

Software Quality Management

Lecture # 5
Tuesday October 12th, 2004

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Housekeeping

Any general issue that is a source of hindrance?

Today's lecture from:

- Course book + Pressman + web links + some books on SQC etc.
- Lets see if we are able to complete this!
- Calculators?

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The Yahoo Group Flashed Again

Group name:

sqm_case_fall04

Group home page:

http://groups.yahoo.com/group/sqm_case_fall04

Group email:

sqm_case_fall04@yahoogroups.com

Subscribe:

sqm_case_fall04-subscribe@yahoogroups.com

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sqm_case_fall04-unsubscribe@yahoogroups.com

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Today's Agenda

- The 3 Techniques.
- The 7 Quality Tools
 - Introduction
 - Usage mainly

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The Quality Testing

- The White Box Testing
 - Logical Path Coverage
 - What & when?
- The Black Box Testing
 - Equivalence Partitioning
 - What & when?
- To be discussed....

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The 3 Techniques & The 7 Quality Tools

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~~Ignorance Is
a Bliss~~

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Some Terms

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Failure

- Non conformance to software requirement specifications.

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Quality Control

- QC is the series of steps, inspections, reviews and tests used throughout the development cycle to ensure that each work product meets the requirements placed upon it.

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Quality Assurance

- Quality assurance consists of the auditing and reporting functions of management.

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Software Quality Assurance

- “Conformance to explicitly stated functional and performance requirements, explicitly documented development standards, and implicit characteristics that are expected of all professionally developed software.

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The 3 techniques

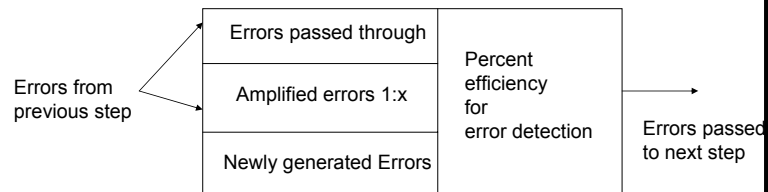
- Defect Amplification Model
- Vital Few Analysis
- Error Index Analysis

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Technique # 1

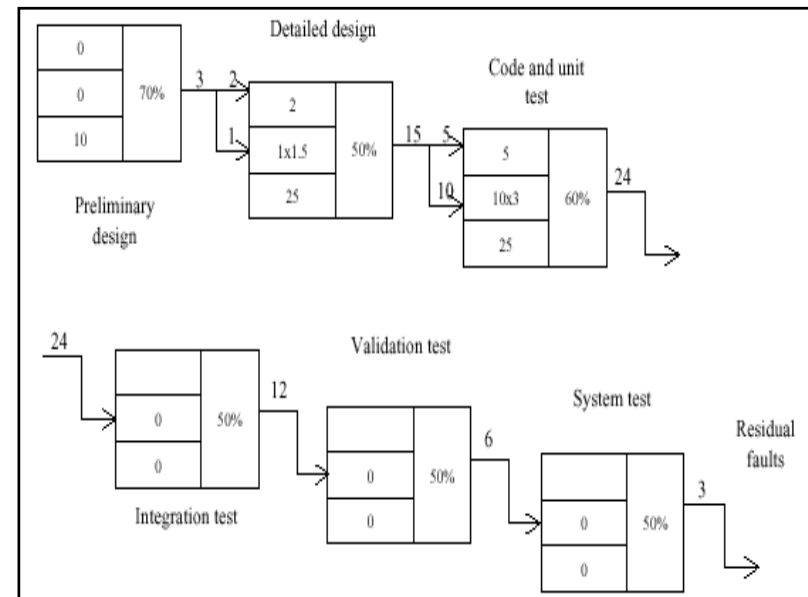
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Defect Amplification And Removal



- A defect amplification model is used to illustrate and detect errors during preliminary design, detail design, coding steps

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Technique # 2

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Statistical SQA

- Information about software defect is collected and categorized
- Attempt is made to trace each defect to its underlying cause
- Obtain the vital few and remove them using PARETO.

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An example!

- Corrective method.

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Information on defects (causes) collected by an organization after 1 year QA. During and post development.

- Incomplete/missing specification (IES)
- Misinterpreting customer communications (MCC)
- Intentional deviation from specs (IDS)
- Error in Data representation (EDR)
- Inconsistent module interfaces (IMI)
- Violation of Programming Standard (VPS)
- Incomplete/erroneous testing (IET)
- Ambiguous user interface or human computer interface (HCI)
- Error in Design Logic (EDL)
- Inaccurate/incomplete documentation (IID)
- Error in programming language (PLT)
- Miscellaneous (MIS)

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Built table & obtain vital few								
	Total		Serious		Moderate		Minor	
Error	No.	%	No.	%	No.	%	No.	%
IES	205	22	34	27	68	18	103	24
MCC	156	17	12	9	68	18	76	17
IDS	48	5	1	1	24	6	23	5
VPS	25	3	0	0	15	4	10	2
EDR	130	14	26	20	68	18	36	8
IMI	58	6	9	7	18	5	31	7
EDL	45	5	14	11	12	3	19	4
IET	95	10	12	9	35	9	48	11
IID	36	4	2	2	20	5	14	3
PLT	60	6	15	12	19	5	26	6
HCI	28	3	3	2	17	4	8	2
MIS	56	6	0	0	15	4	41	9
Total	942	100	128	100	379	100	435	100

Can you suggest
some improvements
here in the last slide?

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- Correct the vital few
- Root Cause
Determination Of
Error

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Technique # 3

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- Calculate E_i , S_i , M_i , T_i , PS , weights after every SDLC Phase and calculate Phase index.
- Error Index: for each major step.

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- $PI_i = w_s(S_i/E_i) + w_M(M_i/E_i) + w_T(T_i/E_i)$ where
 - E_i = total number of errors uncovered during i th step
 - S_i = number of serious errors
 - M_i = number of moderate errors,
 - T_i = number of minor (trivial) errors
 - w_s = serious error weight
 - w_M = moderate error weight
 - w_T = minor error weight
 - Weights should increase with increasing phase.
 - It is recommended that ratio of weights be $w_s: w_M: w_T = 10:3:1$.

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- Error Index:
- $EI = \sum (i * PI_i) / PS$
 $= (PI_1 + 2 PI_2 + 3 PI_3 + \dots + i PI_i) / PS$

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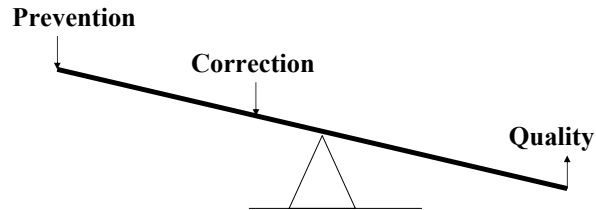
SQA Plan

- For SQA team
- A road map
- Covers software activities by QA department
- Consult Pressman

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A Manager Who Fails To Provide Resources And
Time For Prevention Activities Is Practicing False
Economy

Concentrate on Prevention, Not Correction



Prevention has more leverage when improving quality.
Software Process Standardization: A good preventive tool.

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QC Techniques (Introduction)

- Pareto analysis
- Histogram
- Check Charts
- Control Charts
- Scatter Diagram
- Cause & Effect Diagram
- Run Chart

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Introduction

- Recent past
- Individual abilities of programmers
- Software process improvement
- Quality decline
- Quality enhancement
- Development process standardization and simplification (Our Focus Mainly)
- Time reduction in processes
- Error detection
- We will discuss few possible deployments of these tools.

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Usage

- Can be used for quality control and assurance.
- Can be used by programmers & managers.
- Can be based on data gathered using testing phase & software metrics.
- Can use other parameters as well like project cost, schedules etc.

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Important Notes

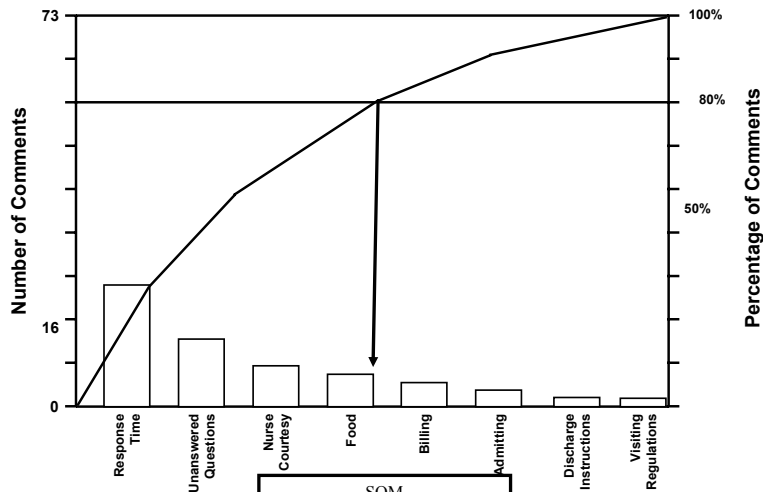
Quality may not be restricted to quality of the software product but also quality of the software development process (with a stronger focus on testing). The usage of some of these quality tools has been restricted to manufacturing industry process refinement only.

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Pareto Analysis

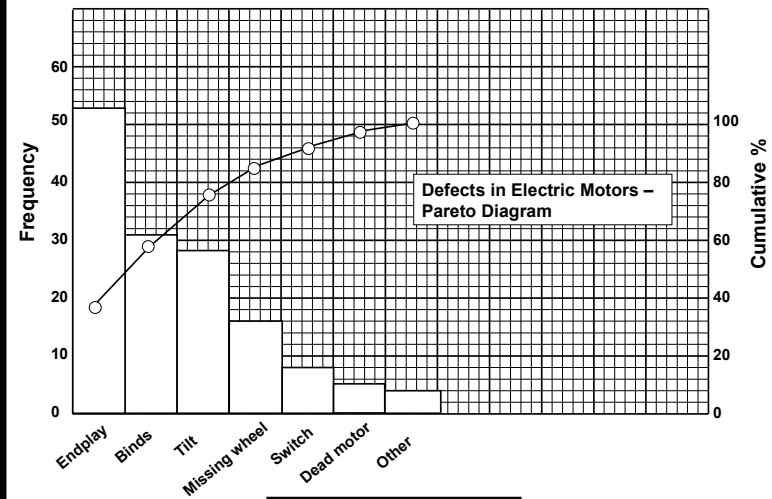
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PARETO CHART FOR PATIENT COMPLAINTS



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PARETO DIAGRAM



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Tally of Data

XYZ	6
XYZ	27
XYZ	1
XYZ	2
XYZ	1
XYZ	2
XYZ	3
Total defects	42

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Tally of data, rearranged in order of frequency

XYZ	27
XYZ	6
XYZ	3
XYZ	2
XYZ	2
XYZ	1
XYZ	1
Total defects	42

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Deployment (PARETO)

- Error categorization by teams
- Obtaining vital few
- Seriousness of errors cannot be based on frequency alone.
- Observe the cause based on its ability to propagate errors.
- If 20% root causes are fixed.
- Is a good tool to identify the reaction to change.

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SCATTER DIAGRAMS

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DATA OF BLOWING AIR-PRESSURE AND PERCENT DEFECTIVE OF PLASTIC TANKS

Date	Air Pressure (kgf/cm ²)	Percent Defective (%)
Oct. 1	8.6	0.889
2	8.9	0.884
3	8.8	0.874
4	8.8	0.891
5	8.4	0.874
8	8.7	0.886
9	9.2	0.911
10	8.6	0.912
11	9.2	0.895
12	8.7	0.896

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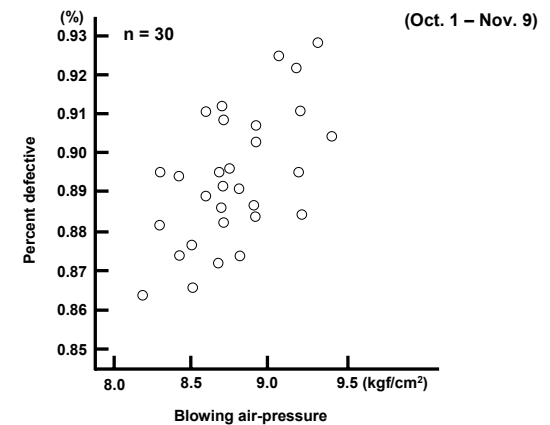
Date	Air Pressure (kgf/cm ²)	Percent Defective (%)
15	8.4	0.894
16	8.2	0.864
17	9.2	0.922
18	8.7	0.909
19	9.4	0.905
22	8.7	0.892
23	8.5	0.877
24	9.2	0.885
25	8.5	0.866
26	8.3	0.896

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Date	Air Pressure (kgf/cm ²)	Percent Defective (%)
29	8.7	0.896
30	9.3	0.928
31	8.9	0.886
Nov. 1	8.9	0.908
2	8.3	0.881
5	8.7	0.882
6	8.9	0.904
7	8.7	0.912
8	9.1	0.925
9	8.7	0.872

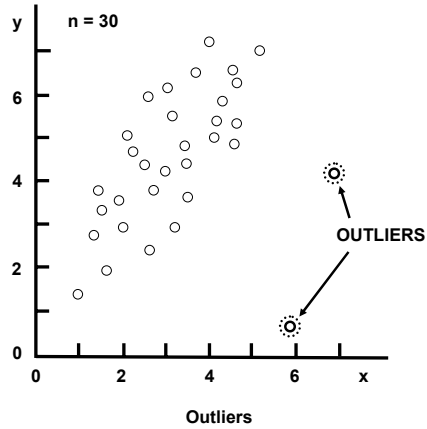
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SCATTER DIAGRAM

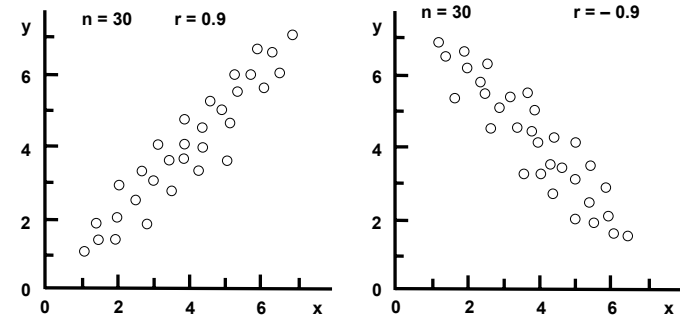


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SCATTER DIAGRAM



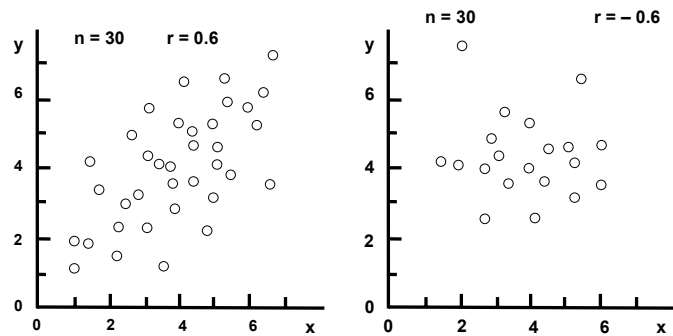
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Positive Correlation

Negative Correlation

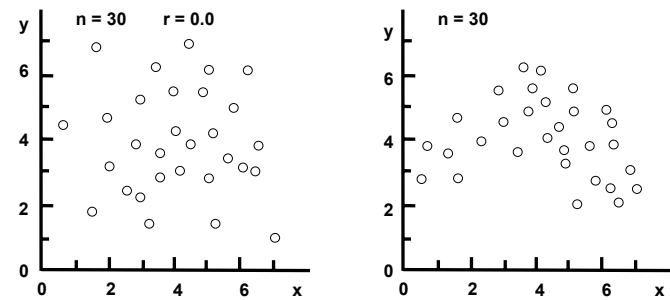
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Positive Correlation
May Be Present

Negative Correlation
May Be Present

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No Correlation

Non Linear Relationship

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Deployment (SCATTER DIAGRAMS)

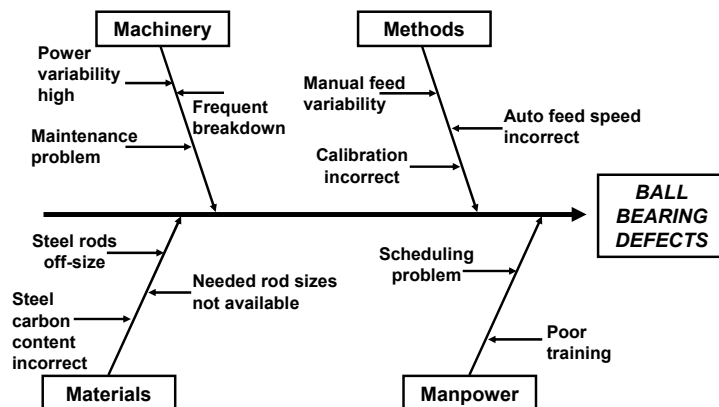
- Identifying deviant reading.
- Very large domain.
- Enormously dependent on choice of 2 variables.
- Managerial processes fixing.
- Development processes fixing.
- Organization policy / rules.
- Coding standards fixing & error identification.

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Cause & Effect Diagram

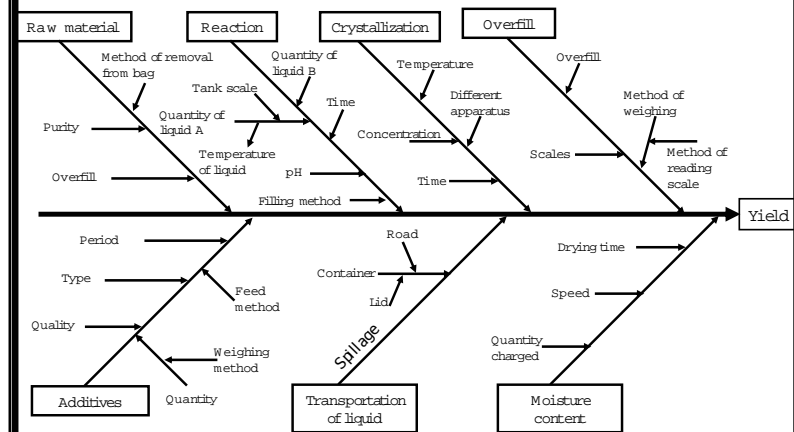
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FISHBONE DIAGRAM



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CAUSE & EFFECT DIAGRAM



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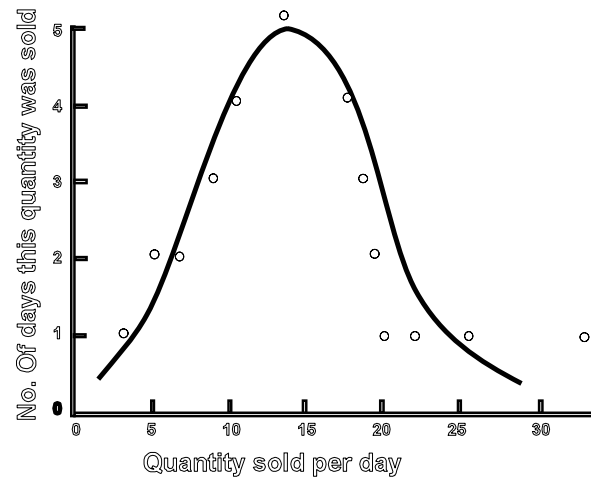
Deployment (FISHBONE)

- ???????

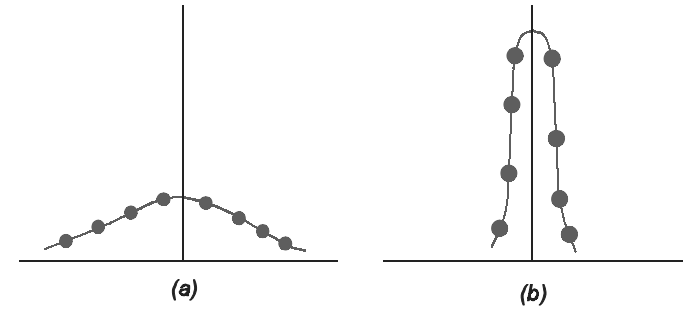
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Histograms

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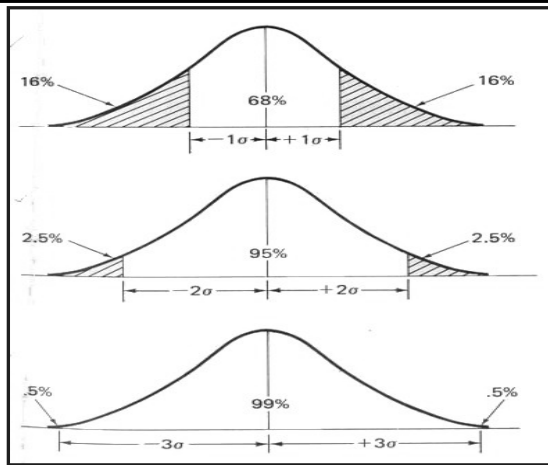


Two variant curves.

(a) The values are widely dispersed away from their mean.

(b) The values are tightly grouped about their mean.

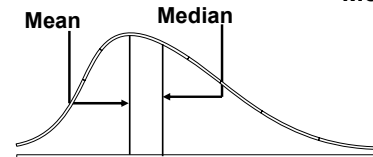
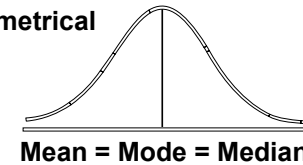
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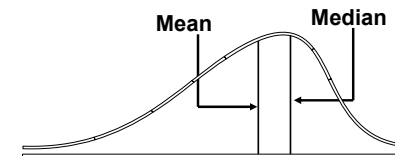
Approximate areas under portions of normal curves

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A. Symmetrical



B. Positively Skewed

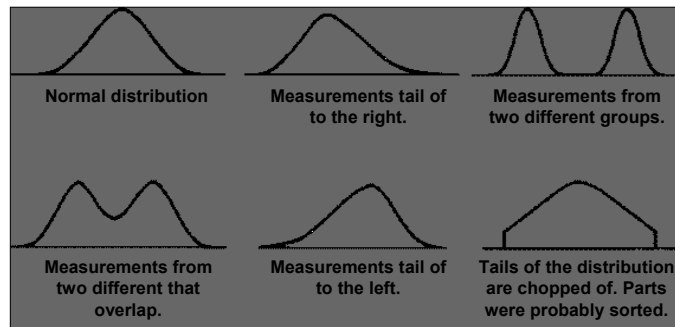


C. Negatively Skewed

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FUNDAMENTAL PRINCIPLES

VARIATIONS DUE TO ASSIGNABLE CAUSES TEND TO DISTORT THE NORMAL DISTRIBUTION CURVE.



DISTORTIONS OF THE NORMAL CURVE

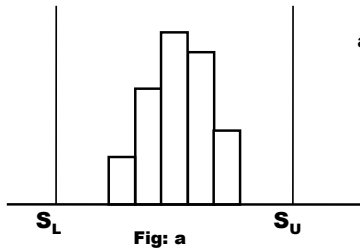
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QUESTIONS ANSWERED BY THE HISTOGRAM PATTERN

- + **Is the process producing bell shaped curve?**
- + **Where is the process centered?**
- + **Is the process capable of meeting the engineering specifications?**

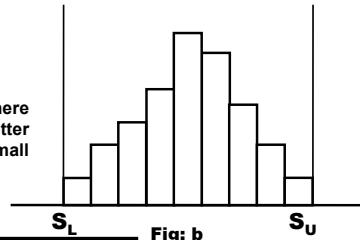
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HISTOGRAMS & SPECIFICATIONS LIMITS

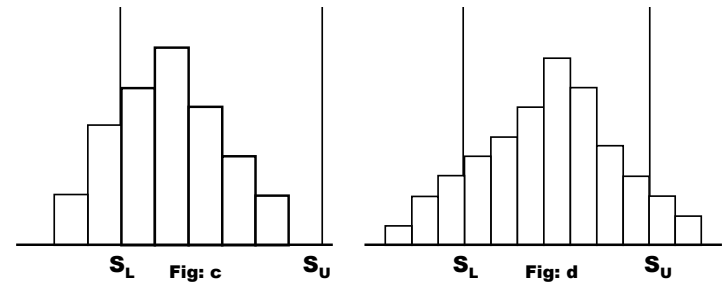


- a) Maintenance of the present state is all that is needed, since the histogram amply satisfies the specification.

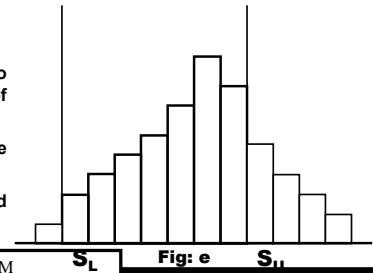
- b) The specification is satisfied, but there is no extra margin. Therefore, it is better to reduce the variation by a small degree.



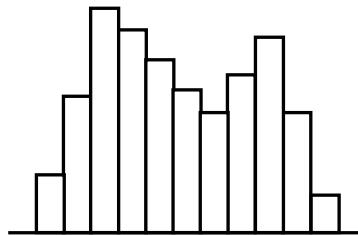
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- c) It is necessary to take measures to bring the mean closer to the middle of the specification.
 d) This requires action to reduce the variation.
 e) The measures described in both c) and d) are required.



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Shape:

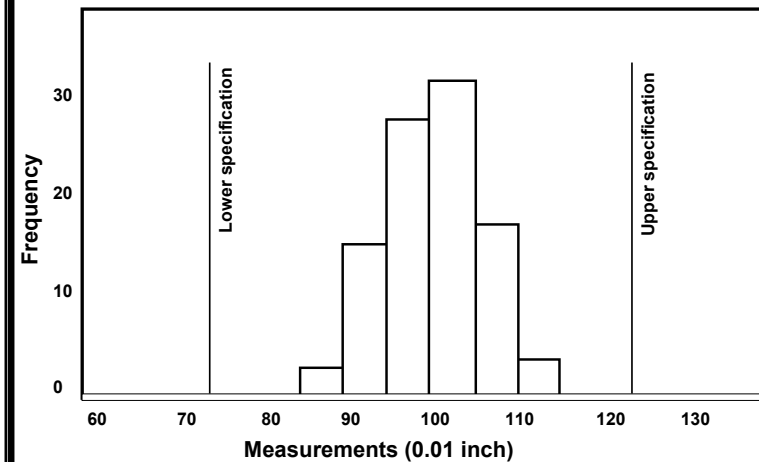
The frequency is low near the middle of the range of data, and there is a peak on either side.

Note:

This shape occurs when two distributions with widely different mean values are mixed.

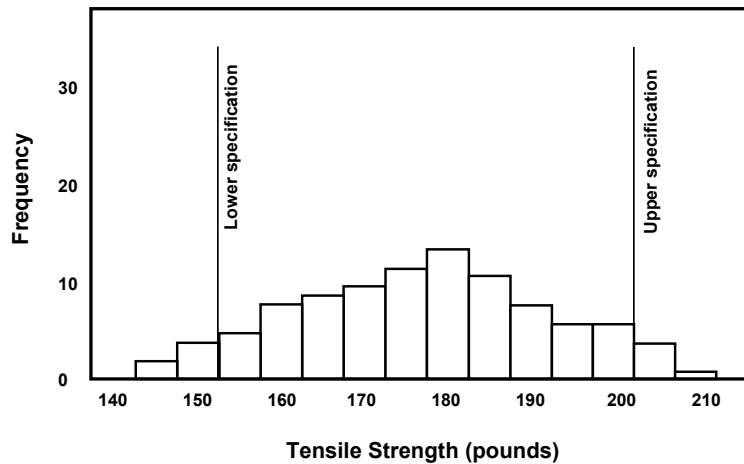
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A GOOD SITUATION: PROCESS SPREAD IS NARROW AND IS CENTERED BETWEEN SPECIFICATIONS.



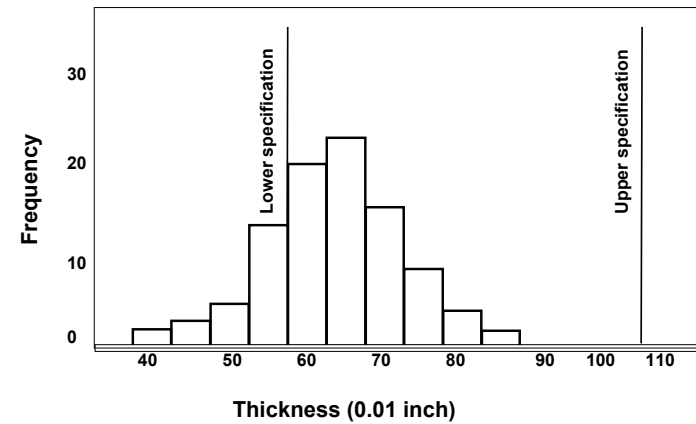
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INHERENT VARIATION IS TOO LARGE FOR SPECIFICATIONS



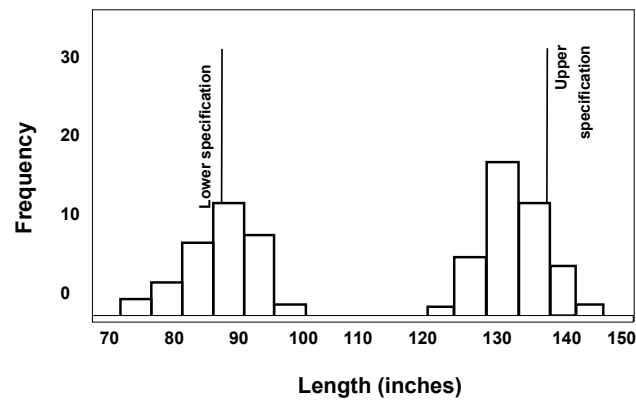
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PROCESS IS OFF CENTER



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TWO DISTRIBUTIONS PRESENT IN ONE SAMPLE

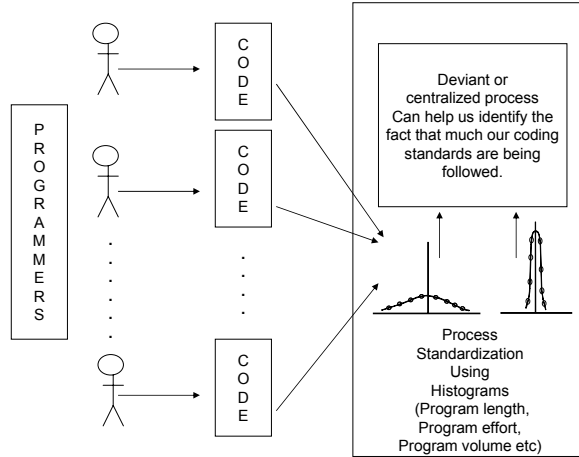


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Deployment (HISTOGRAMS)

- Locating process decentralization.
- Can use software metrics & testing data.
- Post coding preferences.
- Coding standards enhancement.

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Check Sheets

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DAILY BREAKDOWN SHEET

	Mon	Tue	Wed	Thur	Fri	Total
Machine 1	✓ ✓ ✓		✓ ✓			5
Machine 2		✓				1
Machine 3	✓			✓ ✓		3
Total	4	1	2	2		9

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CHECK SHEET - ADMIN SERVICE

Typing Mistakes in Deptt 'A'

	MARCH			
Mistakes	1	2	3	Total
Centering	II	III	III	8
Spelling	𑂔𑂔 II	𑂔𑂔 𑂔𑂔 I	𑂔𑂔	23
Punctuations	𑂔𑂔 𑂔𑂔 𑂔𑂔	𑂔𑂔 𑂔𑂔	𑂔𑂔 𑂔𑂔 𑂔𑂔	40
Missed paragraph	II	I	I	4
Wrong numbers	III	IIII	III	10
Wrong page (s)	I	I	II	4
Tables	IIII	𑂔𑂔	IIII	13
Total	34	35	33	102

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CONSTRUCTING A CHECK SHEET

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ITEMS RECORDED ON A CHECK SHEET

- 1. TITLE:** TO EXPRESS CLEARLY THE PURPOSE OF THE INSPECTION
- 2. OBJECT ITEM:** WHAT TO CHECK AND WHERE TO CHECK IT
- 3. CHECKING METHOD:** WHAT YOU SHOULD USE AND WHAT PROCEDURE TO FOLLOW WHEN MAKING CHECKS
- 4. DATE AND TIME OF CHECK:** AT WHAT INTERVAL CHECKS SHOULD BE MADE AND WHEN THEY SHOULD BEGIN AND END

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- 5. THE CHECKER:** WHO PERFORMED THE CHECKS
- 6. THE LOCATION:** WHERE CHECKS ARE MADE
- 7. SUMMARY OF CONCLUSIONS:** TOTAL, MEAN, CALCULATION OF PROPORTIONS WITHIN THE TOTAL AND OBSERVATIONS

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TYPES OF CHECK SHEETS FOR VARIOUS PURPOSES

Purpose of Checking	Type of Check Sheet
■ Determine defect details	Defective item check sheet
■ Determine occurrence of defects by day of the week, operator machine, etc.	Defect factor check sheet
■ Determine where defects occur	Defect position check sheet
■ Determine dispersion of dimensions, hardness, weight, etc.	Process distribution check sheet
■ Inspect machines or equipment or check the operating procedure	Inspection and validation check sheet

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DEFECT FACTOR CHECK SHEET

Product number: G100B9991	<div style="border: 1px solid black; width: 100px; height: 30px; margin: 0 auto;"></div> Defect Occurrence Status Survey Check Sheet	Process name: FL-SK
Product name: <div style="border: 1px solid black; width: 100px; height: 30px; display: inline-block;"></div>		Inspector: (initials)

○ = IJK

○ = XYZ

△ = MNO

✕ = ABC

□ = DEF

Operator	Jig	1/22 (M)		1/23 (T)		1/24 (W)		1/25 (R)		1/26 (F)		Total	
		a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.		
A	JF-3	○○○○○ △	○○○○○ □	○○○○○ ○	○○ △	○○○○○ ○	○○○○○ ○	○○○○○ ●	○○○ □	○○○○○ ●	○○○○○ △		66
	KF-3	○ △△△ □	○○ △△△		○○○ △△	○○ ○	●	○	○○ ●	○○ △△△ X	○ △△△		40
B	JF-3	○○○ △ X	●● X	●● X		○○○ ○	○ ●	○ ●● △		○○ ●●	●● △△	○○ ●● △ X	37
	KF-3	○ ● △△△△	○○ △△	○○ □	●● X □	○ ● △	○○ ●● □	○ ● X	●●● △△ X	○ ●● △△ □	○○ ●● △△		50
Total		25	20	13	17	16	17	15	18	28	24	193	
		45		30		33		33		52			

PROCESS DISTRIBUTION CHECK
SHEET

Deployment (CHECK SHEETS)

- ????????

SOM

Flow Charts

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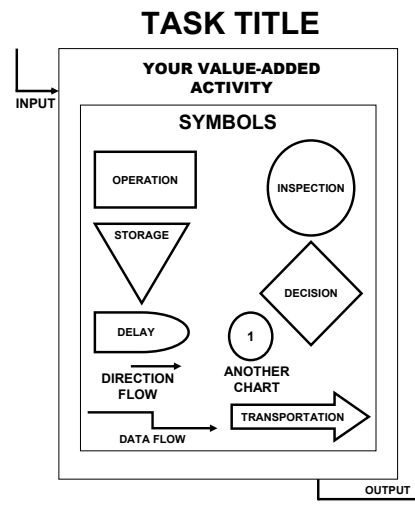
A FLOW CHART IS A DIAGRAM OF ACTIVITIES INVOLVED IN THE PROCESS OR IN THE SOLUTION OF A PROBLEM. THE FLOW CHART IS TYPICALLY THE FIRST STEP IN ANALYZING A PROCESS.

TO PREPARE A FLOW CHART

- **LIST MAJOR WORK AREAS**
- **LIST ALL MAJOR STEPS INVOLVED IN THE PROCESS**
- **LIST ALL MAJOR ACTIVITIES FOR EACH STEP**

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SYMBOLS FOR A FLOW DIAGRAM



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Flow Chart allows you to:

- ◆ **Visualize your process from the point of view of how the work is done.**
- ◆ **To characterize your current processes**
- ◆ **To design new processes**
- ◆ **To stream line existing processes**
- ◆ **To assess weaknesses in your current system**
- ◆ **To spot those places where the system has broken down without your knowledge.**

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Deployment (FLOW CHARTS)

- ????????????

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Control Charts

- Next Time

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The end:

Your Feedback

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