Module 2 III Chapter ⑤ Map.

Understanding variation in process

- Variation is what customer don't like
- Statistical Tools used to ~~ch~~ calculate variation

① Mean
- average data point
- = Sum of all number / Total number of Data
- = X-bar
- Can misleading or give wrong information

② MEDIAN
- Middle value
- array the number in ascending order
- Then select the middle number
- in case of 2 middle number so Median = Sum of these two number / 2

③ Mode
- Value occuring most frequency

④ Range
- difference between highest and lowest values
- larger range means larger variation in process

⑤ Standard Deviation
- Compare data with mean
- $S = \sqrt{\frac{\Sigma (x-\bar{x})^2}{n-1}}$
- ~~Her~~ higher value mean more ~~deviation~~ Variation in process

- Variation in Process :- The difference in values of Mean, Median and Mode
- Assignable / Special cause variation due to 5M + environment

- Six sigma most important Goal ~~is~~ is to reduce Variation

- measure variation in process
- non assignable causes / inherent cause. need to change the way of How we do the process.

12 Chapter (10) Map.

Seven Tools of quality

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- help in visual Presentation of the data.
- Ishikawa :- 95% of quality related problem Can be resolved with these Basic Tools

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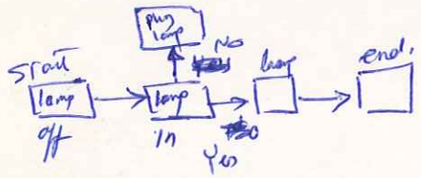
(1) Flow chart (non statistical)

- describe process in graphically displaying (visual steps) with proper sequence.
- The Below Can be analyzed :-
  1. identify critical process Points need Control so it's useful for Appraisil and prevention
  2. looking for missing steps
  3. Check the value added by Each steps



(2) Check sheet

- helps in organization data by category (Data record)
- show How many Times each particular value occurs.
- help to spot the problem

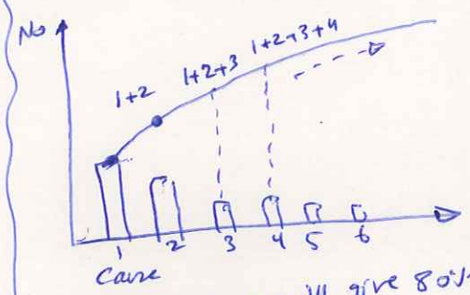
Problem description

Reason	Day					
	Mon	Tues	Wed	Thus	Fri	Total
Cause 1	++++	++++	||	|	|||	16
Cause 2	||	|||	++++			
Total	7					

- attributed / Count Data

(3) PARETO chart

- Prioritization Tool & (Count data)
- Vital few / Trivial many.
- help to find Root Causes
- help to find CTQ, CTPs



may 1+2+3 will give 80%. So those are the main Causes for failure (80/20 rules)

CTQ = No Causes

CTP = Process need to make Cause (1,2,3) as Critical

(4) Histogram

- Display the frequency of distribution of continuous / variable data.

- Story Central Tendency (Mean, Median and Mode close to each other) indicate less assignable Cause variation
- if bar are more spread out mean that range is higher, so i.e presence of non assignable Causes
- More than one Mode indicate assignable Causes.
- Curve Sharp means more stable
- Curve Flate means more variation

13 Chapter 11 Map

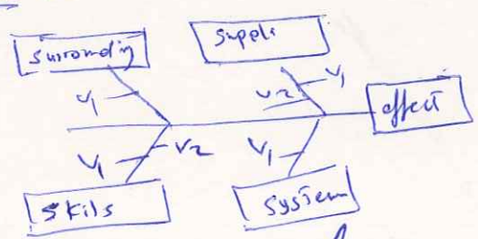
Seven Tools of quality

From Page 12

5 Fish Bone / Ishikawa Diagram / Cause and effect Diagram

- non statistical
- Brain storing
- Root Cause analysis
- Multivoting (Nominal group Tech.)
- 5 M + environment fish bone. (More Variables indicate CTP)

  - used in manufacture
  - Some limit Many and Maintenance are add.
- or 4S fishbone.



- used in Service industries

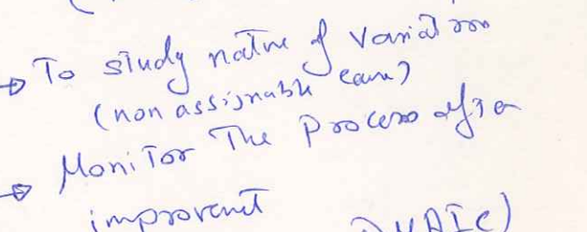
6 Co-relation diagram or Scattered diagram.

- relation between CTQ and CTPs, X
- Correlation
  - if Y increase as X increase (Positive correlation)
  - if Y decrease as X increase (negative correlation)
- Correlation Coefficient (r)
  - Points are very close (CTPs) to the best fit line = strong correlation
    - r => -0.7 to -1.0 or 0.7 to 1.0
  - Weak Correlation (NOT CTPs)
    - Point are far from the best fit line r = -0.3 to -0.69 or 0.3 to 0.69
  - No Correlation (NOT CTP)
    - You cannot draw any best fit line
    - r = -0.0 to -0.29 or 0.0 to 0.29

7 Control chart

- work as SCD
- check Capability of the Process
- check process running in control
- observe the behaviour of process over period of time.

- To calculate Process Capability (Analyze in DMAIC)
- To study nature of variation (non assignable cause)
- Monitor the process after improvement (Control in DMAIC)
- to monitor the process performance on an ongoing basis. (assignable Causes)



Chapter 11 Map.

Use SPC (Statistical Process Control) in Six Sigma.

Control chart.

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① limits.

- specification limits stated by customer
  - standard
  - Low
  - USL
  - LSL
- ② Control limit stated by manufacturer or Service provider as warning.
  - UCL
  - LCL

② Capability of the process.

- depened ent on two elements
  - mean → X-bar of UCL and LCL
  - Standard Deviation SD = S or σ
- UCL = X-bar + 3σ (S) or
- LCL = X-bar − 3σ (S)
  (Chose by Dr. Shewhart)
- ±3σ is selected because because 99.73% of the data under normal distribution Curve
  DPMO = 2700
- Specificat width SW = USL − LSL
- Process width PW = UCL − LCL
  = X-bar + 3σ − (X-bar − 3σ)
  = 6σ
- Process capability index $CP = \frac{SW}{PW} = \frac{SW}{6\sigma}$

Process said Capable if CP > 1 only (measure inherent Causes)

③ Causes of variation

① non assignable (inherent) Causes variation
- CP > 1 - process is Capable
- CP < 1 process is not Capable
- Variation is not acceptable
- Break Though is required to change the way of doing the Proces.

② assignable Causes (Special) SM and Environment
- Points are inside UCL and LCL The Variation is acceptable
- Points ouiside UCL or LCL Variation is not acceptable need to determine Root Cause.
- Corrective action i.e Continual improvent is required.

⊛ Count data → DPMO Table → Process Capability is Calculated Form sigma level.

⊛ Variable data → CP → Process Capability is calculated as 3 X CP.

⊛ So if CP = 1 of Certain Process So the Sigma level of this Process = 3 X 1 = 3 sigma level