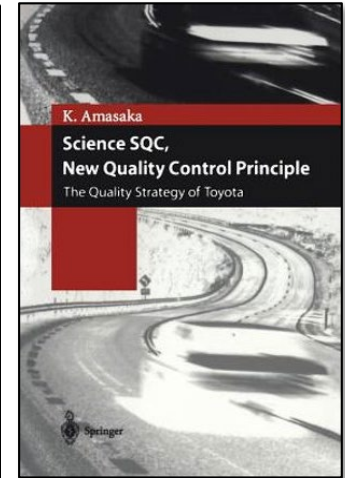
## DMAIC



# Type 2 Analysis Patterns

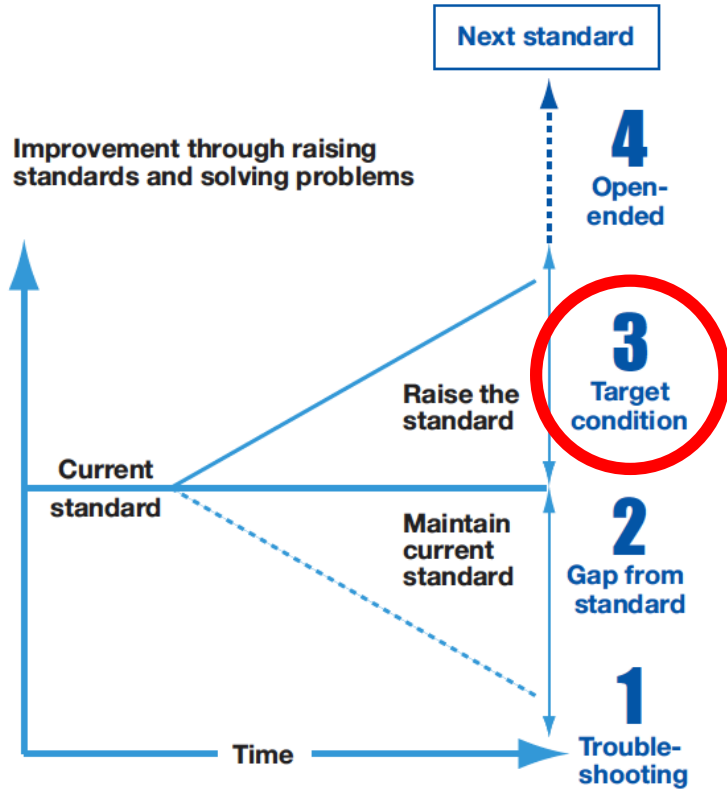


Convergent  
Disciplined  
Focused  
Analytic / Quantitative  
C&E Relationship  
Standard attainment  
Results emphasis

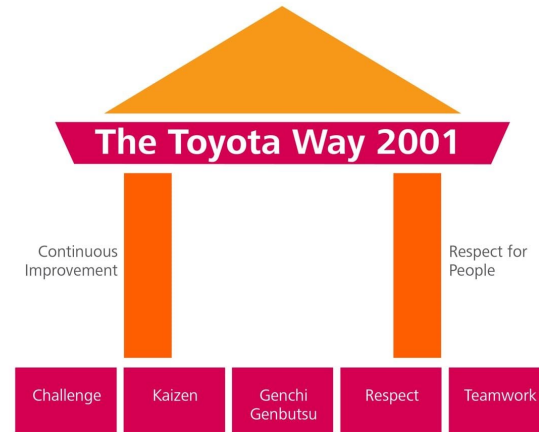




# 4 Types of Problems

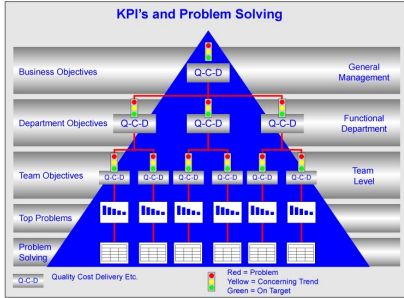


Divergent / Lateral Thinking  
Focus is less clear initially  
Analysis / Synthesis  
Creativity emphasis  
Scope is usually larger  
**Improvement over existing standard**

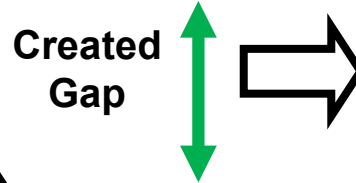


A problem is any outcome other than the desired performance at any given time.

# Type 3 Target State

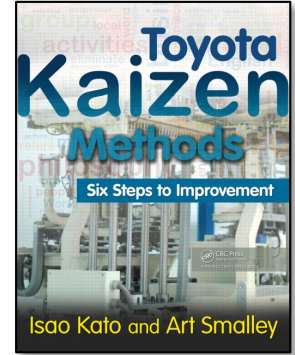


**(Future) Target Situation**

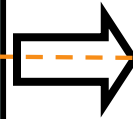


**Type 3 - "Target State"**

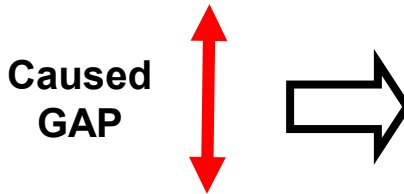
改善方法  
Kaizen Methods  
Creative Thinking



**Process Standard**

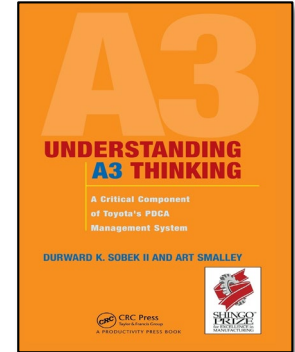


**Standard**



**Type 2 - "Gap from Standard"**

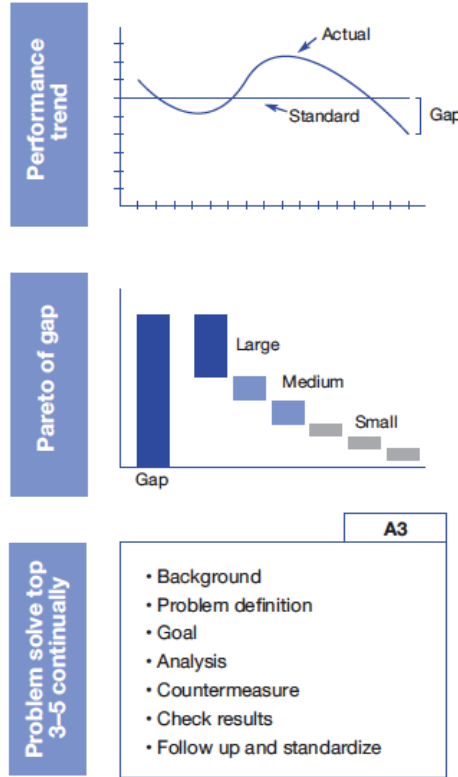
問題解決  
Problem Solving  
Critical Thinking



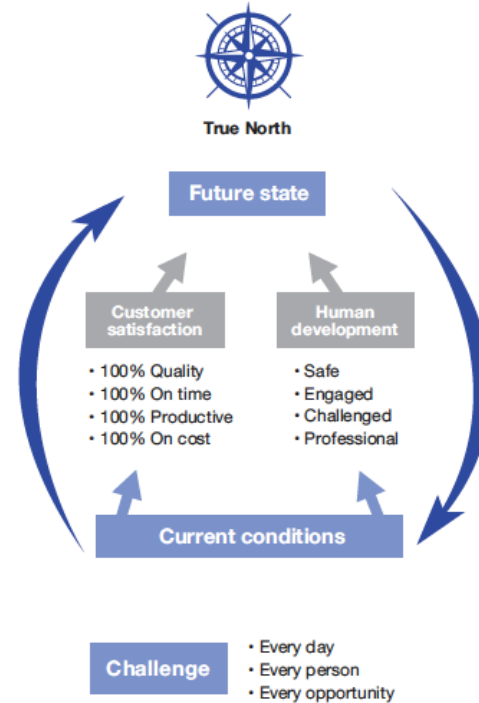
**Current Situation**

# Target State Concept (Future)

**Type 2**  
How things are or were  
(Past)

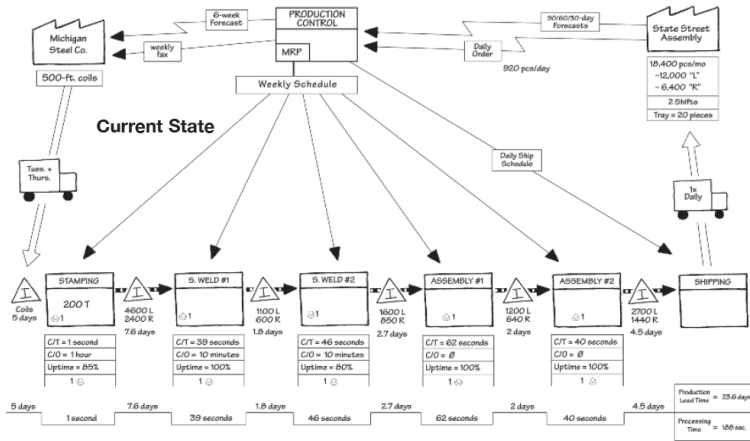


**Type 3**  
How things should be  
(Future)

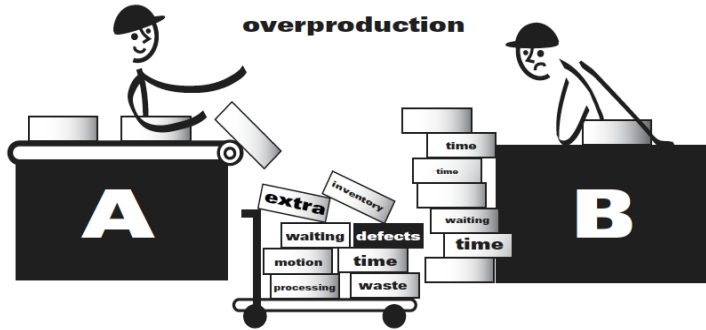


# Value Stream Map

## Current-State Value-Stream Map



- Long lead-time
- Wait time
- Excess inventory
- Variable quality
- Low flexibility
- Poor responsiveness
- Customer complaints
- Some Type 2 “Gaps” & Type 3 “System”



- Many problems / opportunities
- 7 Wastes everywhere
- Not generally a single root cause
- Systemic issues
- Creativity over Capital

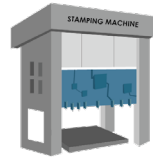
# Process Level Example (SMED)



Dedicated Press  
Part A



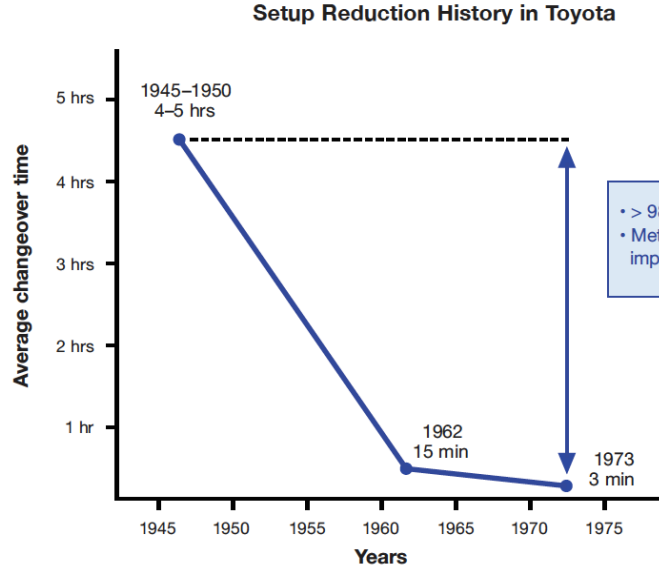
Dedicated Press  
Part B



Dedicated Press  
Part C



3 Dedicated Machines  
No Flexibility  
Each 30% Utilization

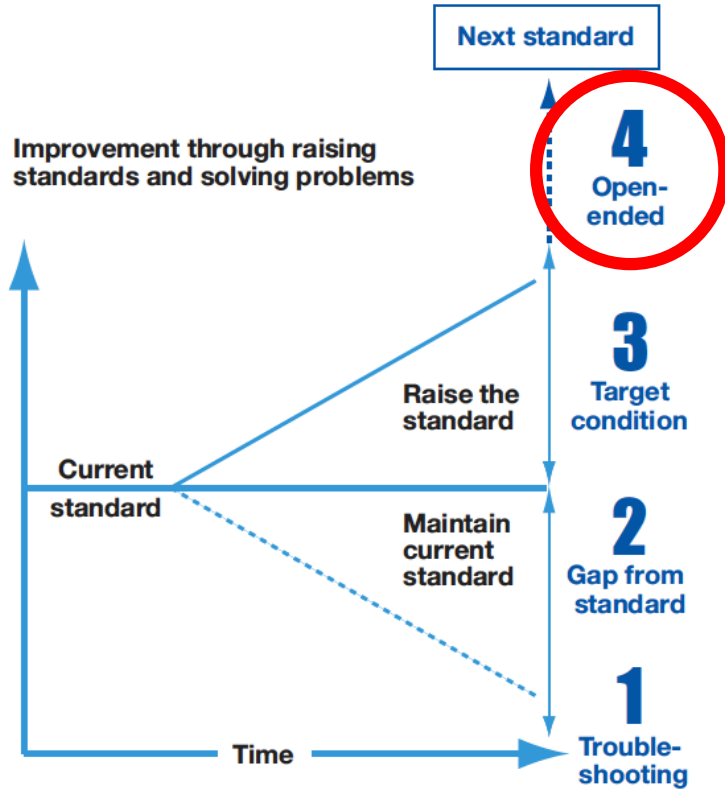


1 Machine / 3+ Tools  
Change Over Flexibility  
90% Utilization



Flexible Press  
Parts A, B, & C

# 4 Types of Problems



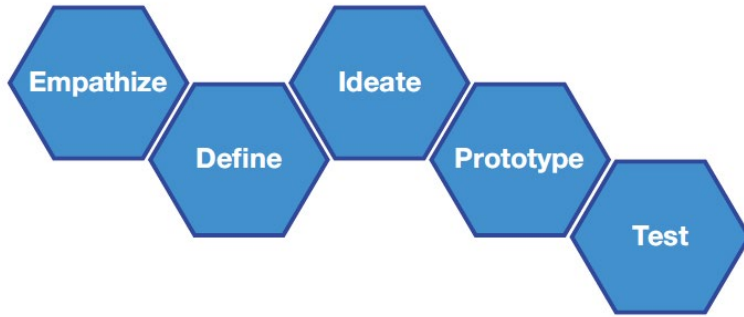
Small, medium & large  
Open ended  
Divergent / Lateral Thinking  
Focus is less clear initially  
Analysis / Synthesis  
Creativity emphasis  
Breakthrough concept

A problem is any outcome other than the desired performance at any given time.

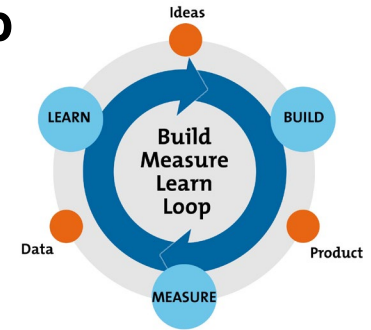


# Type 4 Open Ended / Innovation

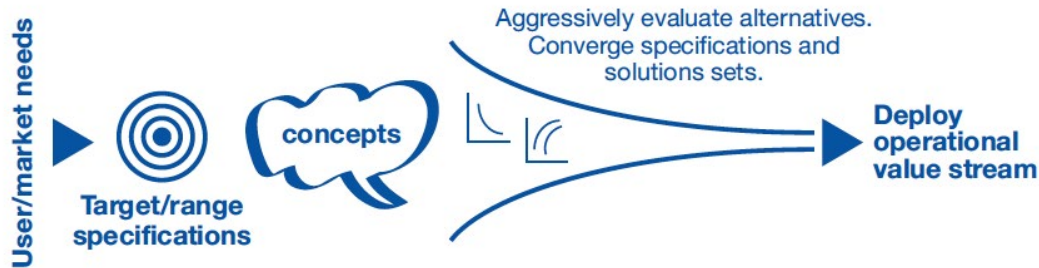
## Design Thinking



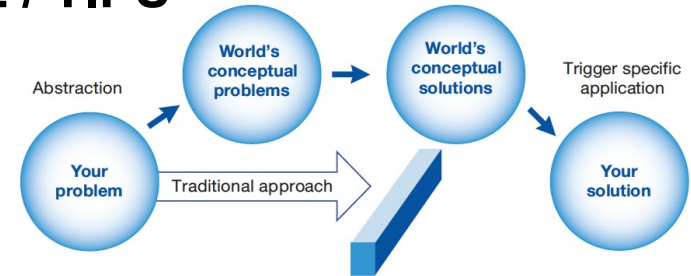
## Lean Start Up



## Set Based Design



## TRIZ / TIPS



# Product Offering Example



Corolla  
1970's



Camry  
1980's



Prius  
1990's

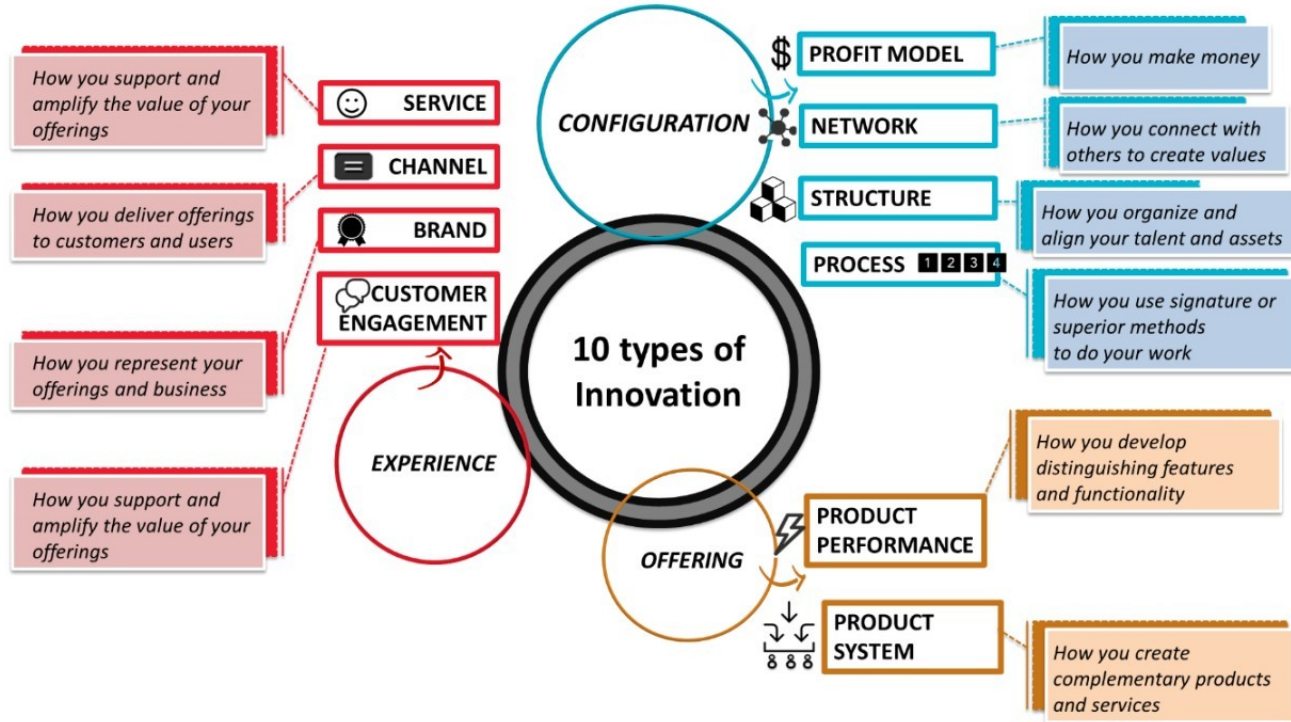


Lexus  
2000's



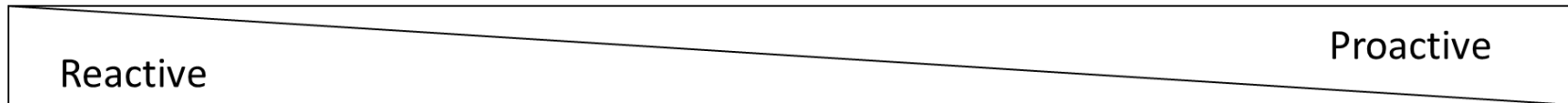
Mirai  
2020's

# 10 Types of Innovation

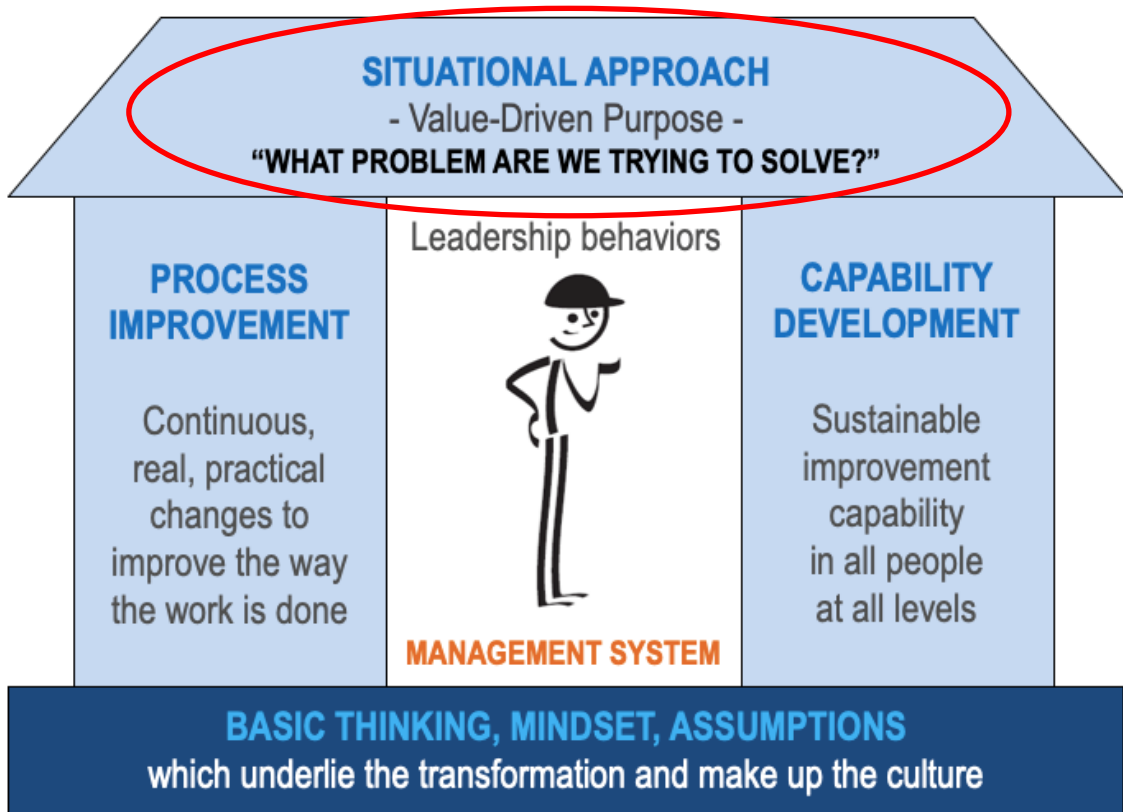


# Known / Unknown Framework

Knowledge Status	Known Problem Known Solution	Known Problem Unknown Solution	Unknown Problem Known Solution	Unknown Problem Unknown Solution
PS Type	Type 1	Type 2	Type 3	Type 4
PS Style	Troubleshooting	Gap From Standard	Target State	Open-Ended
Examples	Andon calls in Toyota Medical Emergency	Scrap Delivery Productivity Cost	Die Change & SMED OTD & Pull System Training Self Service Concept	New Products New Processes New Services
Sample Frameworks	4C's SOP's	Toyota 8 Step (RCA) DMAIC 8D	V.S. Mapping TWI - JI TRIZ	Design Thinking LPPD Framework
Skill & Speed Emphasis	First Responder & Golden Hour	RCA thinking & Speed back to standard	Problem surfacing Pattern recognition	Empathy Exploration



# LEI Transformation Framework



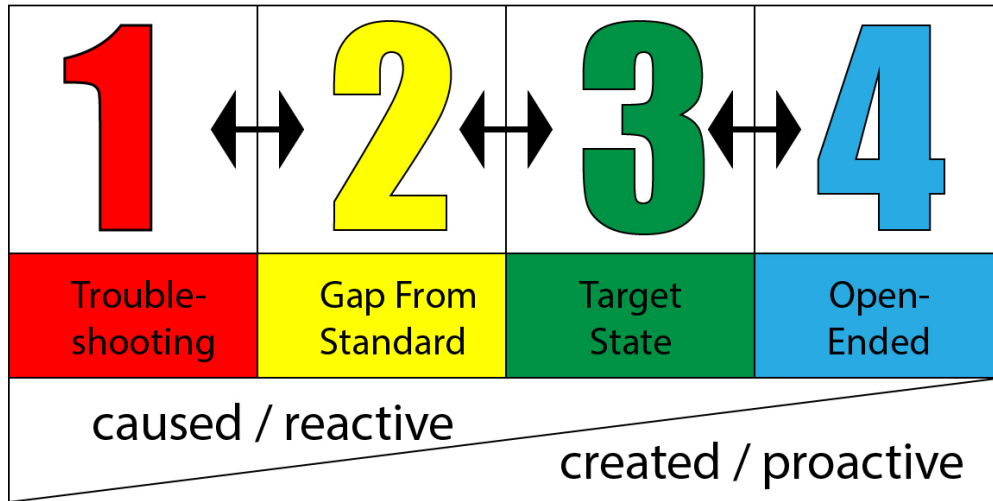
Not just: What lean tool can I use?

Nor: How many kaizen events do I conduct?

Nor: Now much training do I need to schedule?

**What problem are you trying to solve and how will you go about it??**

# 4 Types of Problems



## Why 4 Types?

Different focal points

Different time frame

Different approaches

Better thinking!

Better human engagement!

Better results!



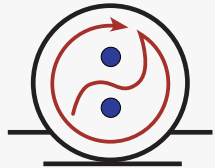


**Uri Levine**  
**Co-Founder Waze**

15<sup>th</sup> Annual Northeast Lean Conference

# Four types of problems

**Art Smalley**  
President



ART of Lean

