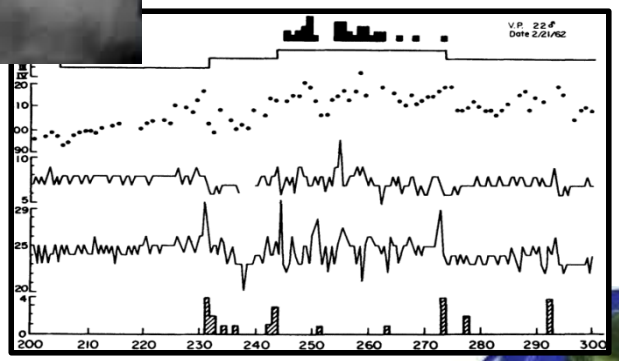
ANALYZE PHASE

Analyze

- Identify
- Variation
- Sources



$$Y = f(X1, X2, X3 \ldots\ldots Xn)$$

Dependent
Process Output
Effect
Symptom
Monitor

Independent
Process Input / Step
Cause
Problem
Control

Analyze

- Process Analysis
  - Calculate Process Capability (C_{pk}) and Rolled Throughput Yield (RTY)
  - Analyze Layout and Process Flow
- Graphical Modeling
  - Use Fishbone diagram to map causes and effects
- Root Cause/Statistical Analysis
  - Brainstorm to prioritize inputs
  - Use Charts and Descriptive Statistics to evaluate each output and inputs
  - Use Pareto Charts
  - Use Correlation Analysis

Analyze

- Cause and Effect Modeling
  - Use Influence Diagrams to map relationships between inputs, process outcomes, and overall performance metrics
  - Use time-series and regression modeling to estimate relationships
- Simulate Models and Identify Process Improvement Strategies
  - Develop and Use Decision Support Systems
  - Evaluate potential scenarios
  - Evaluate performance implications of various strategies

6 M'S

The 6 M's are;

- Machine (technology)
- Method (process)
- Material (Includes Raw Material, Consumables and Information)
- Man Power (physical work)/Mind Power (brain work): Kaizens, Suggestions
- Measurement (Inspection)
- Milieu/Mother Nature (Environment)

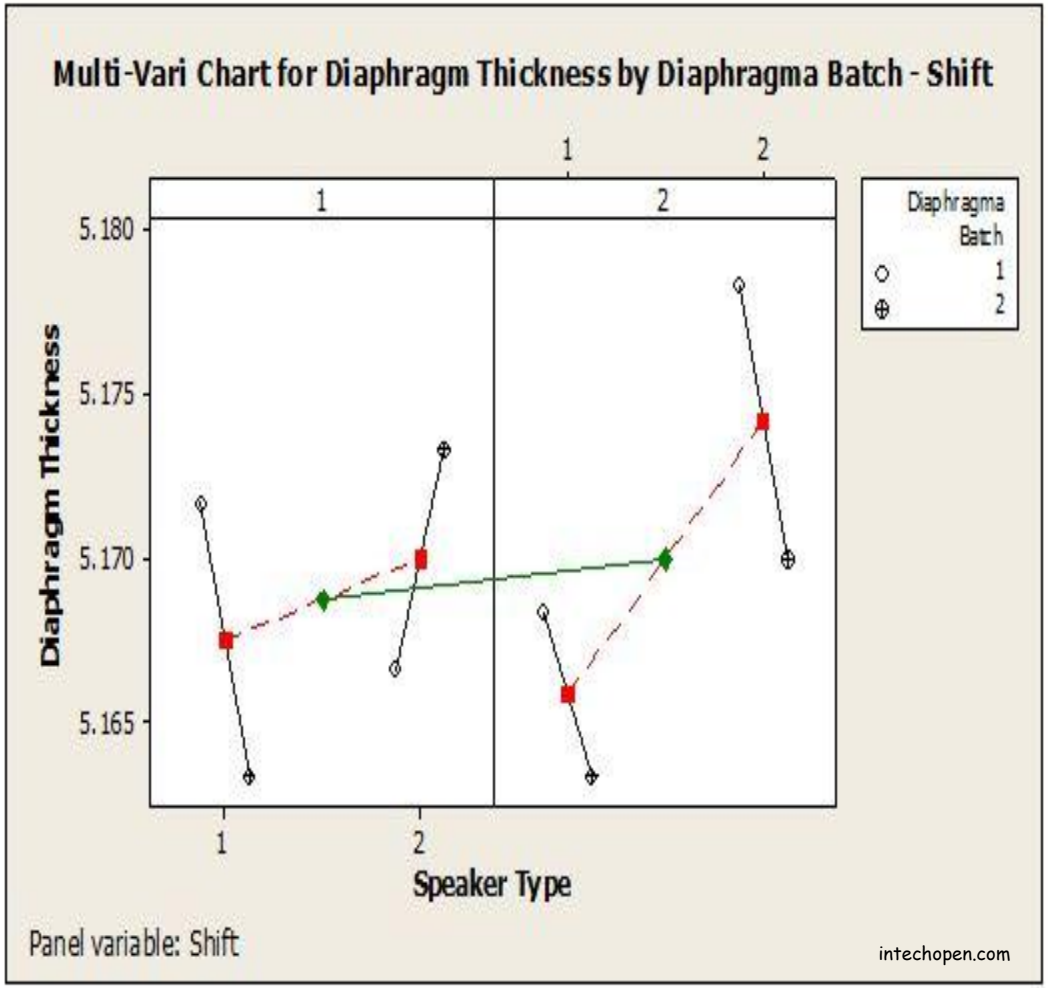
Multi-Vari Analysis

- An efficient way to significantly reduce the number of likely factors that cause impact on metrics(cost, Time, resources)
- Adds in determining the primary factors of variation.

Multi-Vari Charts

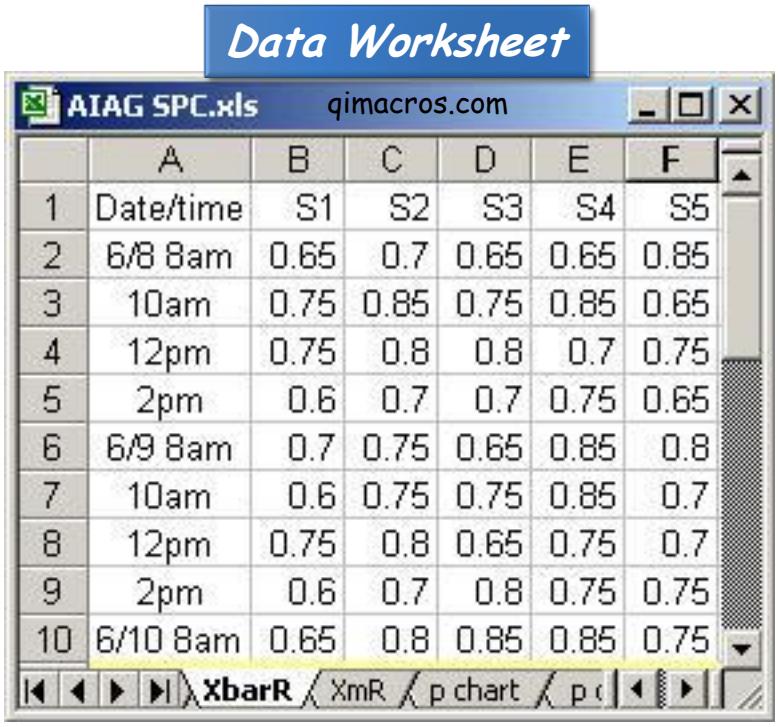
- Multi-Vari Charts helps in evaluating process variability in respect to deviation in classes

- The Multi-Vari chart indicates the extreme values as well as precise points in the sample



Multi-vari Analysis data

- Multi-vari data is a table containing columns of words or numbers and the last column contains the summarized values that is grouped and charted.

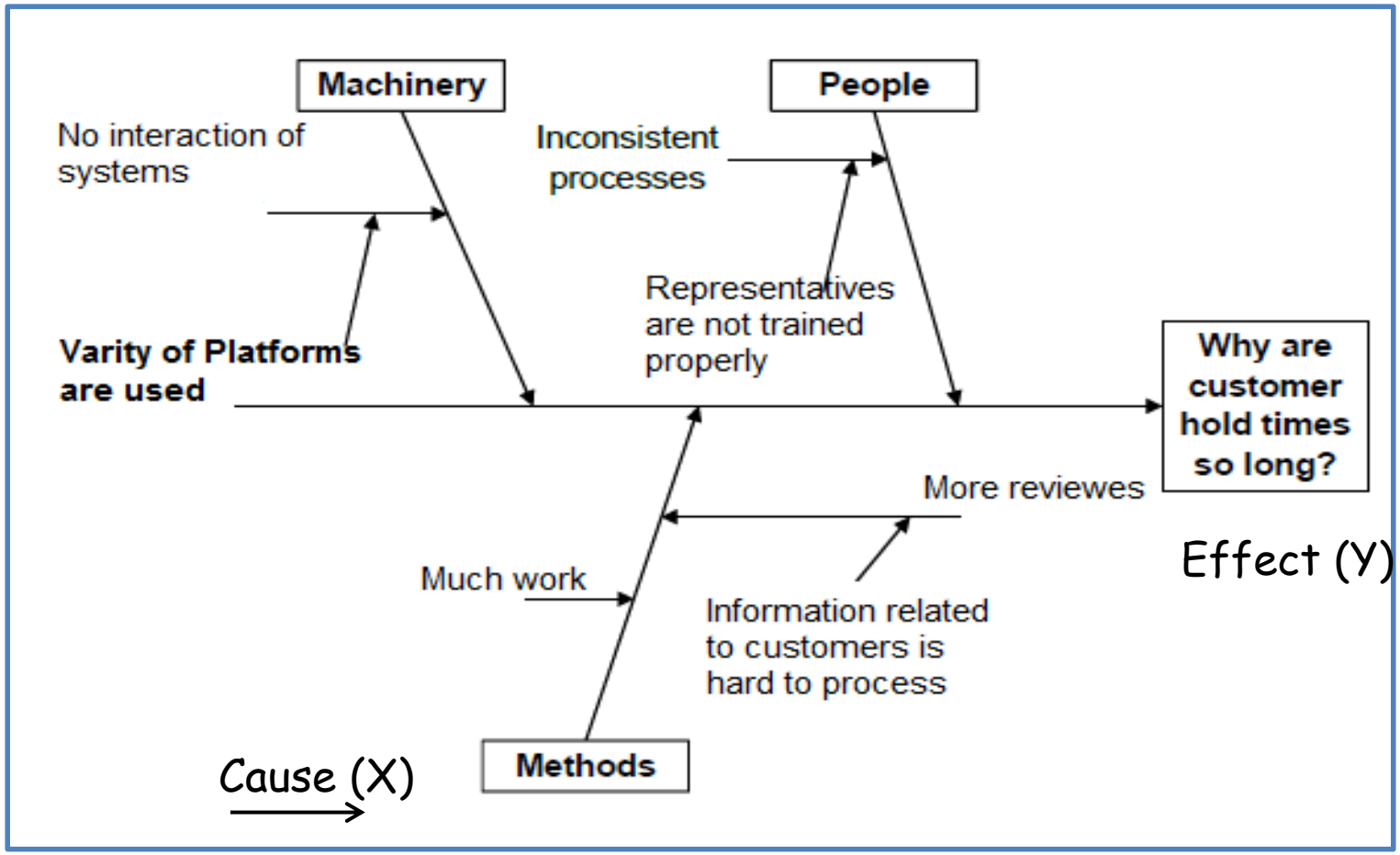


	A	B	C	D	E	F
1	Date/time	S1	S2	S3	S4	S5
2	6/8 8am	0.65	0.7	0.65	0.65	0.85
3	10am	0.75	0.85	0.75	0.85	0.65
4	12pm	0.75	0.8	0.8	0.7	0.75
5	2pm	0.6	0.7	0.7	0.75	0.65
6	6/9 8am	0.7	0.75	0.65	0.85	0.8
7	10am	0.6	0.75	0.75	0.85	0.7
8	12pm	0.75	0.8	0.65	0.75	0.7
9	2pm	0.6	0.7	0.8	0.75	0.75
10	6/10 8am	0.65	0.8	0.85	0.85	0.75

Advantages of Multi-vari charts

- A visual way to display analysis of variance data
- A visual way to display the variation from piece to piece
- A visual representing of data free from variation
- Visualize time sensitive data
- A visual representation of data stream more prone to variation

Root Cause


Machinery
People
No interaction of systems
Inconsistent processes
Representatives are not trained properly
Varity of Platforms are used
Why are customer hold times so long?
More reviewes
Effect (Y)
Much work
Information related to customers is hard to process
Methods
Cause (X)

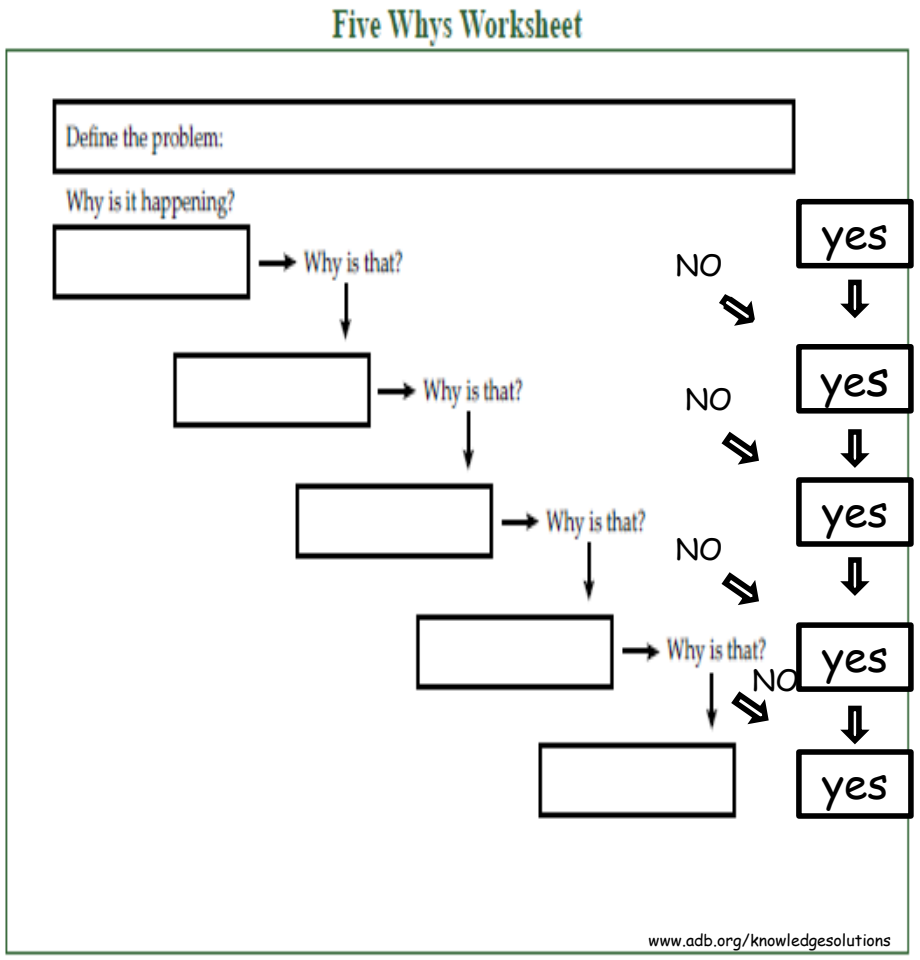
Why do, root cause analysis?

- What an Employer want?
  - Save Money
  - Increase Market
- What an Employee want?
  - Less Effort
  - More Enthusiastic work
  - Good Pay
- 5 Whys are used to find the root cause of a problem.

Example 1: 5 why's?

- 1 WHY ?
- 2 WHY ?
- 3 WHY ?
- 4 WHY ?
- 5 WHY ?

These questions lead to finding root Cause.



Disadvantages of 5 Whys?

- Not reliable
- Not determined by data
- More precisely context oriented
- Not suitable for complicated problems
- Cannot accommodate for more causes

Example of 5 why?

- Water leaking from tap. (the problem).
  - Why? - The tap is not working. (first why)
  - Why? - The stopping rubber is not functioning. (second why)
  - Why? - The stopping rubber has broken. (third why)
  - Why? - The stopping rubber was well beyond its useful service life and not replaced. (fourth why)
  - Why? - The tap was not maintained according to the recommended service schedule. (fifth why, a root cause)

What is Value?

- It is the worth of a commodity equivalent to something at a particular time determined by demand and supply

- Quality
- Price
- Time

Mistake proofing and Poka Yoke

- **All Humans commit mistakes knowingly or unknowingly**
- The basic concept of this is avoiding the problems by correcting the process and features of the usage.
- Poka yoke , in japanese is "avoiding ", "errors".
- Effective
- Not Expensive

Types of Mistakes by employees

Forgetting
Misunderstanding
Wrong identification
Lack of Experience
Wrong doing unknowingly
Lack of clarity
Wrong order
Counteract
Laziness.

Types of Mistake proofing

- Poke-yoke eliminates the set of actions that requires intelligence of operator. The activities include:
  - ✓Attention
  - ✓Perception
  - ✓Memory
  - ✓Reasoning

Devices that can be used to alert when error occurs

- ✓Physical contact devices

Shut down process when an error occurs

- ✓Energy sensing devices

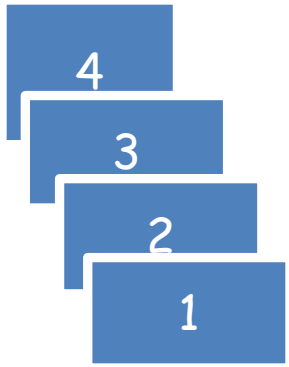
Signaling device when process behavior is unusual

- ✓Warning sensors

Activate the operate to correct errors in the process

Mistake proofing techniques

Sequencing Steps
eliminates errors



Location/Size
Specific components

Automatic switching

Inaccurate range
Stops processes

Everyday Example

- The plug doesn't fit into socket until it is correctly inserted.

- Car beeps until the front seat passengers wear seat belt.

3 rules of Poka Yoke

- Don't wait for the perfect POKA YOKE. Do it right now!
- If subjected POKA YOKE idea has better than 50% chance to succeed…Do it!
- Do it now….improve later!

cost effect

- It cost very less in implementing process improvement techniques
- Better process always gives more:
  - Reliability
  - Low Cost production
  - Reduced Inspection
  - Saves repair cost

Difficulties with Human Errors

Motorola findings:

...it became evident early in the project that achieving a C_p greater than 2 would go only part of the way. Mistake proofing the design would also be required ... Mistake proofing the design is an essential factor in achieving the [total number of defects per unit] goal.

Smith, B. IEEE Spectrum 30(9) 43-47 Ref:Velaction.com

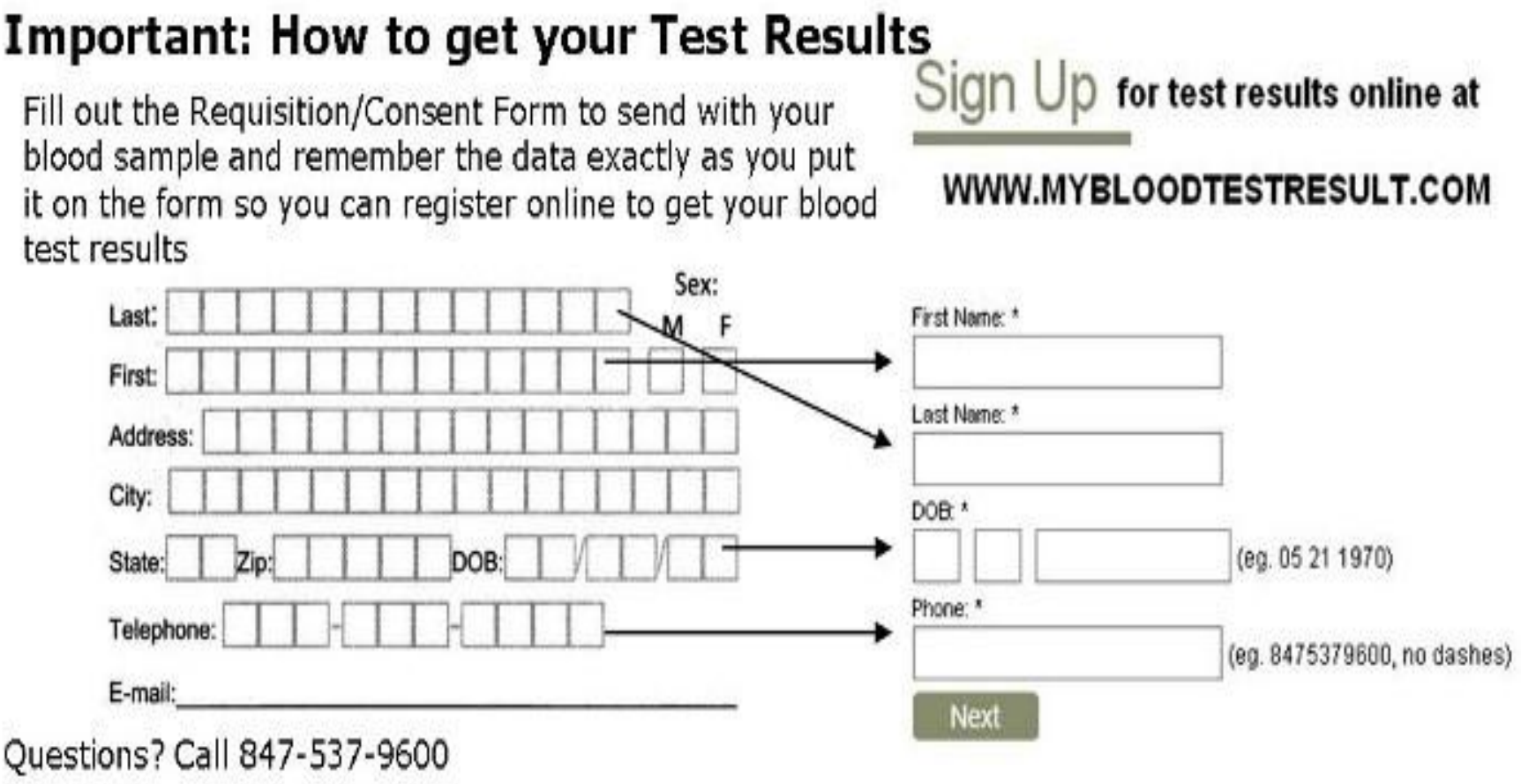
Inspection is Bad

- Self-inspection" would entail an activity performed by an operator either during the course of the activities at their work station, or, just prior to moving the product to the next operation.

self-inspection= value add
final inspection=non value add

A premise within the Toyota Production System on quality: "Don't get it, don't make it, don't send it."

Which gives more clarity ?



Example : Productivity improvement Methods

Methods for Productivity Improvement(Example)

Big Category	Middle Category	Category of Result and Effect	Requirement (What do you want?) \ Useful Method	IE: Process Analysis	IE: Transportation Anal	IE: Operation Analysis	IE: Motion Analysis	IE: Time Analysis	PM: 6 big Loss of Machine	PM: Autonomous Mainte.	PM: Productive Mainte.	PM: Quality Maintenance	PM: POKA-YOKE	PM: 4M in Production	JIT: 3 Elements in Standard	JIT: Lead Time Reduction	JIT: Leveling of Production	JIT: KANBAN System	JOB Control System	5S Activity	P-Q Analysis	VRP Method	QC 7 Tools	New QC 7 Tools	FMEA	Quality Audit System	Production Aprroval Sys	Statistical Method	Experimental Design	VE/VA	Idea Method	Flow Frequency Chart	Muda Elimination Method	Performance Evaluation	Break Even Point Anal.
Productivity Improvement	IE	P,C	Improvement of Job Method	☆	☆	☆	☆	☆			☆	☆	☆	☆						☆			☆	☆					☆		☆		☆		
		P,C	Efficient Man Power	☆	☆		☆	☆		☆									☆				☆	☆							☆		☆		
		C	Elimination of Muda in Material																				☆	☆									☆		
		P	Improvement of Operational Ratio	☆	☆	☆	☆	☆	☆	☆	☆		☆	☆					☆	☆			☆	☆				☆			☆		☆		
	TPM	P	Improvement of Machine Efficiency						☆	☆	☆	☆	☆	☆						☆			☆	☆					☆	☆					
		Q	Good Quality with machine							☆	☆	☆	☆							☆			☆	☆					☆		☆		☆		
		P,C	Capable Operator for machine							☆			☆						☆	☆			☆								☆				
	JIT	P,C,D	Production System for Small Lot						☆	☆	☆	☆	☆	☆	☆	☆	☆	☆																	
		C,D	Reduction of WIP						☆	☆	☆	☆				☆	☆	☆																	
		P,C,D	Layout Change	☆	☆	☆		☆																											
		P,C,D	Steps for layout improvement	☆	☆																☆														
Cost Reduction	Layout Impvmt	C	What is Unit Consumption																☆																
		C	Production Cost by Process																☆											☆				☆	
	Unit Consu.	C	Elimination of Muda in Material																☆			☆											☆		
		C	Material Change																											☆				☆	
	Yield Ratio	C	New Idea for Product Development																											☆	☆				
		C	Summary of Product Performance																											☆				☆	
	VE/ VA	C	Design with Cost Consciousness																			☆								☆				☆	
		C	Plan for Cost Reduction																			☆								☆					☆
Inventory	Daily Control	P,C,D	Variation of WIP																													☆			
		C,D	Term in Process																													☆			
	Product Control	D	Clear Process Progress																☆													☆			
		D,C	Standard Process Schedule																													☆			

Note: P: Production
C: Cost
D: Delivery

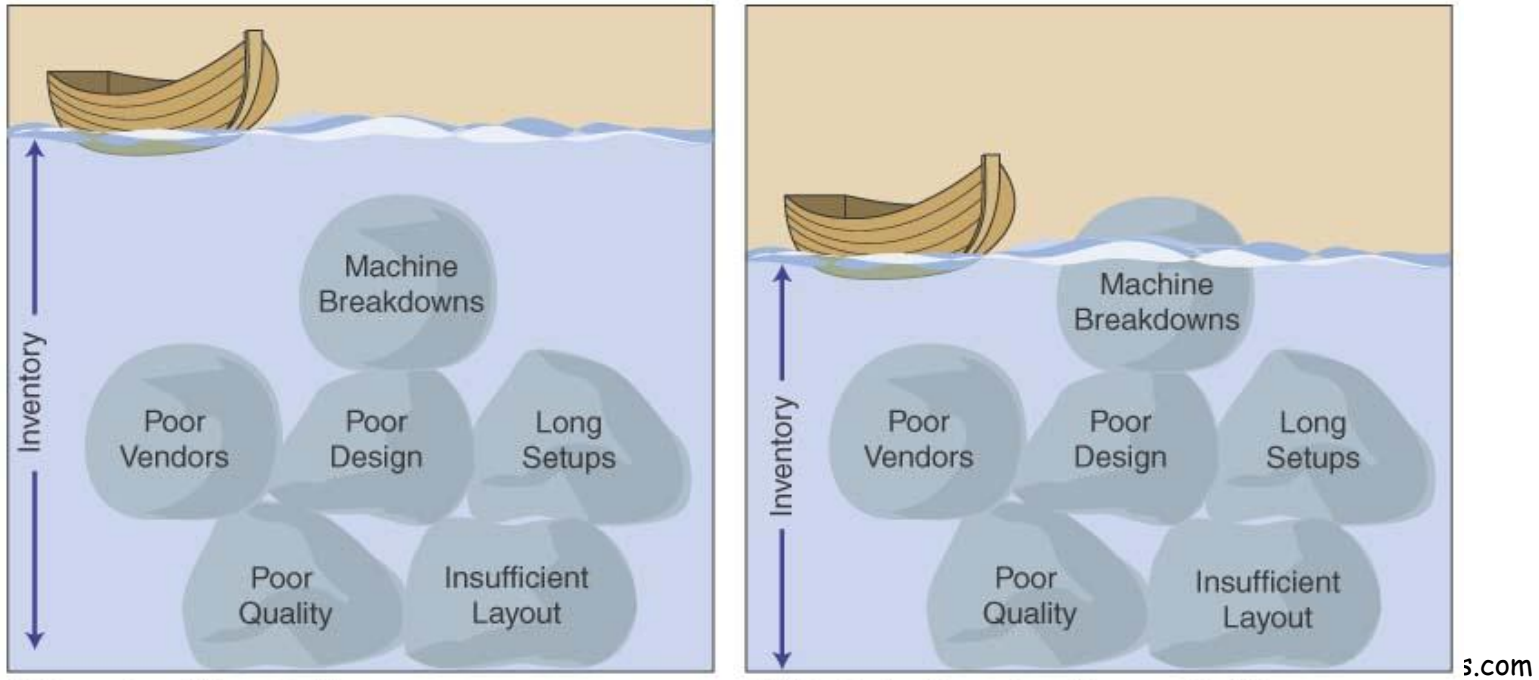
Presentation:JICA Expert-Keji Takemura

Just In Time

- Just-In-Time (JIT) production system was founded by Taiichi Ohno (Vice President at Toyota).
- Successfully implemented at the Toyota Motor Company's plants in Japan.

Just In Time

- JIT reducing variability, improving product quality, reducing production and delivery lead times, and reducing costs.



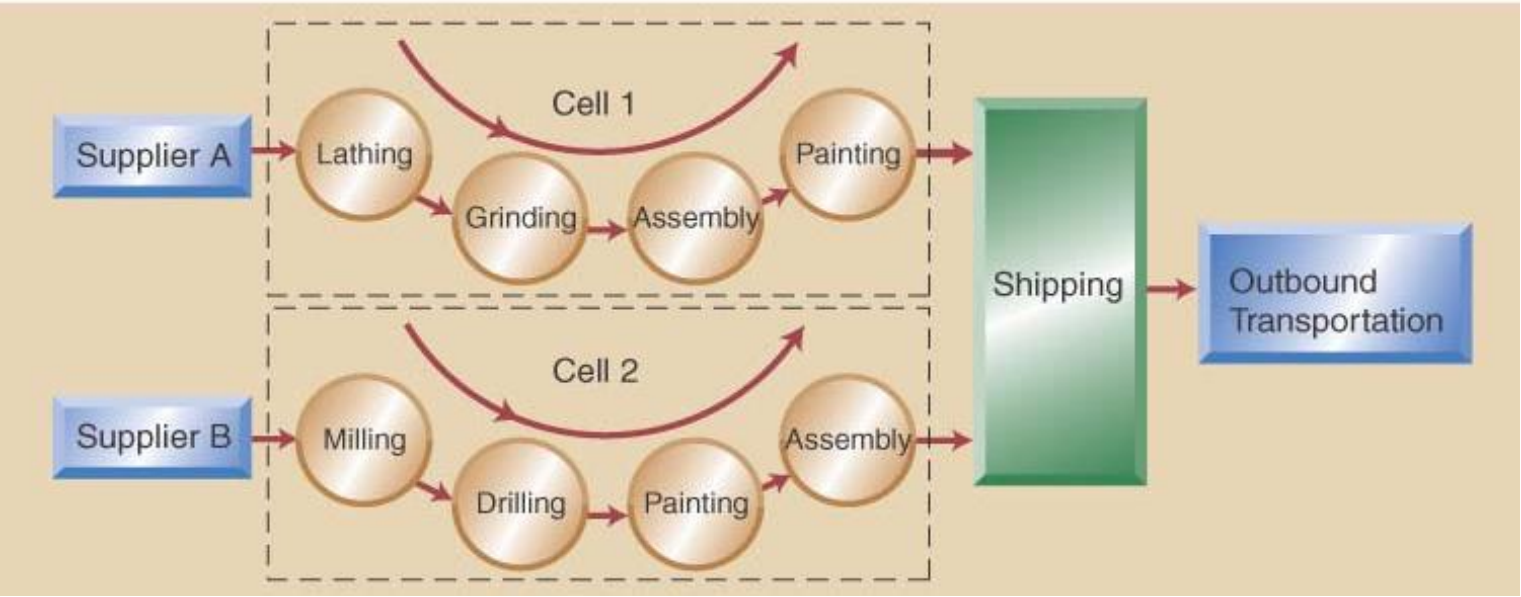
(a) Inventory Hides Problems

(b) Reducing Inventory Exposes Problems

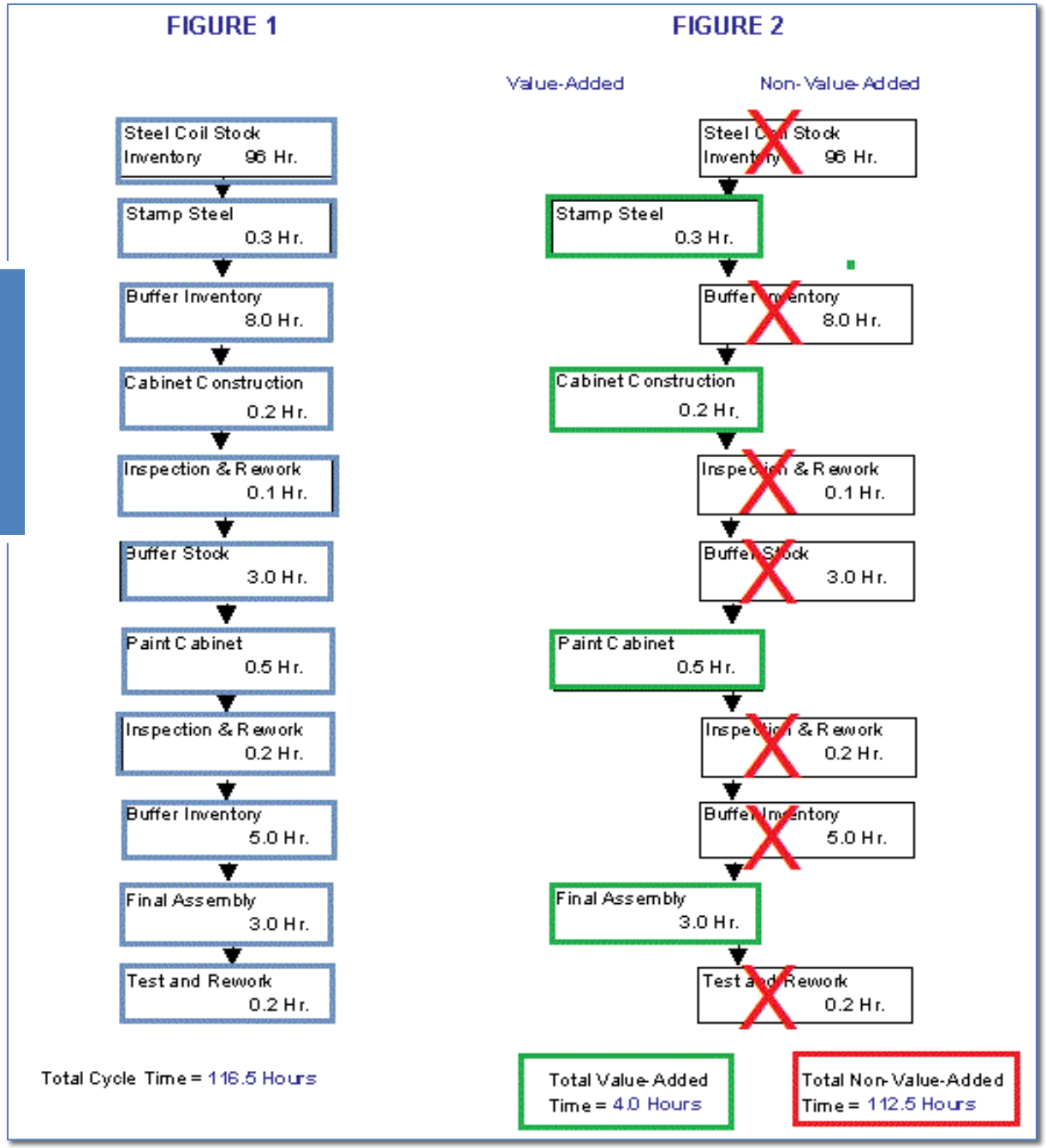
JIT Cellular Manufacturing

- Product focused cells, flexible equipment, high visibility, easy to schedule, short cycles

(b) JIT with Cell Manufacturing

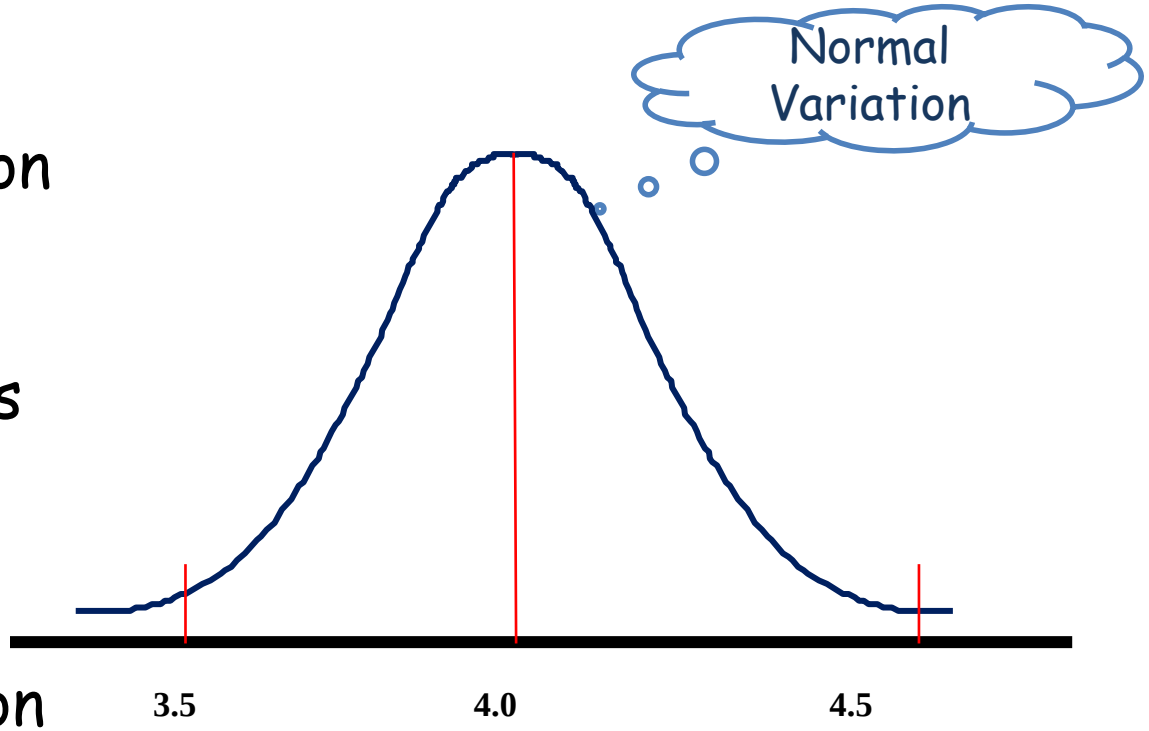


Value added and Non-Value added activities



Normal Distribution

- The normal (or Gaussian) distribution is a continuous probability distribution that has a bell-shaped probability density function, known as the Gaussian function or informally as the bell curve.

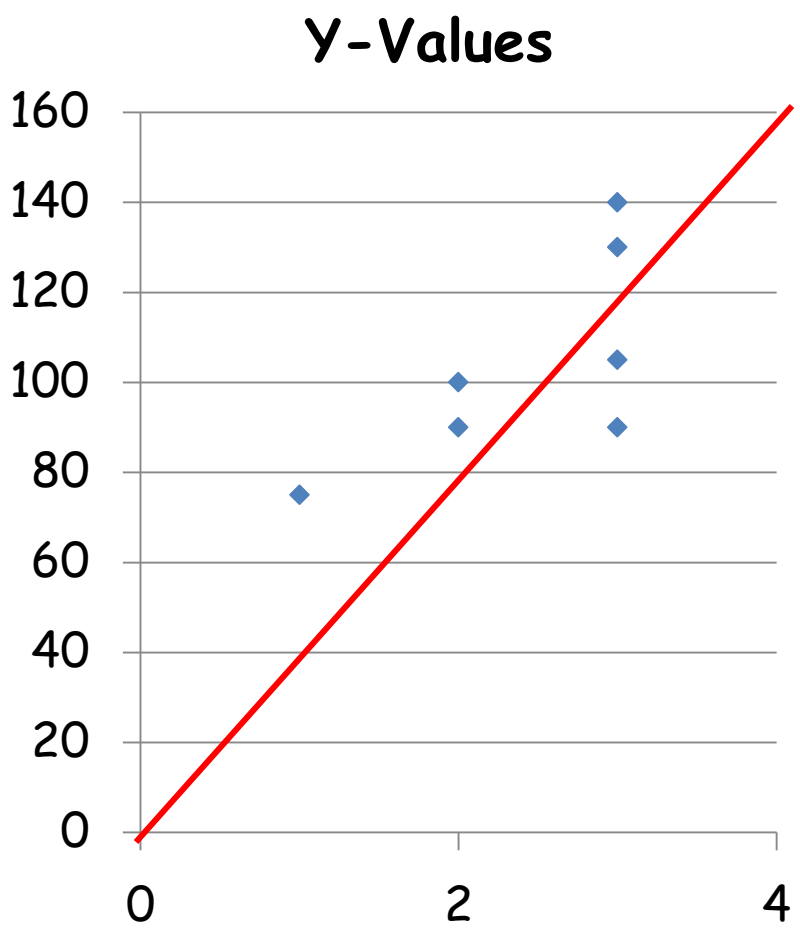


http://en.wikipedia.org/wiki/Normal_distribution

Example of Linear Distribution

Person	Time(min)	Distane(mts)
A	2	100
B	3	105
C	1	75
D	4	140
E	2	90
F	3	130
G	4	150

Distribution for a person travelling at meters per minute



Histograms

- When performing post-processing in your digital darkroom you can use a histogram to: