

D M A I C

Manual



Project

- . 6 Sigma
- . Pre-DMAIC Process
- .

DMAIC Process

- . Define
- . Measure
- . Analyze
- . Improve
- . Control

- . Cp, Cpk, Pp, Ppk
- . Sigma
- . DMAIC

PROJECT



. 6 Sigma ?

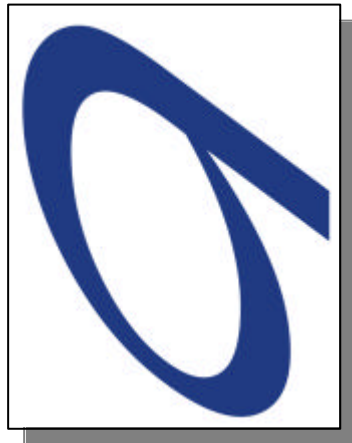
What is Sigma? ()

Sigma ($=\sigma$)

6 Sigma

/service

. 가



σ , Sigma

- Greek letter

-

data ,

6σ , 6 Sigma

- Data

- Data가

가

- Process sigma
service가

process , ,

2 Sigma*:	/Service	69.146%가
		308,538 ()
4 Sigma:	/Service	99.379%가
		6,210 ()
6 Sigma:	/Service	99.99966%가
		3.4 ()

* Short term

6 Sigma ()

6 Sigma

process, culture

methodology

performance excellence

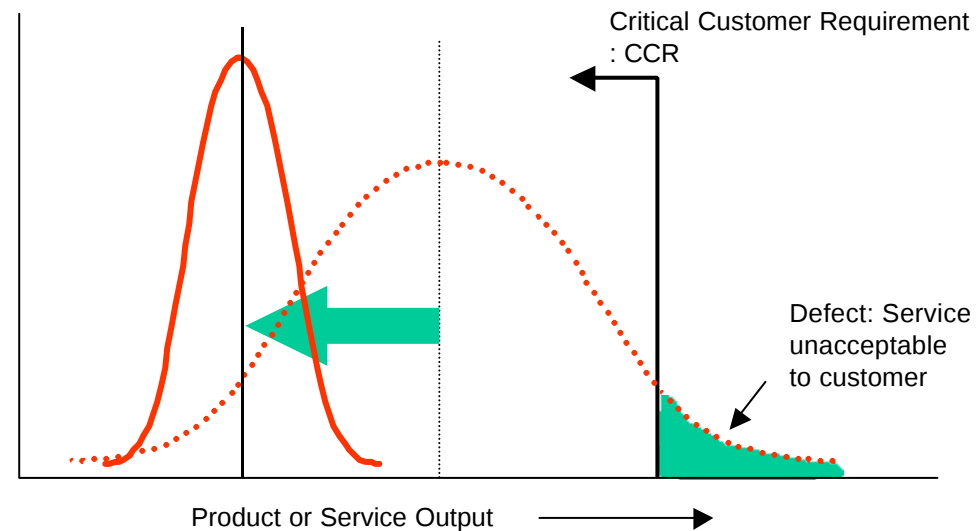
...Performance excellence

- Transformational Change
Across-the-board:

process, culture, customer

- Operational Change
Business processes:

tool, methodology



6

6

‘ ’

‘ ’

QC, TQC, TQM

6

‘

’

’

QC 7가

’

가

가

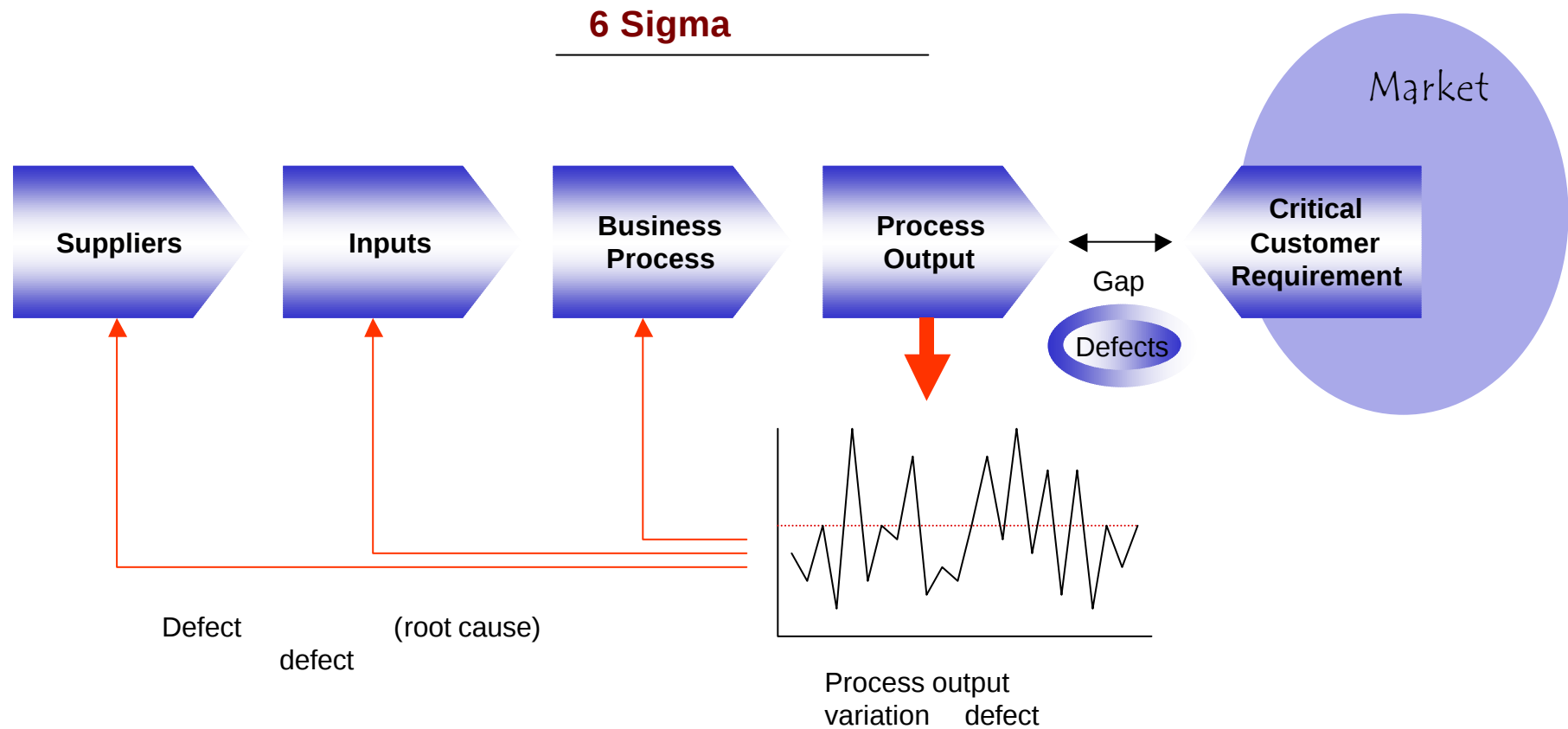
Sigma

6 Sigma

output

defect

supplier, input, process



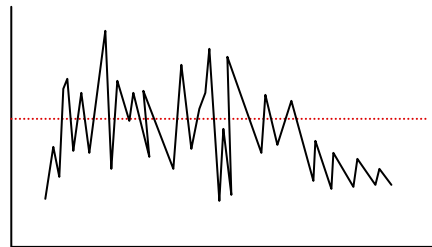
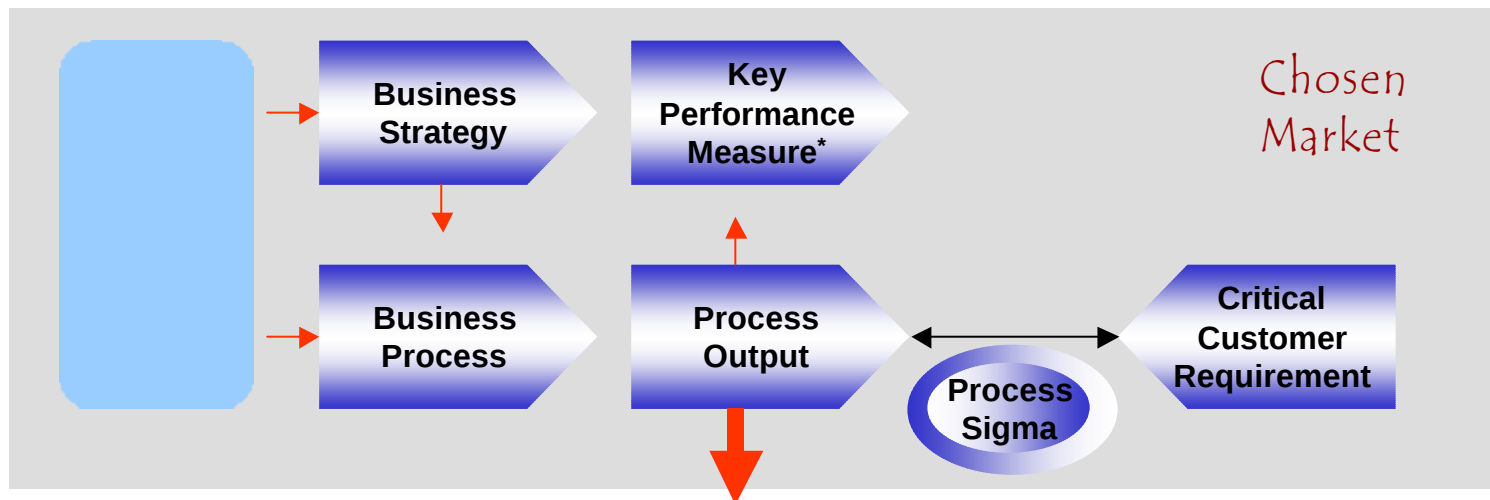
가
,
gap process .

A stylized illustration of a person with a lightbulb idea. The person is depicted in a simple, grey silhouette style, standing with one arm raised and pointing upwards. Above their head is a glowing yellow lightbulb with three short lines radiating from it, symbolizing a bright idea or inspiration. The background is plain white.

6 Sigma
Measure”

process “Key Performance

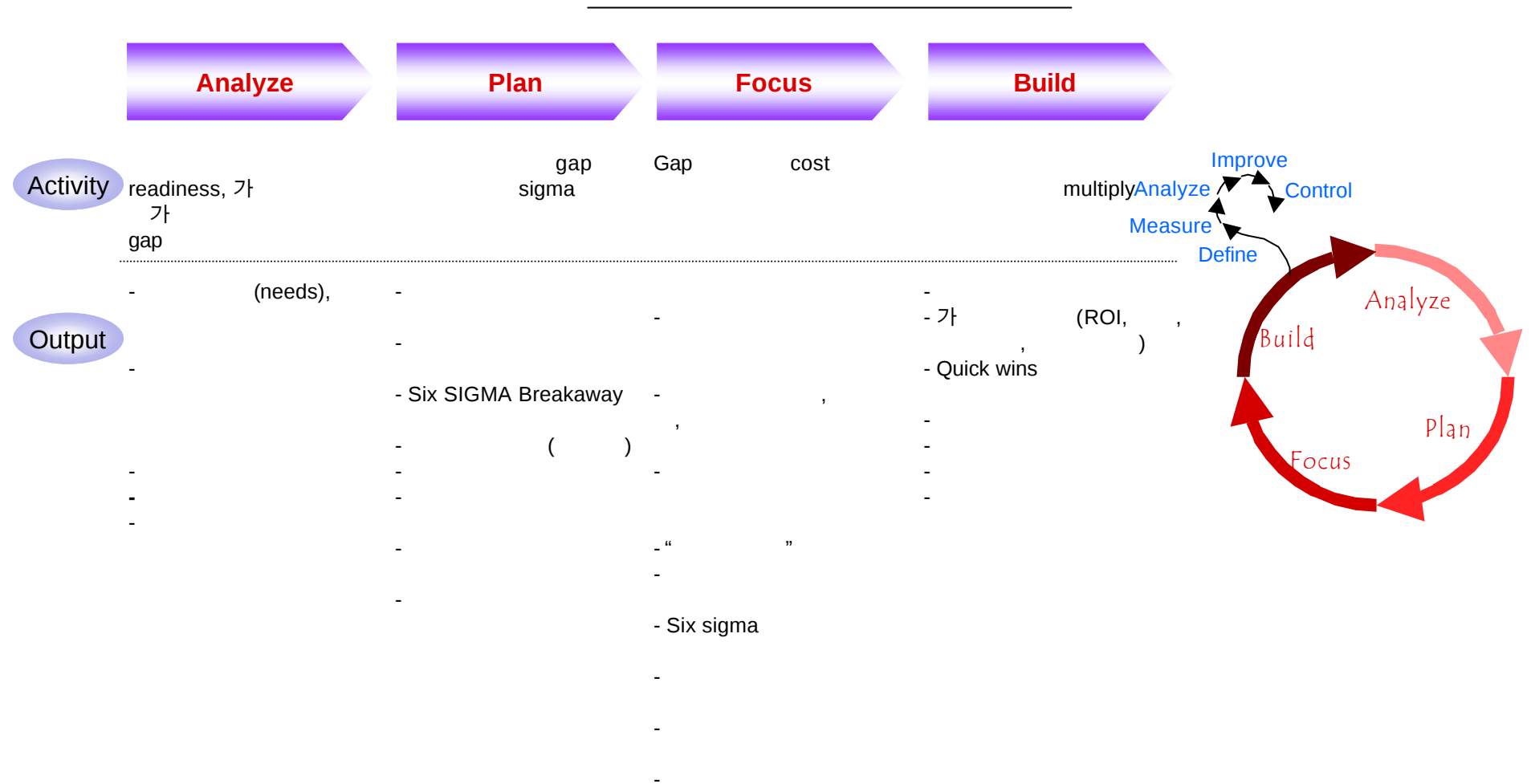
process



6 Sigma

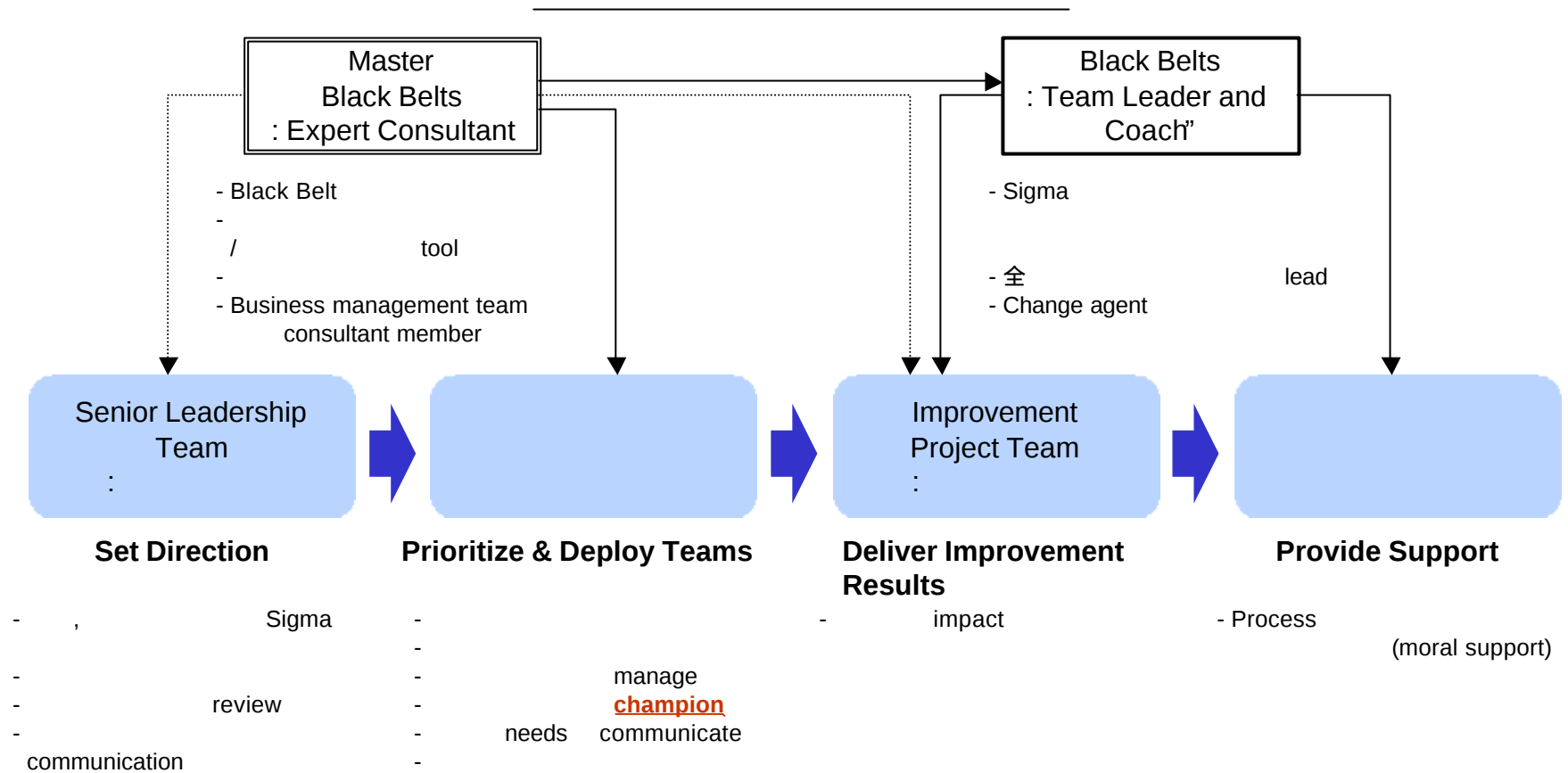
6 Sigma

gap



Black Belt

Master Black Belt





6 Sigma Process

6 Sigma

data

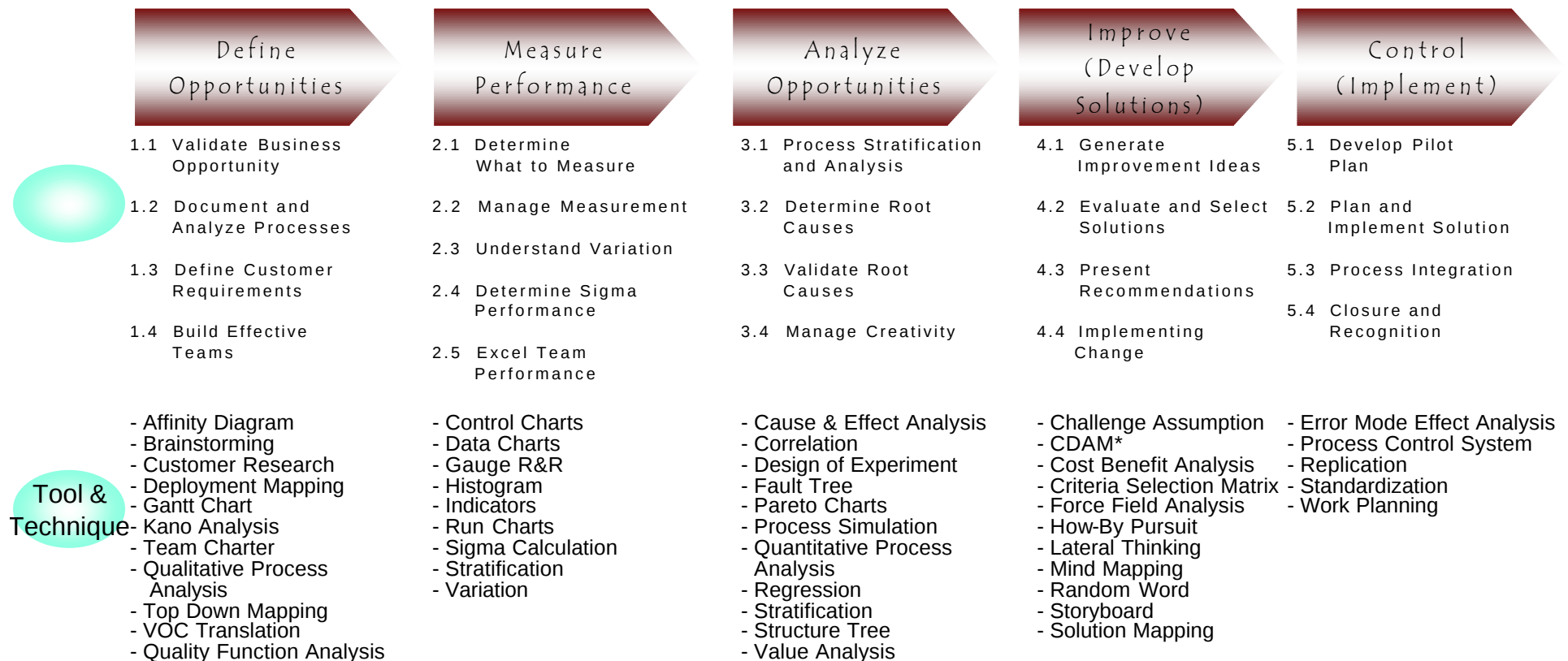
, data

가, pilot

process

5

6 Sigma 5



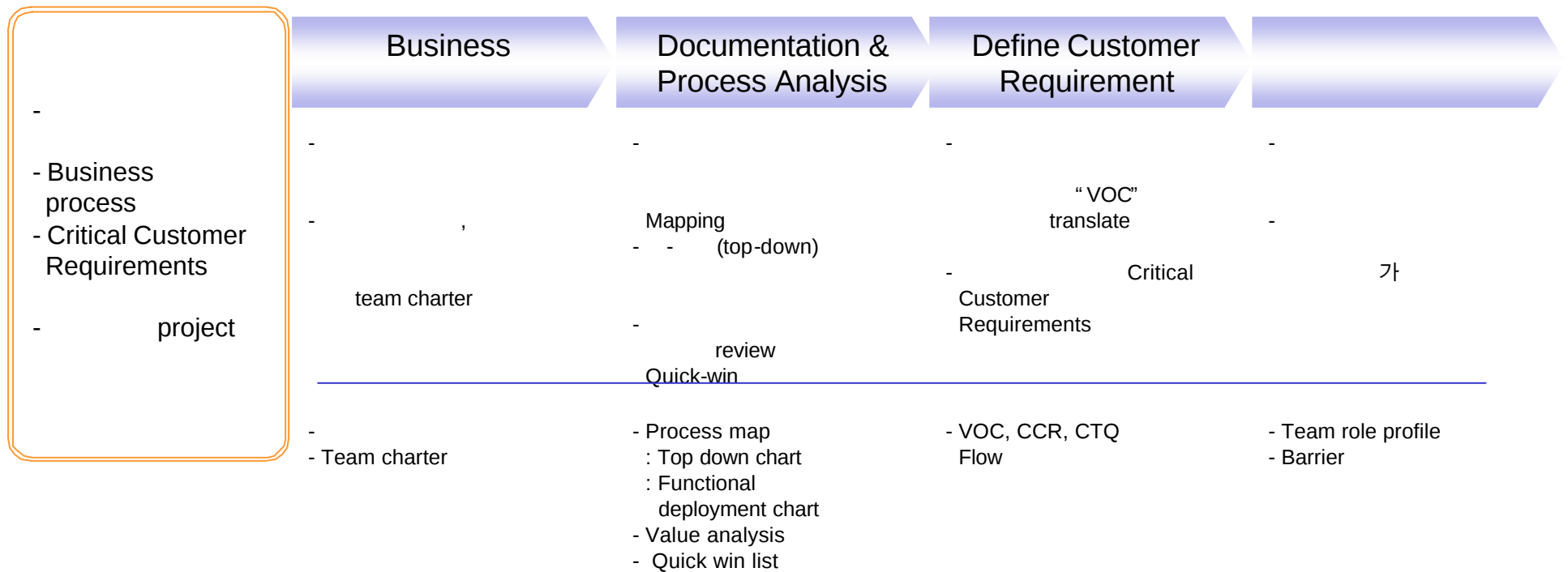
* Combine, delete, add, modify

. Define



Define
process

가 가



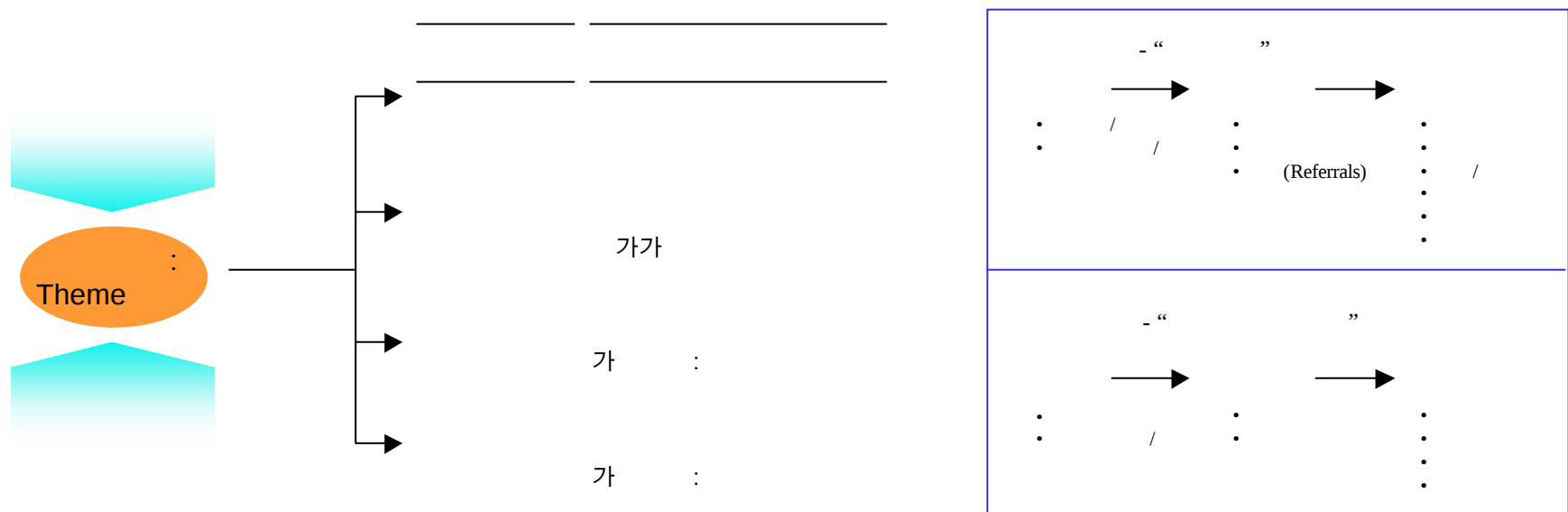
1.1 Business

impact (operation) 가 (value) 가
customer impact business impact .

Business

가

Process



project

team charter

. Charter

가

/ 가 .

Team Charter

Team Charter ()

1. Business Case ()

- boundary
- Project

2. (Business)

- 가?
- 가 가?

3. ()

-

:

4. Project (Boundary)

-Business 가 가
- 가 ?
- ?

5. Project

- Key job communication plan

6. Team

- 가?
- ?

Business Case

5000

가

9

가 .

Project

Process

Process

- process
- R&D
- Engineering

Project

1	2	3	4
---	---	---	---

Team

```

- Champion:
- Master BB:
- BB      :
-
-
-      :
-      :
-      :
-

```

가
SMART

Specific

11. *Journal of the American Medical Association*, 273, 1994, 2221-2222.

Measurable
: 가 가?

Attainable : 가 가?

가?

Relevant
: Biz

가?
Time bound

가?



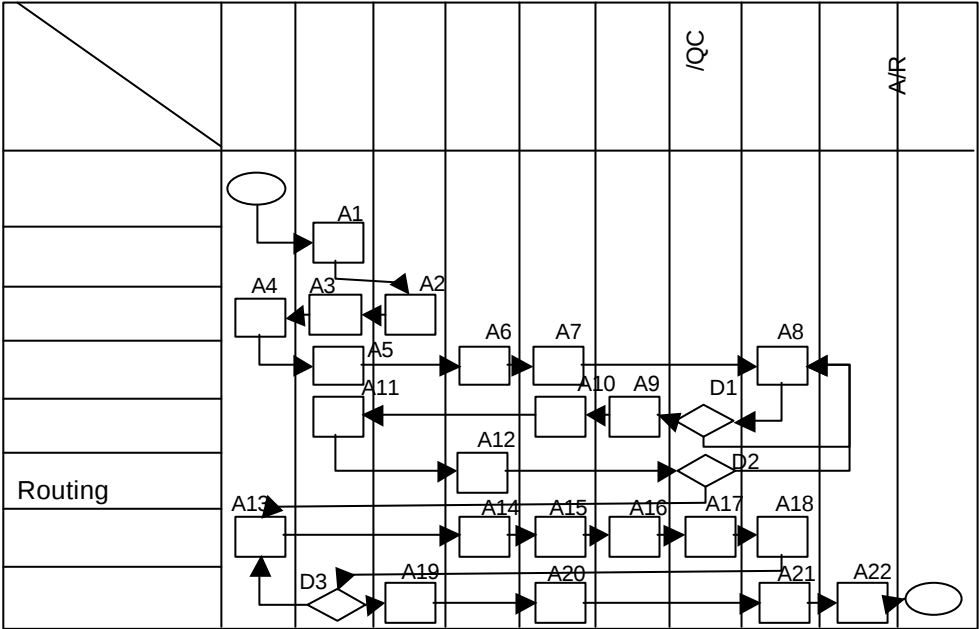
business

- 가
- Communication

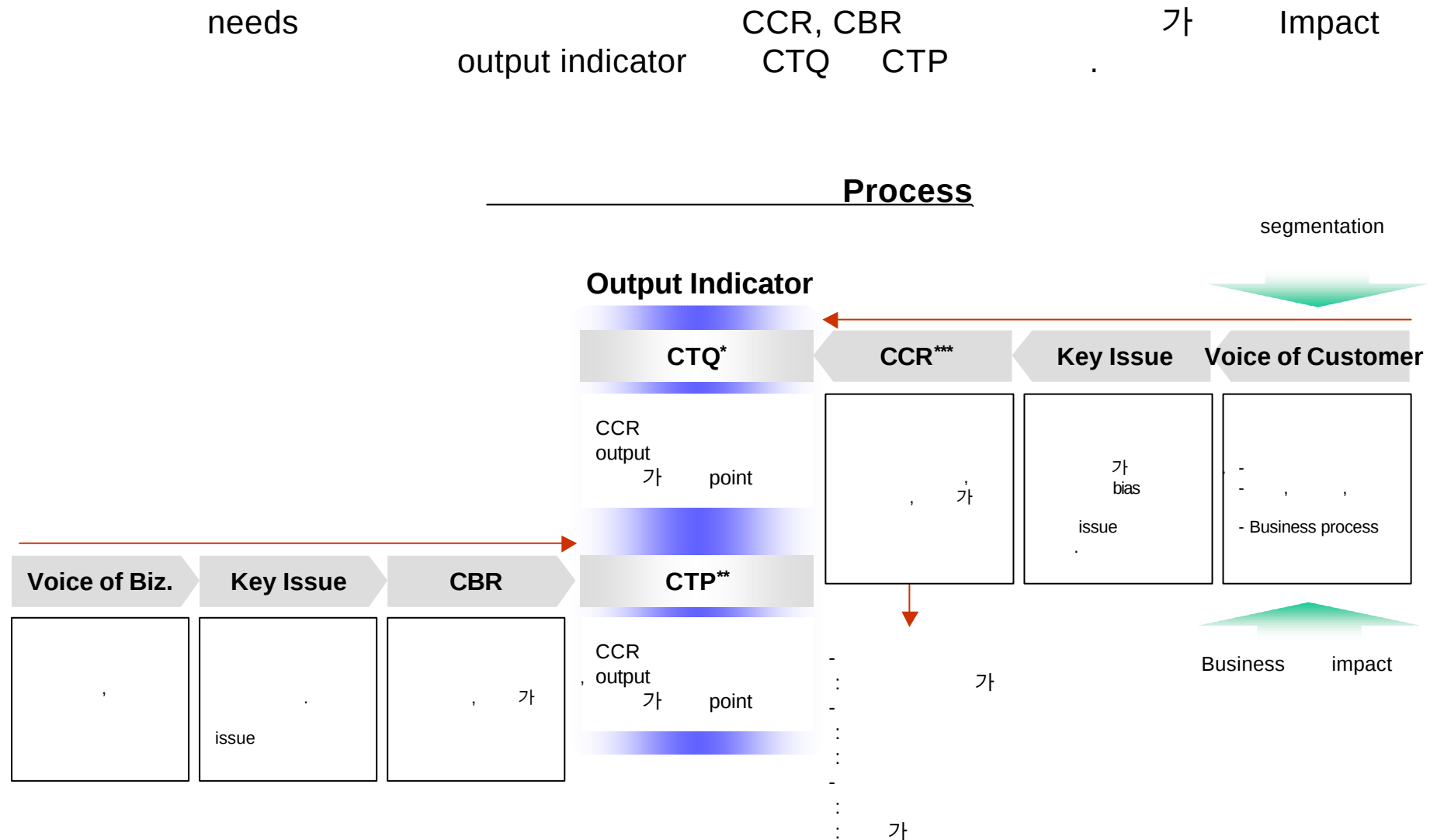
Top Down Mapping ()

			Routing
	/		
		/	3
S-form	Release		
Pick List	Work order		, A/R
/	/QC	Least-cost	
carrier			

Functional Deployment Process Map ()



1.3 Define Customer Requirement



* Critical To Quality
 ** Critical TO Process
 *** Critical Customer's Requirement

CCR	Key Issue	Voice of Customer
- 2kgf/cm² leak가 - lot range가 20mV - 300 / 70% ...	- Dead cell - - - lot ...	- / - - - - ...

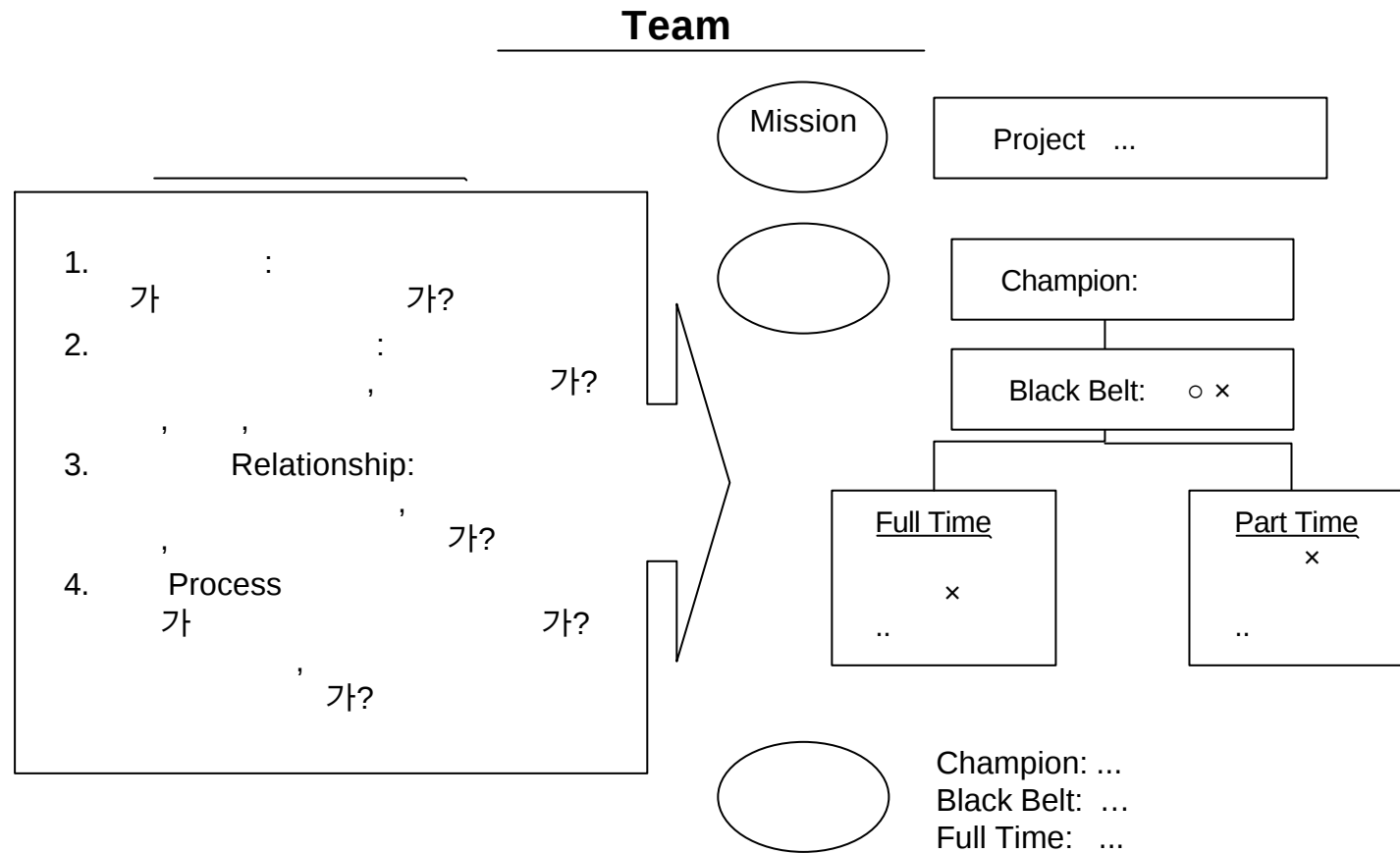
Voice of Business	Key Issue	CBR
- Leak가 가 - - Ni-Strip - Slitting wave가 - Loading 가 ...	- Seam, Ball, Gasket - - 가 - Slitting ...	- 2kgf/cm² leak가 - Ni-Strip 가 2kg - - slitter ...

1.4

Project

,
process

, relationship,

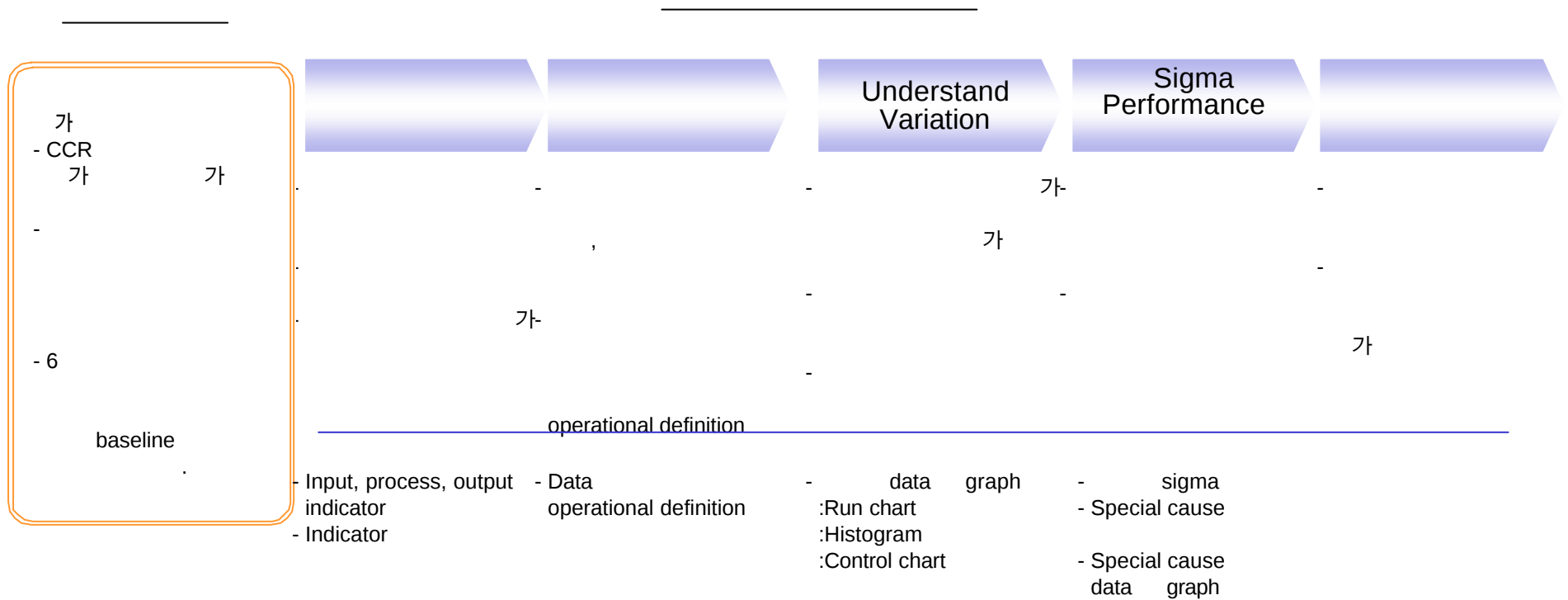


. Measure



가 process variation CCR sigma CTQ input, proce

output indicator

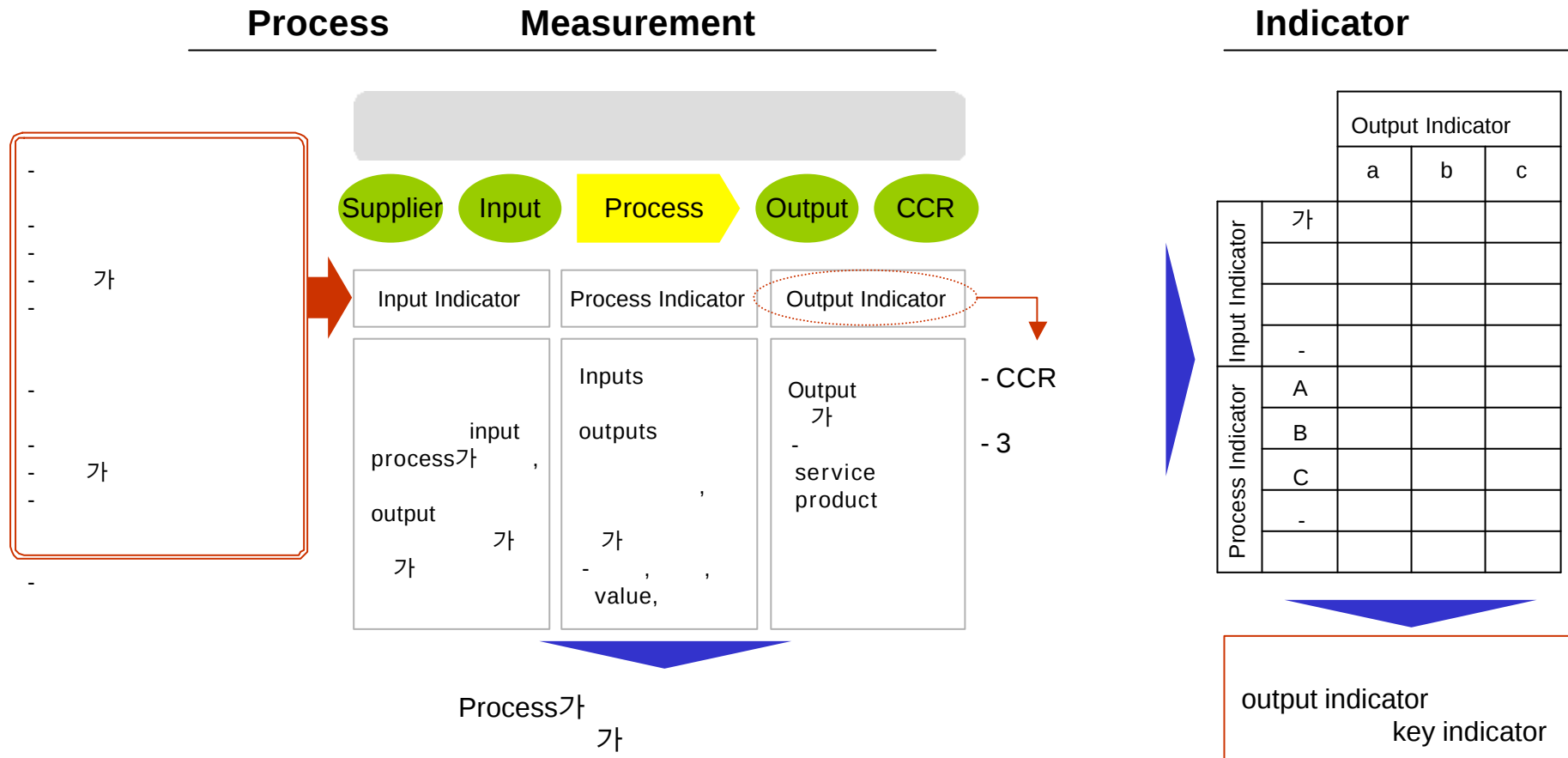


2.1

CCR

output indicator (=measurement)

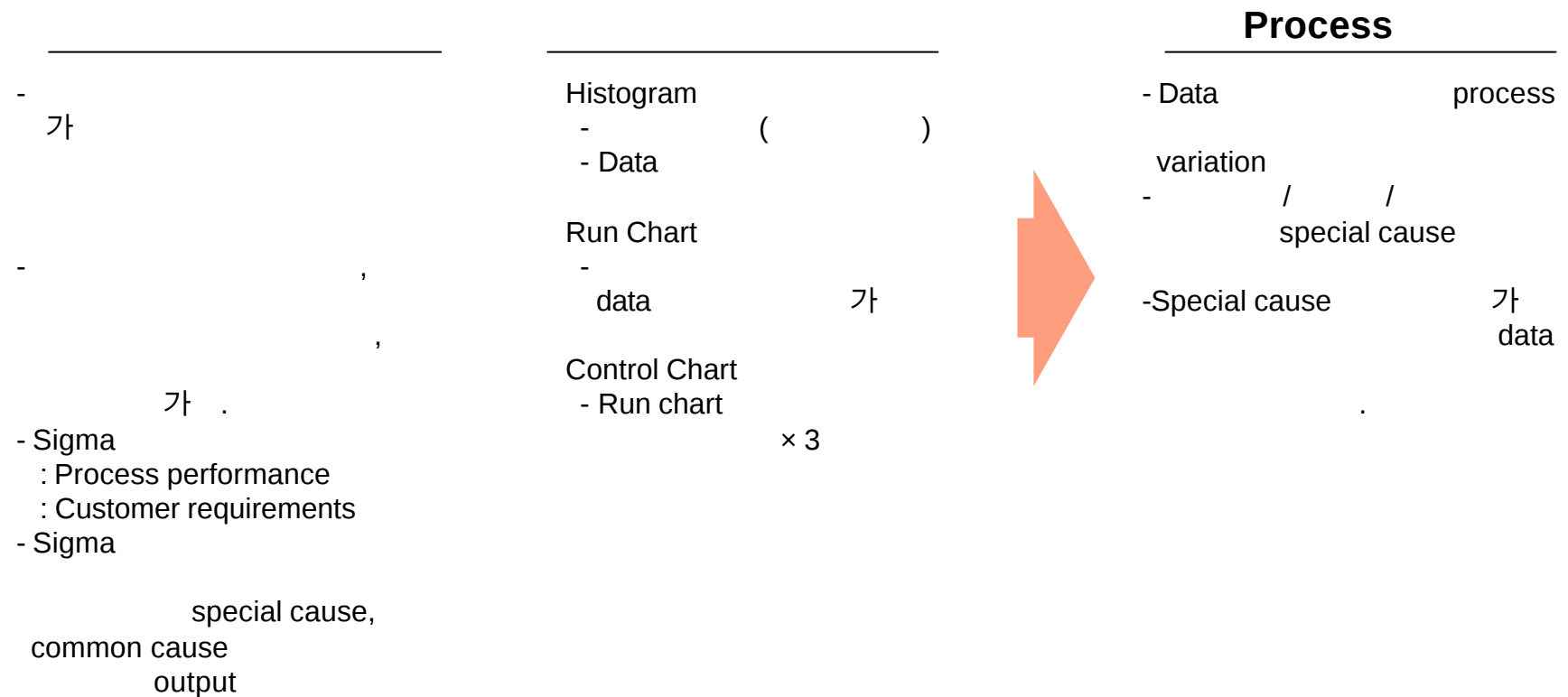
input, process indicator



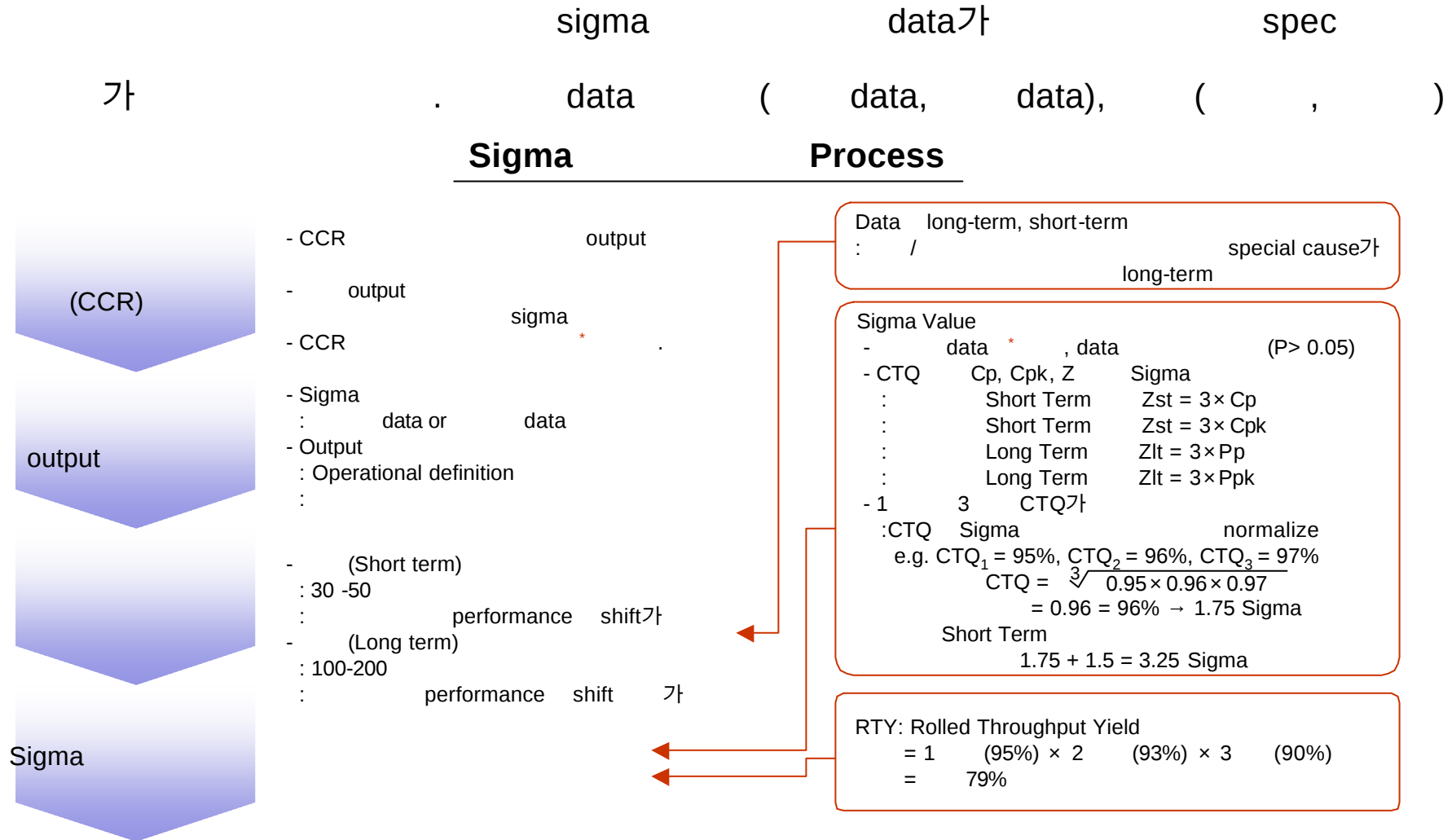
Measurement	Operational Definition	Data source	Sample	Data 가	Data	Data	Data
Cycle time	Fax / () or Fax / ()	Fax Center	289			全月	

2.3

control chart 가 data special cause common cause histogram, run chart,



2.4 Sigma



* Data

$$n = \left(\frac{1.96s}{\Delta} \right)^2$$

n =
P =
Δ =

("s")

$$n = \left(\frac{1.96}{\Delta} \right)^2 P (1 - P)$$

P =
Δ =

()

CTQ가
normalized

sigma

CTQ

sigma

Paste resin for Glove

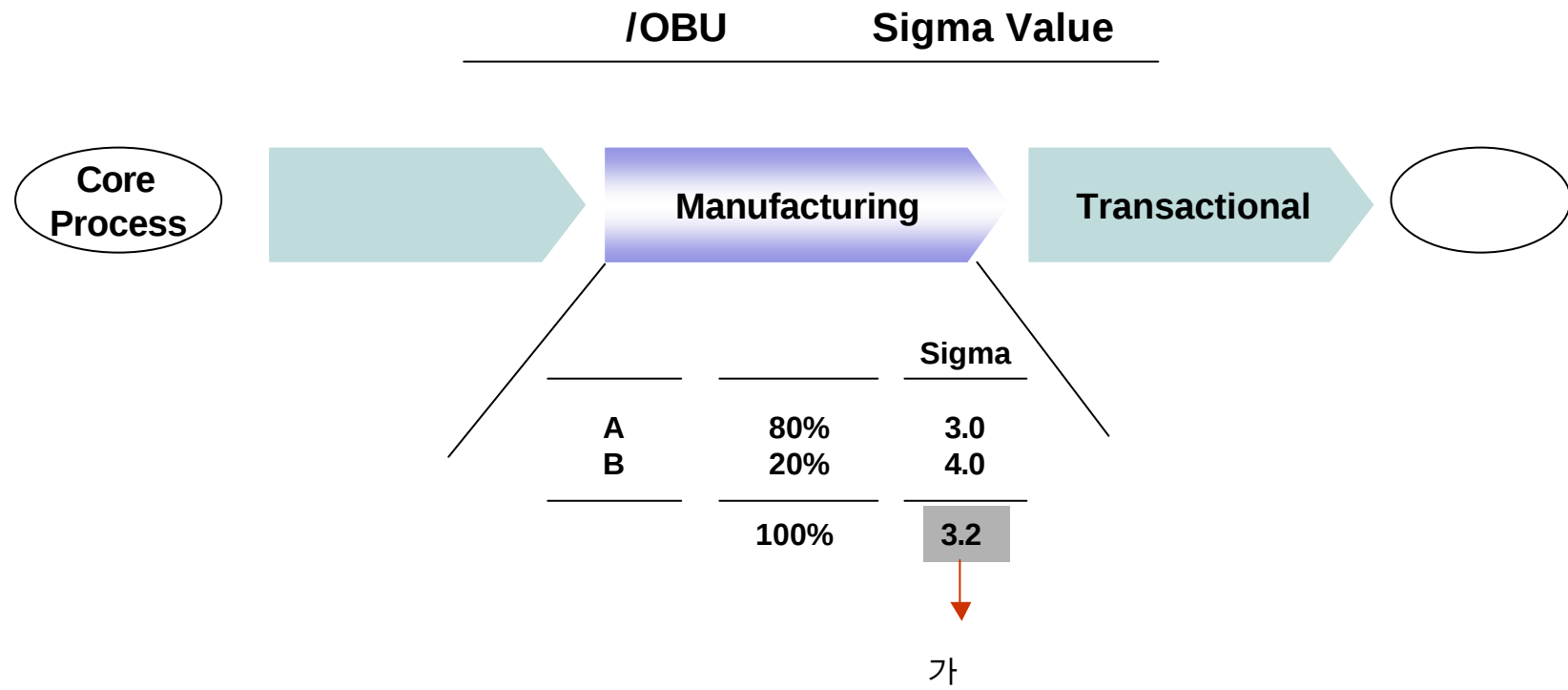
CTS : 1) Pinhole
2)

CTQ					
New Spec.	6.0	40μm	0.8%	3,300() 3,800()	
(n=30)	15	50μm	0.8±0.13	3,550±220	±220
Cp,Cpk,Z	Z=1.45	Cpk : 0.96	Cp : 1.12	Cp : 1.15	Z=3.45
Sigma	Z=1.45	0.96×3 =2.88	1.12×3 =3.36	3.45	Z=3.45
Z					
Sigma /	92.647%	99.801%	99.961%	99.972%	99.972%

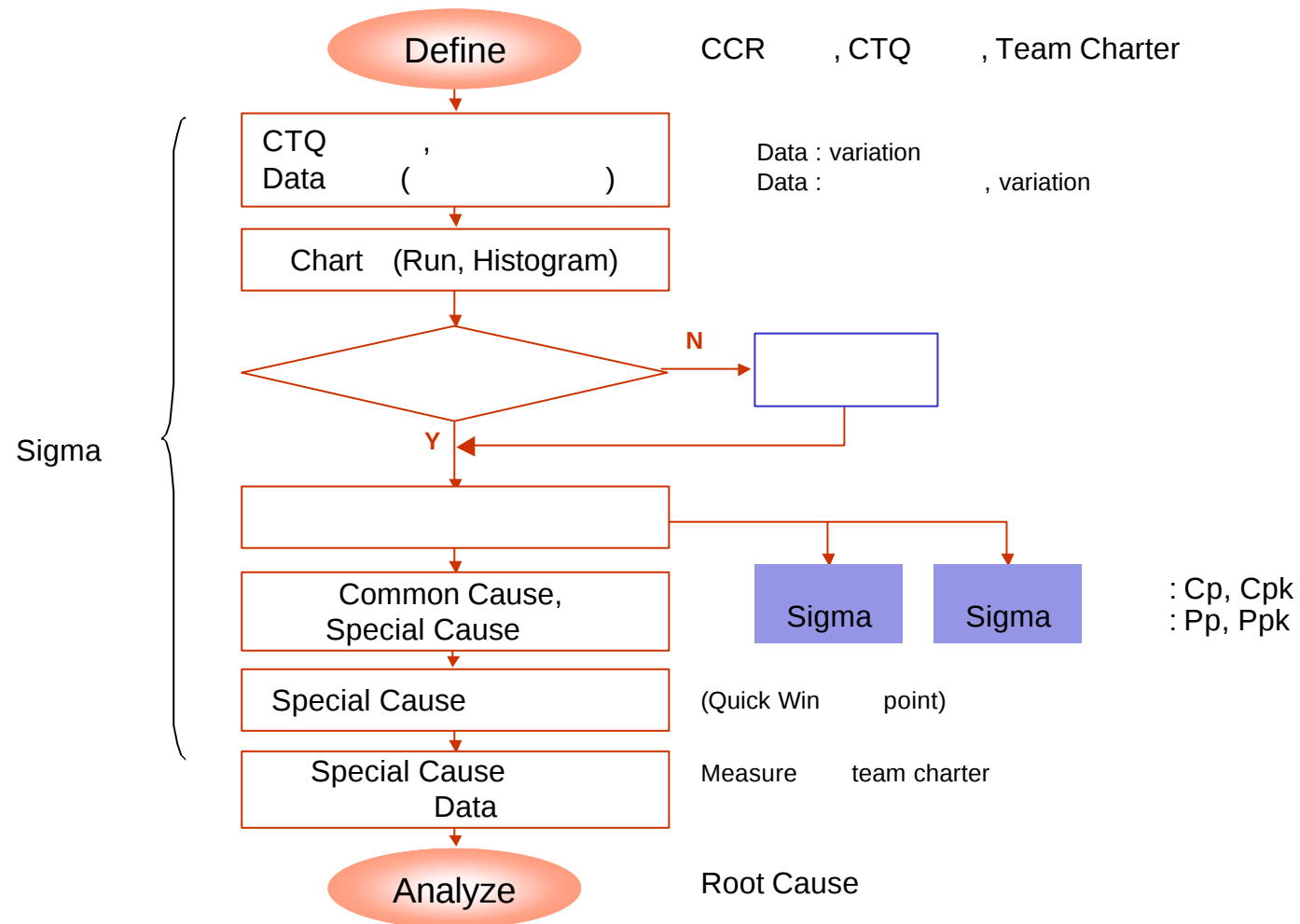
$$Y_{\text{norm}} = \sqrt[5]{92.647\% \times 99.801\% \times 99.961\% \times 99.972\% \times 99.972\%} = 98.426\%$$

Sigma It=2.151**

Service sigma / , service sigma



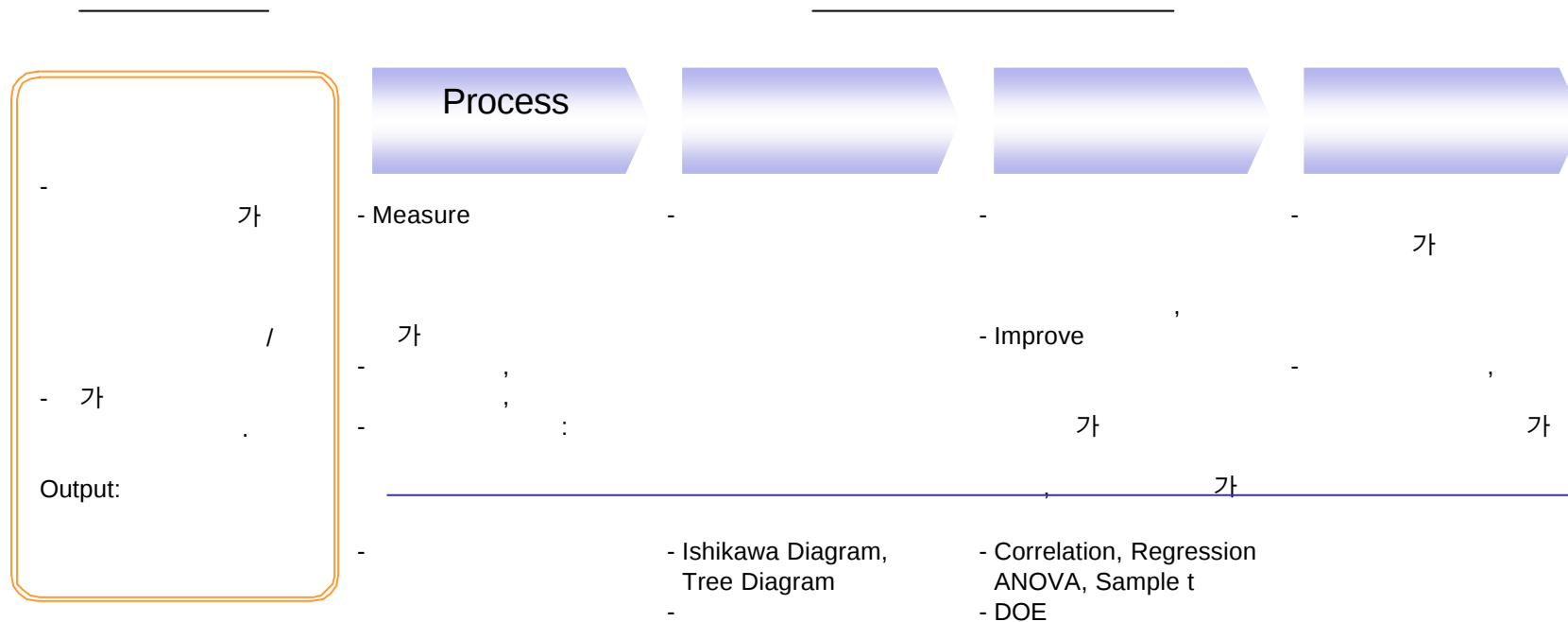
Define Opportunity



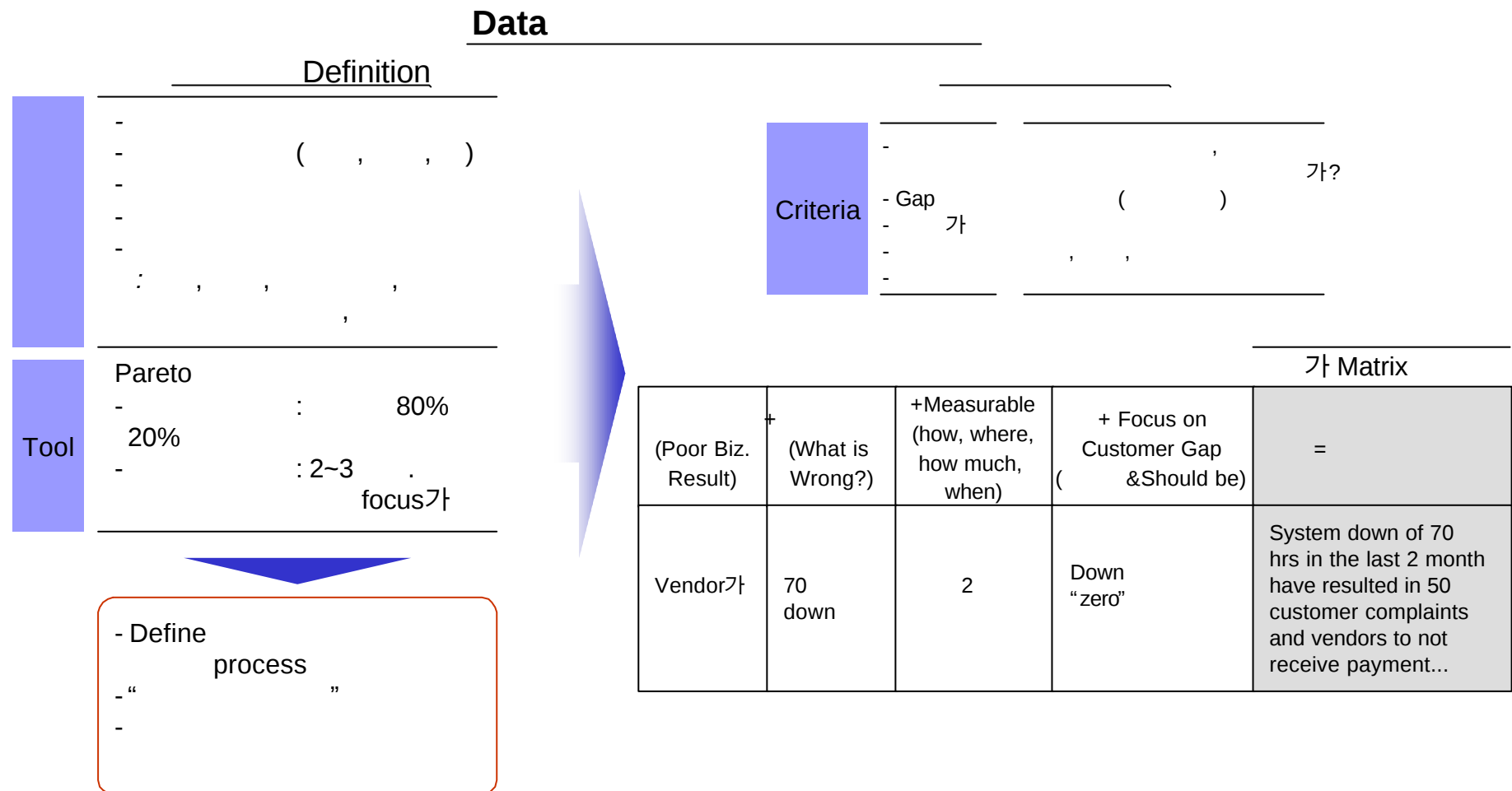
. Analyze



Measure data special cause가 data
data, Ishikawa diagram



3.1 Process



3.2 (Root Cause)

Output (symptom)
가 가

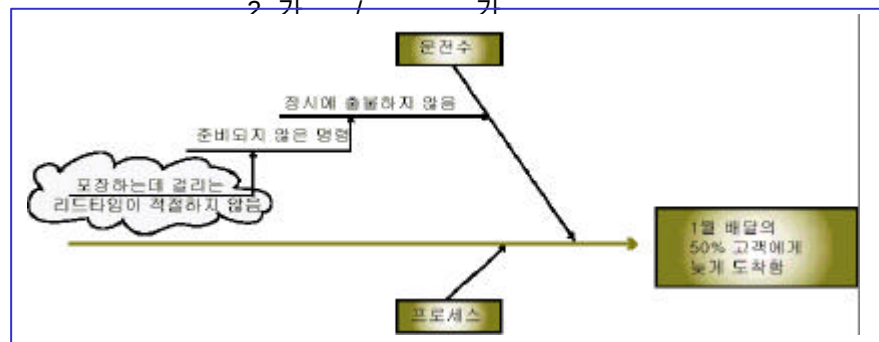
tool Ishikawa diagram tree diagram

Tool

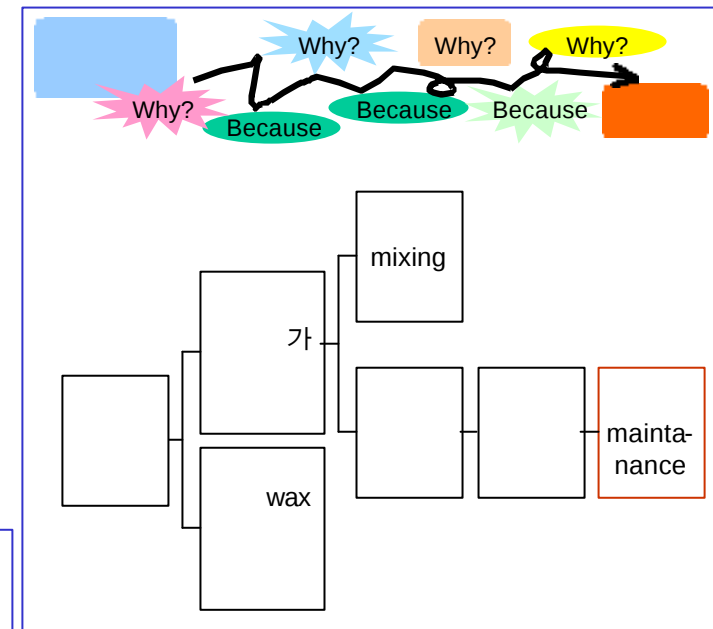
Ishikawa Diagram

- 가? - identify
- Man, Method, Machine, Material, Environment
- Brainstorming
- Diagram
- 1. .
- 2. “ ” . 3~5
- Environment
- Position
- type
- Material
- Differences in products
- Symptom

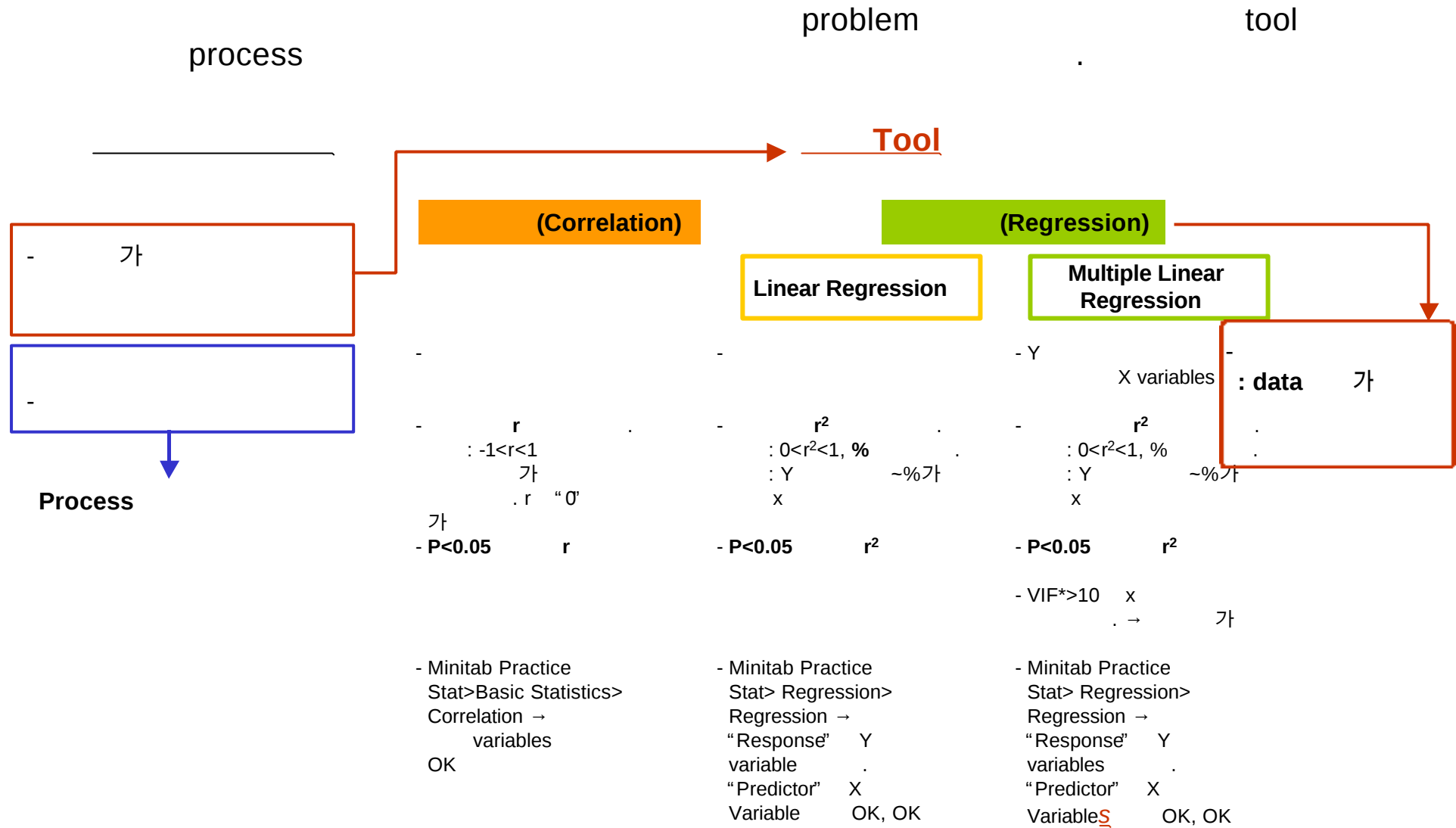
1. check “because” ...



Tree Diagram



3.3



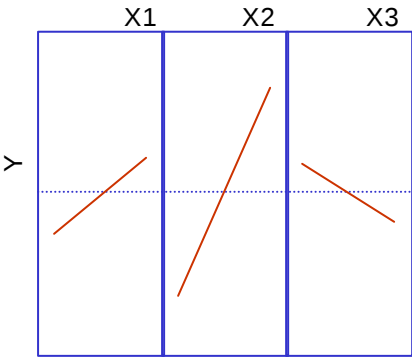
ANOVA (Analysis of Variance) Y x 가 , X

ANOVA*

Main Effect Plot

- Y 가

- Minitab Practice
Stat>ANOVA> Main effect plot>
Responses " Y "
Factors "x " > OK
: 가

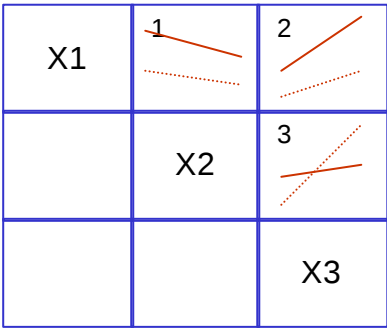


Interaction Plot

- Y 가

x

- Minitab Practice
Stat>ANOVA> Interaction plot>
Responses " Y "
Factors "x " > OK
: 가 가



- 1. X1, X2 無
- 2. X1, X3 無
- 3. X2, X3 有

DOE (

- Main Effect Plot, Interaction Plot, Cube plot

- Minitab Practice
Stat>DOE> Create Factorial Design> Design OK
- Stat>DOE> Factorial Plots> Main Effect set up
→ OK
Interaction set up
→ OK
Cube set up
→ OK OK

One-way ANOVA

- data

- Minitab Practice
Stat>ANOVA>One-way>
Response Column
OK
- P< 0.05 가
P> 0.05 가

General Linear Model

- Y 가

x

- Minitab Practice
Stat>ANOVA> General Linear Model>
responses " Y "
Model " x "
Covariates> Covariates
"x " >OK>OK
- P< 0.05

* Analysis of Variance

Sample T

가 (가 가?)

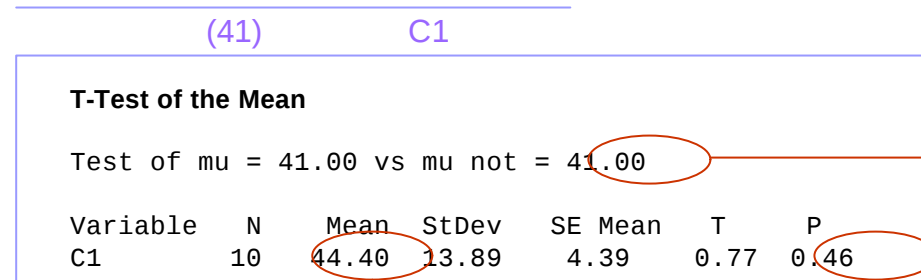
1-sample T

- Data가

:
: 1250hr 가?

- Minitab Practice

Stat> Basic Statistics>
1-Sample t → Variables
Column , Test Mean
Alternative "not equal"
Confidence "95" or "99" > OK



P가 0.05

가 (=not equal)

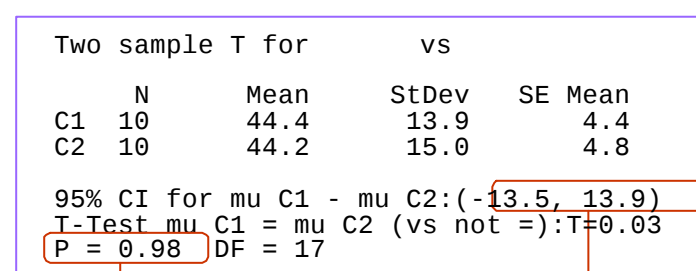
2-sample T

- 가 Data가

:
: A社 B社 가 가?
?

- Minitab Practice

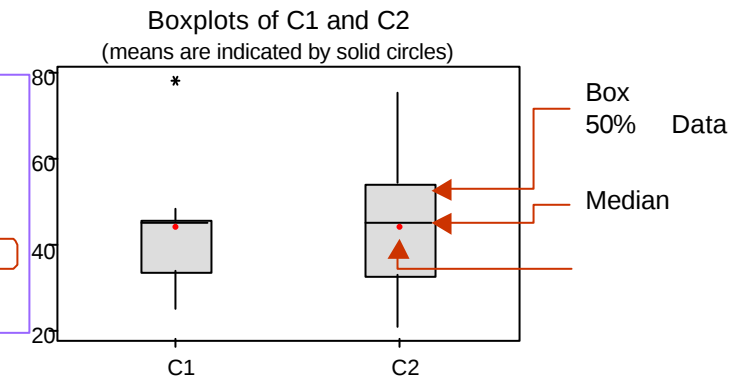
Stat> Basic Statistics>
2-Sample t →
Samples in different Column>
(가 : Sample)
First " column"
Second " column"
Alternative "not equal"
Confidence "95" or "99" > OK



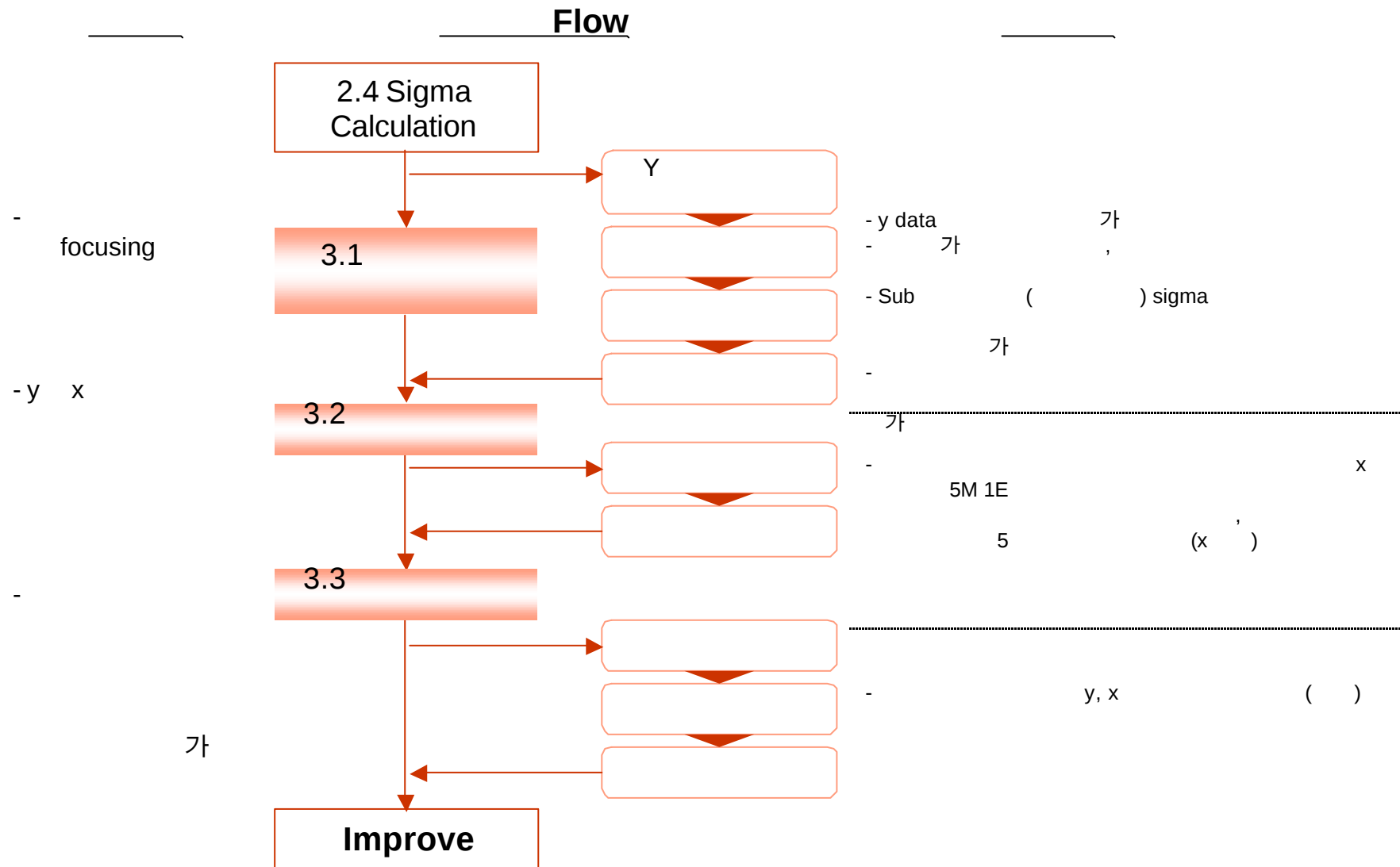
P>0.05

가 : 가

"0"



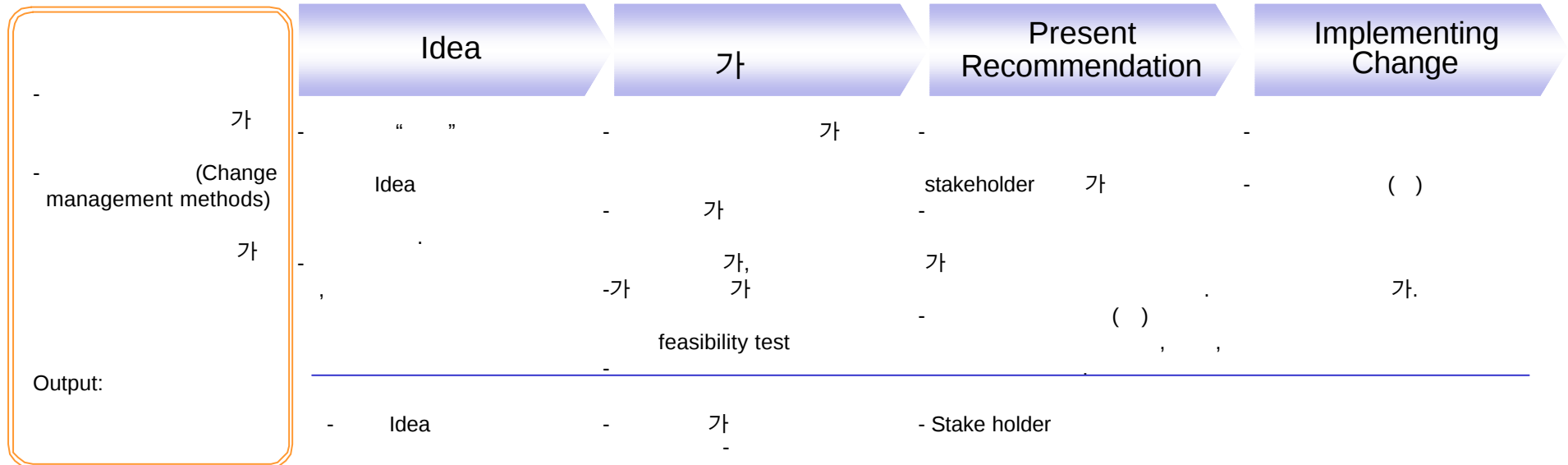
Analyze Process



. Improve



stake holder / idea , commitment 가

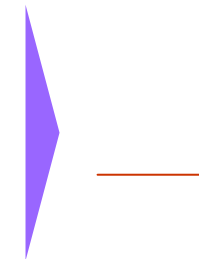


4.1 Idea

brainstorming,

idea

		Idea Matrix	
Tool	Description		
Traditional Idea Generation	Brainstorming	- focus - idea - 가	idea 가
Non-Traditional Idea Generation	가 (Challenge Assumptions)	- 가 (assumption) - Mapping	- idea
		-	
		-	
		-	
	Mind Map	-	- picture mental
	Six Thinking Hats	- Idea - issue brainstorm - 6 가	-
	- Non-linear thinking - 가		



Go to
next page

From previous page



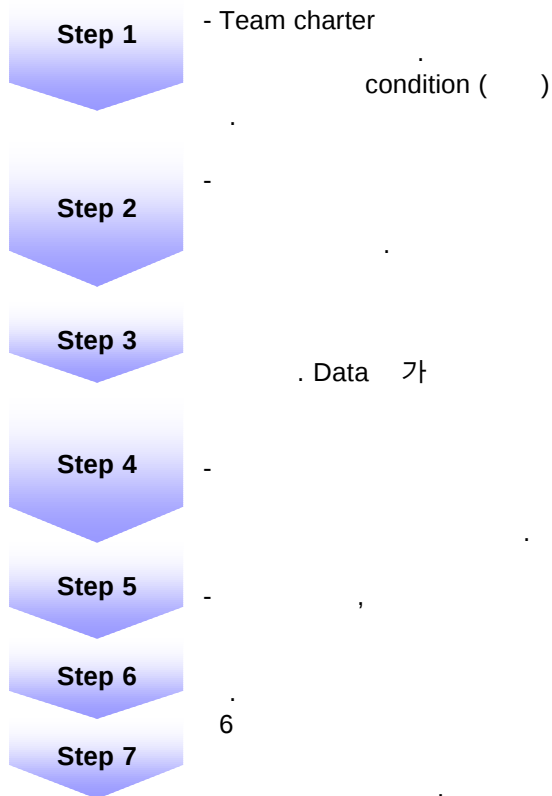
_____ risk control

, 가

Risk			
			/ control

stake holder

Presentation



Presentation Tools

Gantt Chart

, milestone

Action Plan

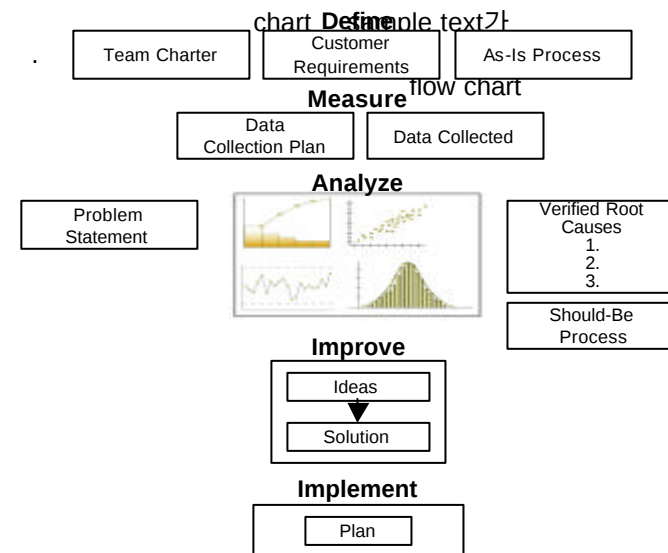
가?

가

가?

?

Storyboard



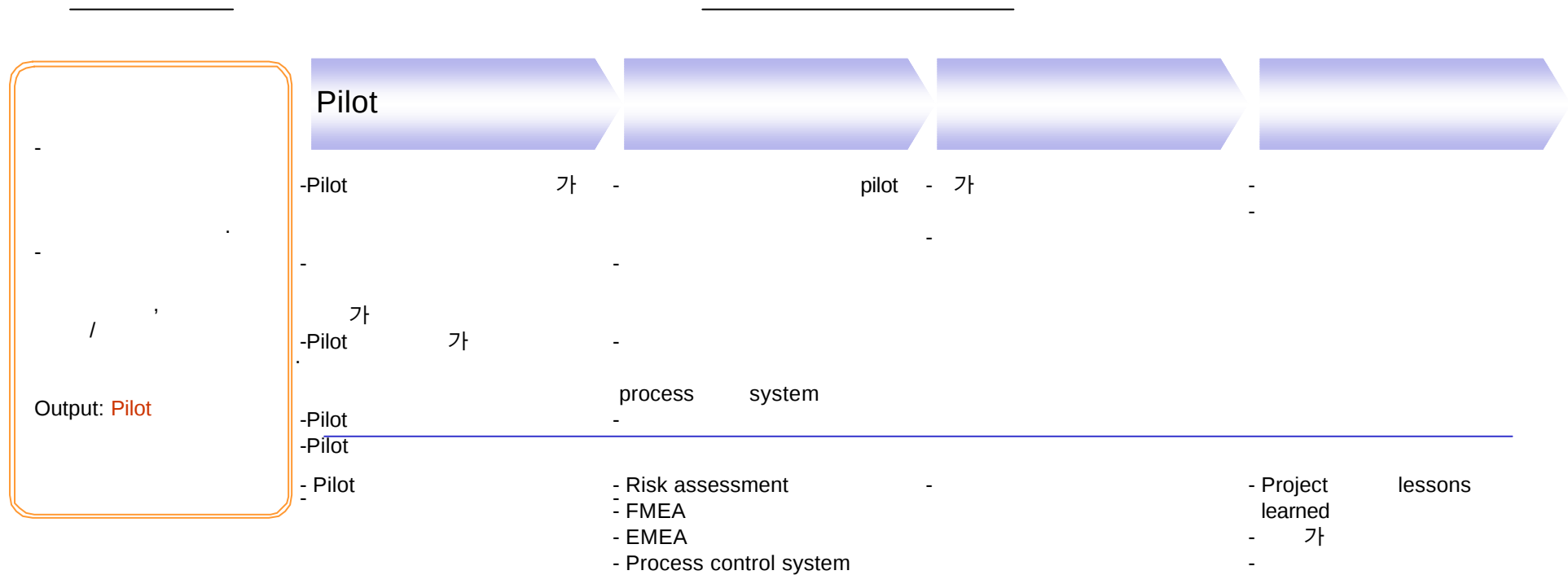
4.4 Implementing Change

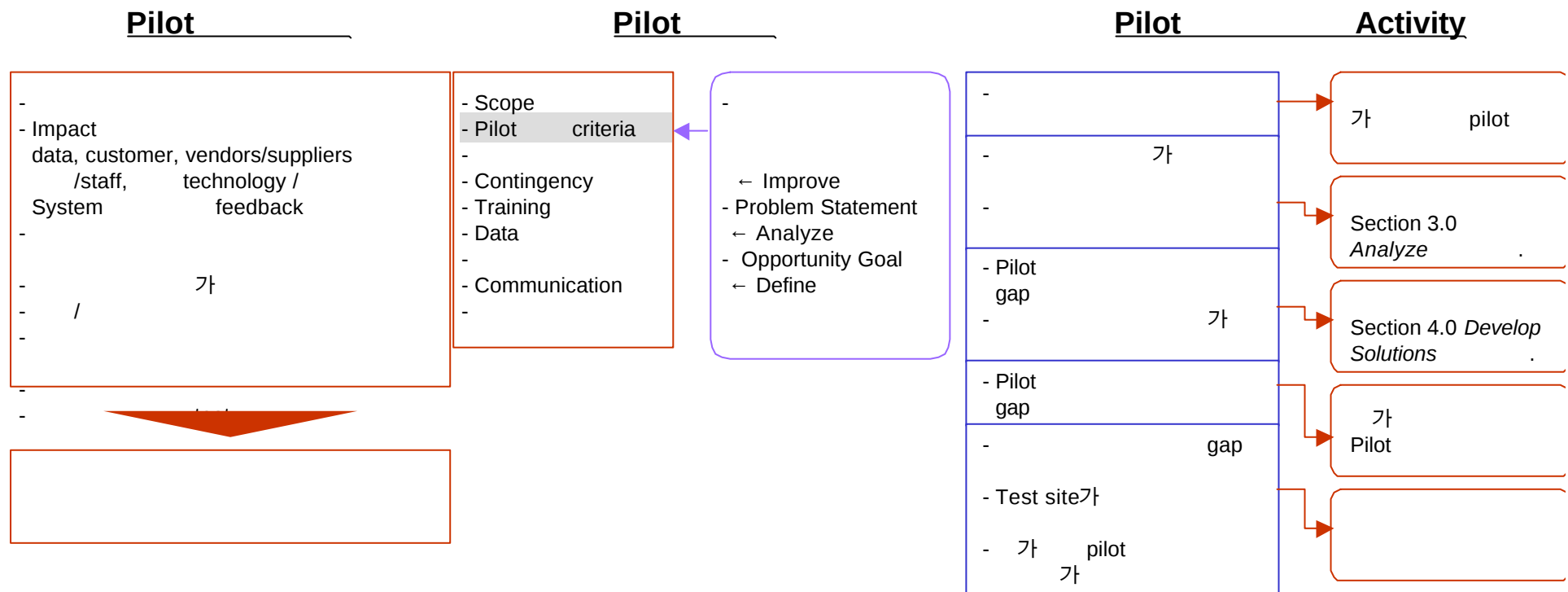
12가 Drivers

-	,	
-		
-	가	,
-		,
-		.
-		.
-	가	.
-	.	가
-		data
-		.
-	.	“
-	”	가
-	.	

. Control

pilot





5.2

Pilot 가 FMEA, EMEA tool

system, , .

Plan Element

Risk Assessment
EMEA
FMEA

가

Risk Assessment

	(, ,)	(, ,)	*

control

data

가,

가,

가?

(1.0)

solution benefits in 4.0

가,

, milestone

Next Page

EMEA*

- 가

- 가

- EMEA 가

- , 가

-

Error Mode Effect Analysis (EMEA)								
#	(Process Step)	(Error)	(Cause)	(Effect)	(Degree of Effort)			[(Occurrence Prevention [Countermeasur])]
4.2.1	outbound	-	-	-	0+2=2	4	3	9
4.2.2	pallet	-	가	-	2+2=4	1	1	6
	pallet가		pallet					
				가				
				pallet가				

FMEA*

- 가

-

- 가

Example: Appeal Process

Process															
								RPN*			Action				RPN
Appeal Application	Incomplete	Delay	5	Sales Rep Rushed	8	Clerk Checks upon Receipt	1	40							
		Bad Decision	8	Sales Rep Untrained	8	Sign off Territory Manager	1	64							
	Incorrect	Bad Decision	8	Entry error, Research error	5	Review by Territory Manager	9	360	Create a list of official checks for Territory Manager	JRK 2/16/99					
Appeal Committee	Missing Members	Delay	5	Business Travel Illness Vacation	10	Schedule M.F	1	50							

* EMEA: Error Mode and Effect Analysis
FMEA: Failure Mode and Effect Analysis

5.3 Process

Pilot test

.

(replication)

(Standardization)

	Pilot			
가 , cycle time	3 가	3		cycle time
	\$5,000,000	\$1,000,000	\$1,000,000	job
				air filters

5.4

Project

가
가

.

Lessons Learned

Compile - 가
document

Categorize - , , ,

Communicate / , ,

- 가

Team Evaluation

feedback

가

teaming skill

- , 가

-

- 가 가

- 가

- 가

- ,

- 가

-

-

Recognition

/

- 가

/

-

, 6

task

/ 가

가

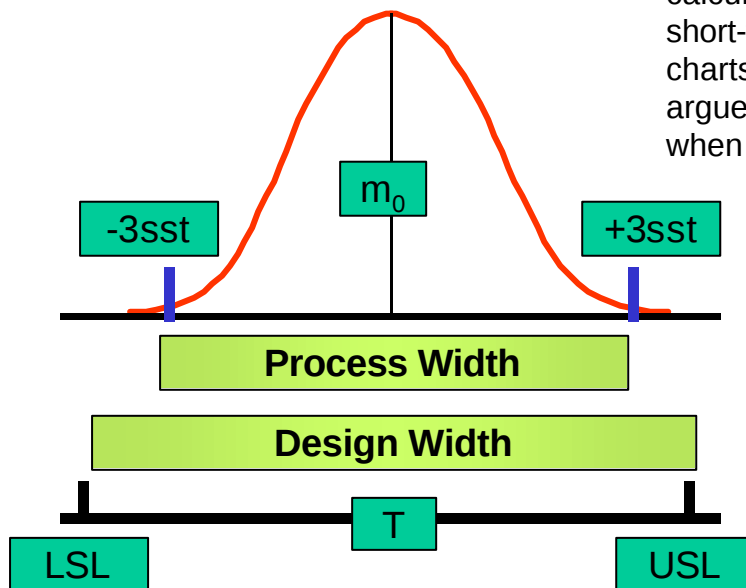
1. Cp, Cpk, Pp, Ppk

Process Capability Ratios: Cp

- The greater the design margin, the lower the Total Defects Per Unit(TDU).
- Design margin is measured by the Process Capability Index(Cp)

$$C_p = \frac{(\text{Maximum Allowable Range of Characteristic})}{(\text{Normal Variation of Process -- Short Term})}$$

Note: It is often suggested that the short-term standard deviation should be corrected for certain theoretical bias(which may be present) prior to calculation of Cp, Cpk, Pp, or Ppk. Such an adjustment is made by dividing the short-term standard deviation by C4, a constant used in conjunction with control charts. The theoretical merits of such a corrective device can be mathematically argued; however, the practical implications of such argument is highly unwarranted when given a sufficient sample.



$$C_p = \frac{|USL - LSL|}{\pm 3s_{st}}$$

$$Z_{ST} = 3 C_p$$

Note: Pp is based on the same equation as Cp with one exception: namely, Pp employs the long-term standard deviation(whereas Cp employthe short-term standard deviation.)

Process Capability Ratios: Cpk

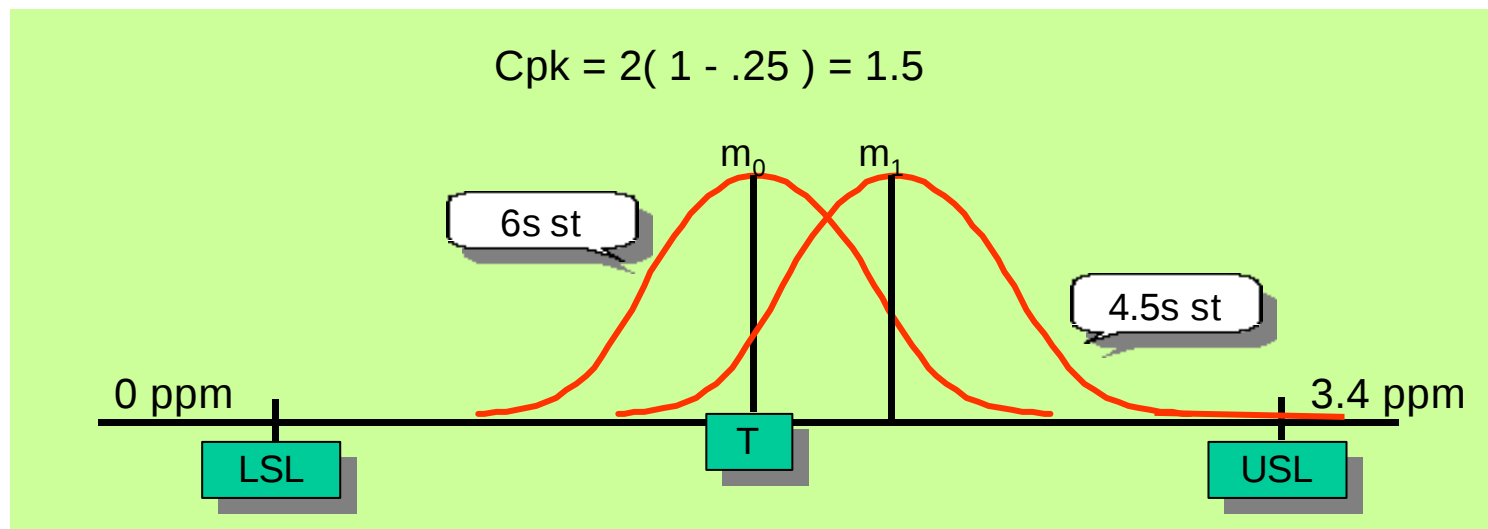
$$Cpk = Cp (1 - k)$$

Note: Ppk is based on the same equation as Cpk with one exception: namely, Pp employs the long-term standard deviation (whereas Cp employs the short-term standard deviation.)

Where k is the proportion of the tolerance zone consumed by the static mean shift

$$k = \frac{|T - m|}{(USL - LSL)/2}$$

Example: $Cp = 2$, $k = .25$



Process Capability Ratios: Pp

Note: Pp is based on the same equation as Cp with one exception: namely, Pp employs the long-term standard deviation (whereas Cp employs the short-term standard deviation.)

$$Pp = \frac{|USL - LSL|}{\pm 3s_{LT}}$$

$$Z_{LT} = 3 Pp$$

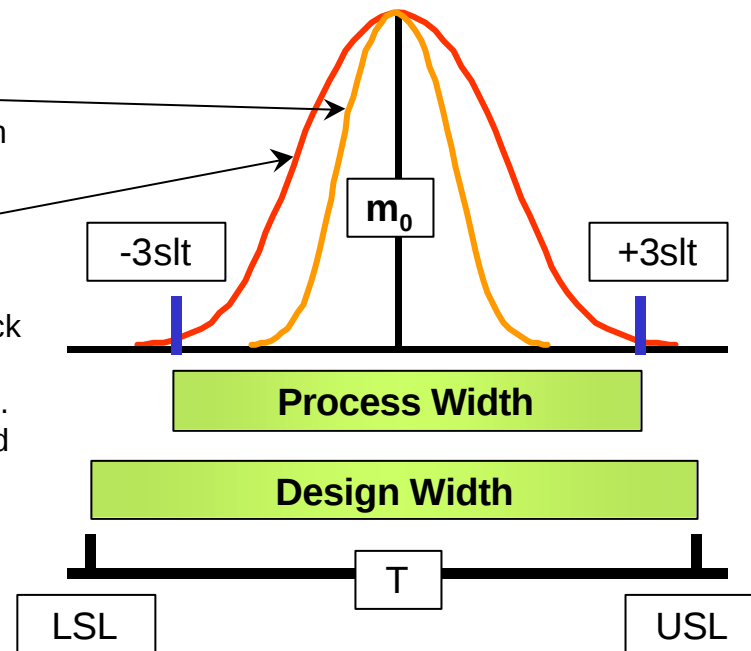
$$Pp = \frac{\text{(Maximum Allowable Range of Characteristic)}}{\text{(Normal Variation of Process -- Long Term)}}$$

Short-term distribution

displays only pure error, i.e., white noise only. Mean is artificially centered on the target value (by virtue of the equation).

Long-term distribution

displays white and black noise. In this instance, black noise are the nonrandom variations in the process mean which tends to expand the standard deviation. In the instance of Pp, the mean is artificially centered on the target value (by virtue of the equation).



Process Capability Ratios: Ppk

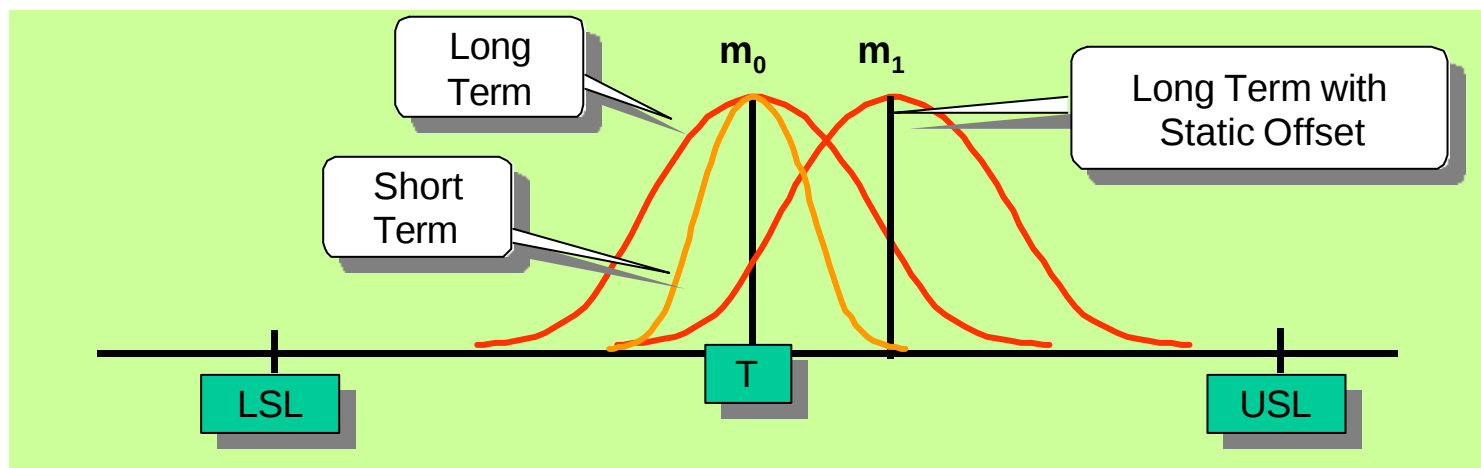
$$Ppk = Pp (1 - k)$$

Note: Ppk is based on the same equation as Cpk with one exception: namely, Pp employs the long-term standard deviation (whereas Cp employs the short-term standard deviation.)

Where k is the proportion of the tolerance zone consumed by the static mean shift

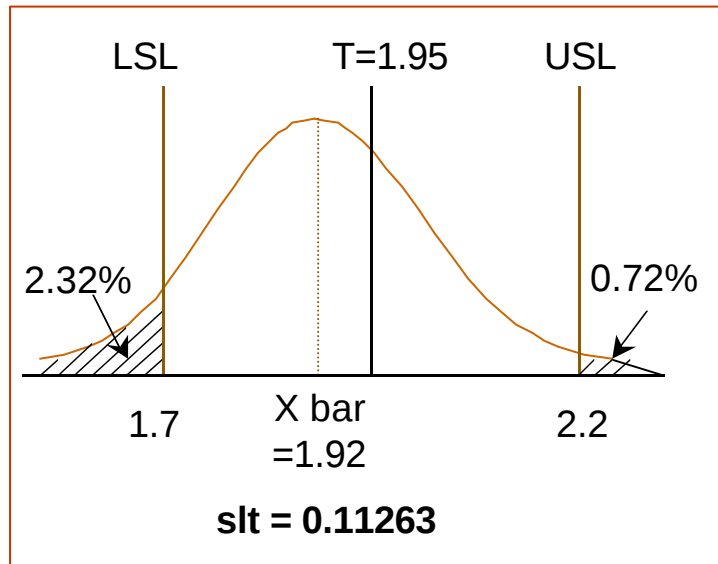
Note: The k value is computed the same way as in the Cpk metric. Again, the only difference is that Cpk utilizes the short-term standard deviation whereas Ppk employs the long-term standard deviation.

$$k = \frac{|T - m|}{(USL - LSL)/2}$$



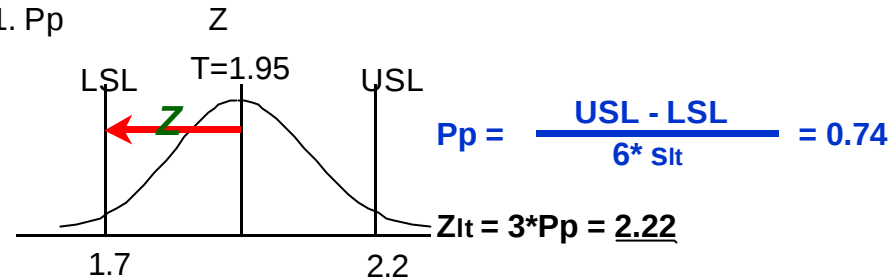
2. Sigma

Example : LDPE LB7500 MT
Long Term Data

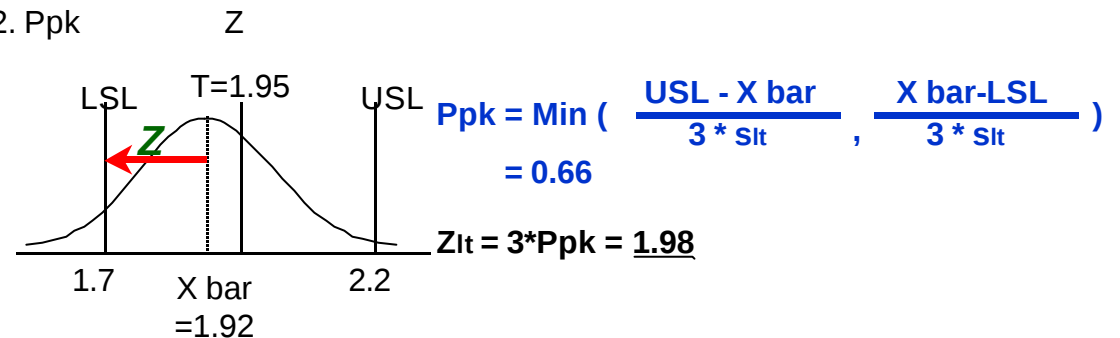


Z_{It}

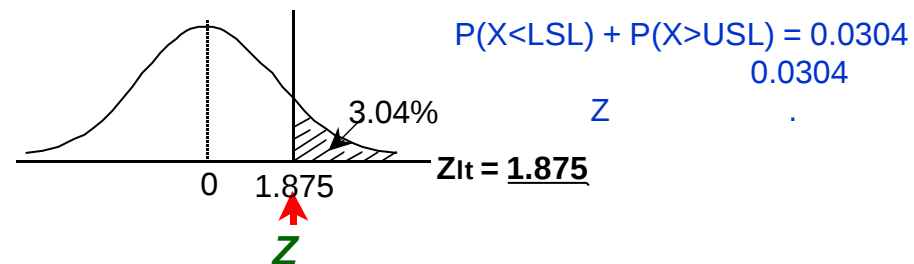
1. Pp



2. Ppk



1. Z



3:DMAIC

Package

	Define	Measure	Analyze	Improve	Control
Activity	BAP(A → P → F → B) - Team Charter - Process - Top Down Charting - Non-value Added - Quick-win (VOC)	CCR CTQ Baseline Sigma - Output, Input, Output (O.D) - Special Cause - Quick-win - Sigma	“ ” 【 Y=f(X)=X1+X2+X3+...】 - Process - Quin-win - Fault Tree - Data - Quick-win - Map	Idea - Idea - Quin-win - Sigma - Time Line - Story Board - Process Map - Story Board - Change Map	1.Pilot - Pilot 가 - Pilot 가 - EMEAFMEA - Pilot Solution 1.Process Control System - Pilot - 가 - Pilot - Change Map
Key deliverables	- CCR - Process Map - Quick-win - CCR,CTQ (VOC) - CCR - Kano	- Input, Process, Output - Indicator - Operational Definition - Quick-win - Data Format - Process	- Data - Quick-win - Map - Process	- Story Board - Process Map - Story Board - Change Map	- Pilot - 가 - Pilot - Change Map
Check Point	- CTQ - 가 가 - CTQ - Scope	/ σ - Data σ () R² () ()	- Vital Few () - Quick-win - Special Cause () DOE - 가 ()	- DOE () DOE, - Breakthrough - 가	/ () 20 Data ? - CTQ Red-X ()
【 Follow up & Auditing 】	Daily:BB/ Monthly:	(Issue , Transition)	Weekly: (, , ,)	() X-R	4.

