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ABSTRACT

This booklet is one of six texts from a workplace literacy curriculum designed to assist learners in facing the increased demands of the workplace. The booklet contains five sections that cover the following topics: (1) importance of reliability; (2) meaning of quality assurance; (3) historical development of quality assurance; (4) statistical process control; and (5) statistical tools (checklist, fishbone, flowchart, histogram, control chart, run chart, pareto chart, and scattergram). (KC)

QUALITY ASSURANCE

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WOULD YOU HIRE EMPLOYEES WITH 90% RELIABILITY?

Without much thought, the answer to this question might be, "Surely, I would." It sounds pretty good at first. After all, 90% in education means an "A". Most students would be satisfied with that.

When employers hire employees who are 90% reliable, it means workers can be depended on 90% of the time and not depended on 10% of the time.

Let's rephrase the question. Would you like the computer in a large city bank to operate 90% of the time? Would you wish your car to drive only 90% of the time? Would you like your microwave oven (or refrigerator, stove, television, etc.) to work 90% of the time? Would you fly in an airplane that is 90% reliable? Remember that means 10% of the airplane is unreliable. Most people would not want to test that quality twenty thousand feet in the air.

What happens to quality assurance when three employees are 90% reliable? A simple math example answers that question.

MULTIPLY WORKER 1'S RELIABILITY WITH WORKER 2

90% X 90% = 81% (RELIABILITY IS 81%)

MULTIPLY WORKER 3'S RELIABILITY WITH 81%.

81% X 90% - 72.9% (RELIABILITY IS 72.9%)

THE GREATER THE NUMBER OF 90% EMPLOYEES, THE LESS THE PERCENTAGE OF RELIABILITY.

WOULD YOU HIRE EMPLOYEES WITH 90% RELIABILITY?

The question and explanation on the previous page shows how important it is to hire employees who are committed to improving their work and work situation each day. A business, or any other facility for that matter, is only as good as the total quality commitment of all its members.

This book presents an overview and simple explanation about quality assurance: what it is, how it developed, how it is measured and brought under control, and what tools are helpful in organizing and analyzing data for decisions regarding quality improvement.

Quality assurance is the watchword and future direction for businesses, industries, government, and private agencies. Knowing the basic principles about quality assurance builds job opportunities and provides the groundwork for becoming a reliable employee.

WHAT IS QUALITY ASSURANCE?

Manufacturers' understanding of quality assurance has changed and grown over the last forty years or more. Prior to that time, they believed that quality happened when products were well made and services efficiently provided.

Quality was generally measured by inspection. Products were closely checked when they came off the assembly line, but only AFTER they were made. Any materials or products with errors were sent back to be corrected, reworked, or scrapped. The fewer the number of errors, the greater the quality of the product.

There was not too much scientific thought about what went into the step-by-step process that produced a product or rendered a service.

People recognized quality when they saw it and when it happened. For example, customers knew when restaurant food was delicious and the service was good, when clothing materials were of the quality highest fibers, when automobiles worked well, when time was well managed, when a book was well written, when music was played correctly, when teachers understood their subjects, when production increased, when costs were reduced, or services improved. The list could go on forever.

After a while, manufacturers realized that the traditional method of inspecting products for errors AFTER they were made was foolish, time consuming, and costly. They felt quality could be measured and defined more scientifically. They asked serious questions.

1. What is quality?
2. Are there ways to set quality goals BEFORE making a product or offering a service?
3. Are there ways to prevent errors up front rather than pick up the pieces at the end?
4. Are there ways to catch errors DURING the manufacturing process?
5. Are there scientific tools to measure quality in an on-going manner?
6. Are there ways to set a standard or average for normal distribution of goods?

Industrial engineers investigated new ways to measure quality and developed what is known today as quality assurance (QA). Other names for this development are quality control (QC) and quality improvement (QI). This booklet attempts to answer the questions about quality assurance listed on the previous page.

Webster's dictionary defines quality as "a degree of excellence". Assurance means "certainty or sureness". According to Webster, quality assurance is a tool or technique that measures excellence or quality with certainty or sureness.

Quality assurance begins with a philosophy or a new way of thinking that has two basic beliefs:

1. Quality can be scientifically measured.
2. Quality can be measured on a continuous basis.

QUALITY ASSURANCE IS A COMMITMENT TO EXCELLENCE THAT FOCUSES CONTINUOUSLY ON IMPROVING PRODUCTS OR SERVICES AND THAT OPPORTUNITIES FOR GROWTH NEVER END.

VOCABULARY

1. QUALITY	-	EXCELLENCE
2. ASSURANCE	-	CERTAINTY OR SURENESS
3. INSPECTION	-	LOOK AT CAREFULLY, EXAMINE OFFICIALLY
4. RELIABILITY	-	CAN DEPEND ON FOR SOMETHING
5. PROCESS	-	SERIES OF CONTINUOUS ACTIONS
6. MEASURED	-	JUDGED BY COMPARING WITH A STANDARD, AVERAGE, OR NORM
7. IMPROVE	-	MAKE BETTER OR MORE VALUABLE
8. COMMITMENT	-	PLEDGE ONESELF ON A POSITION OR ISSUE
9. DEFINE	-	DESCRIBE OR MAKE CLEAR THE MEANING OF A WORD
10. RESULT	-	ENDING IN A PARTICULAR WAY

HISTORICAL DEVELOPMENT OF QUALITY ASSURANCE

There are many men and women who developed and contributed to the field of quality assurance. Among the quality experts are Philip Crosby, Walter A. Shewhart, Dr. W. Edwards Deming, and Dr. Joseph M. Juran. This booklet concentrates mainly on the work of Dr. Deming because he is regarded as the founder of the new economic industrial era.

Deming received his doctorate in statistics from Yale University. He was a student of Dr. Walter Shewhart who pioneered statistical process control (SPC). Deming used his ideas to developed methods of using numerical data to improve quality production.

DR. DEMING DEVELOPED A DATA-BASED OR SCIENTIFIC APPROACH TO QUALITY ASSURANCE.

Deming's quality assurance methods were very popular and successful in the 1930's and 1940's, particularly on improving industrial products needed for World War II. In fact, Japanese engineers were amazed at the quality of military equipment captured during the war. They recognized the superiority of American goods. At that time, any product labelled, "Made in Japan" was considered inferior.

A critical industrial shift took place in the United States after the War. There was a great demand for consumer goods. Americans wanted to make up for the material goods they lacked during the war. Also there was no foreign competition because countries had to rebuild their own industries. Consequently, the post-was years were a prosperous field day for United States businesses and industries.

Workers in the lower levels of industries were very interested in making quality products but they were not supported by management. Managers got all caught up in quantity (mass) production that brought high profits. The downside of mass production was the company's loss of interest in quality production.

On the other hand, Japan knew it had to make major changes if it was to compete in the world market. Japanese leaders invited Dr. Deming to show them how. Deming di not want to happen in Japan what had happened in the Unite States. For quality assurance to work, Deming maintained, it needed the total support of management. This philosophy became known as Total Quality Management (TQM) and is the subject of a separate booklet under that name.

In Japan, managers applied Deming's Total Quality Management methods and built a strong industrial base. By the 60's and 70's, quality assurance was in full swing. If anyone wanted quality products, they bought them from Japan.

Since the 1980's, with the assistance of Dr. Deming, United States industries have successfully returned to quality assurance (QA) and total quality management (TQM). Quality assurance gradually replaced quantity production. Management by quality replaced management by quantity.

There is great competition in the world market today. Companies must produce quality products and services if they wish to stay in business. It makes the difference between a company's success or failure.

IMPLEMENT QUALITY ASSURANCE

OR GO OUT OF BUSINESS.

VOCABULARY

1. STATISTICS	-	SCIENCE THAT DEALS WITH NUMBERS, FACTS, AND DATES
2. FOREIGN	-	OTHER COUNTRIES
3. INFERIOR	-	LOWER QUALITY OR GRADE
4. SUPERIORITY	-	HIGHER QUALITY OR GRADE
5. SHIFT	-	CHANGE OR REPLACE SOMETHING WITH SOMETHING ELSE
6. CONSUMER	-	BUYER
7. COMPETITION	-	CONTEST
8. PROSPEROUS	-	FINANCIAL SUCCESS
9. IMPLEMENT	-	PUT INTO PRACTICE
10. PRODUCTION	-	MAKING PRODUCTS

HOW TRUE IS THIS STORY?

ONCE UPON A TIME AN AMERICAN AEROSPACE COMPANY AND THE JAPANESE DECIDED TO HAVE A COMPETITIVE BOAT RACE ON THE TENNESSEE RIVER. BOTH TEAMS PRACTICED HARD AND LONG TO REACH THEIR PEAK PERFORMANCE. ON THE BIG DAY, THEY BOTH FELT AS READY AS THEY COULD BE.

THE JAPANESE WON BY A MILE!

AFTERWARDS, THE AMERICAN TEAM BECAME VERY DISCOURAGED BY THE LOSS AND MORALE SAGGED. CORPORATE MANAGEMENT DECIDED THAT THE REASON FOR THE CRUSHING DEFEAT HAD TO BE FOUND. A CONTINUOUS MEASURABLE IMPROVEMENT TEAM WAS SET UP TO INVESTIGATE THE PROBLEM AND RECOMMEND APPROPRIATE CORRECTIVE ACTION. THEIR CONCLUSION:

> THE PROBLEM WAS THAT THE JAPANESE TEAM HAD EIGHT PEOPLE ROWING AND ONE PERSON STEERING; WHEREAS, THE AMERICAN TEAM HAD ONE PERSON ROWING AND EIGHT PEOPLE STEERING. THE AMERICAN CORPORATE STEERING COMMITTEE IMMEDIATELY HIRED A CONSULTING FIRM TO DO A STUDY ON THE MANAGEMENT STRUCTURE. AFTER SOME TIME AND MILLIONS OF DOLLARS, THE CONSULTING FIRM CONCLUDED THAT: TOO MANY PEOPLE WERE STEERING AND NOT ENOUGH WERE ROWING.

TO PREVENT LOSING TO THE JAPANESE AGAIN THE NEXT YEAR, THE TEAM'S MANAGEMENT STRUCTURE WAS TOTALLY REORGANIZED TO FOUR STEERING MANAGERS, THREE AREA STEERING MANAGERS, ONE STAFF STEERING MANAGER, AND A NEW PERFORMANCE SYSTEM FOR THE PERSON ROWING THE BOAT. TO GIVE MORE INCENTIVE TO WORK HARDER, WE MUST GIVE HIM OR HER EMPOWERMENT AND ENRICHMENT AND THAT OUGHT TO DO IT.

THE NEXT YEAR THE JAPANESE WON BY TWO MILES.

HUMILIATED, THE AMERICAN CORPORATION LAID OFF THE ROWER FOR POOR PERFORMANCE, SOLD ALL THE PADDLES, CANCELED ALL CAPITAL INVESTMENTS FOR NEW EQUIPMENT, HALTED DEVELOPMENT OF A NEW CANOE, GAVE A "HIGH PERFORMANCE" AWARD TO THE CONSULTING FIRM, AND DISTRIBUTED THE MONEY SAVED AS BONUSES TO THE SENIOR EXECUTIVES.

STATISTICAL PROCESS

CONTROL

STATISTICAL PROCESS CONTROL (SPC)

As mentioned earlier, Dr. Deming developed a data-based or scientific approach to quality assurance. Deming felt that inspection alone did not improve quality. He believed that quality happened by controlling the production while in process.

This data-based or scientific approach to quality assurance is called STATISTICAL PROCESS CONTROL or SPC for short. This means that every step in the total production process is studied and brought under control by means of statistics and statistical tools. SPC is the backbone of quality assurance and helps create a climate of excellence.

STATISTICAL - A SCIENCE THAT DEALS WITH NUMBERS, FACTS, AND DATA

PROCESS - A SERIES OF CONTINUOUS ACTIONS

CONTROL - REGULATE OR EXERCISE DIRECTION OVER

MEANING OF STATISTICS

Statistics is the science that uses numbers, facts, and data for the purpose of solving problems and improving quality. Statistics are used to:

IDENTIFY PROBLEMS

HELP UNDERSTAND THE ACTUAL SITUATION

ELIMINATE DEFECTS AND ERRORS

PROVIDE DATA FOR ANALYSIS AND DECISION MAKING

BRING OPERATING PROCESS UNDER CONTROL

IMPROVE THE WORKING PROCESS

Statistics are gathered, organized, and recorded on statistical tools. Statistical tools are charts, graphs, and diagrams which visually show when things aren't working as well as expected. There are many types of statistical tools. The choice of which tool to use depends on the project under study. The most commonly used statistical tools are listed below. Their purpose and usage are explained in another section of this booklet.

CHECKLIST	CONTROL CHART
FISHBONE	RUN CHART
FLOW CHART	PARETO CHART
HISTOGRAM	SCATTERGRAM

THE MEANING OF PROCESS

A process is a group of step-by-step activities that are directed toward a particular outcome. Each step is performed in sequence; that is, one step follows another. Each step is related to and affects all the other steps.

PROCESS IS A SERIES OF SEQUENTIAL STEPS TAKEN TO PRODUCE AN END RESULT.

Process is as much a part of quality assurance as the end result. Knowing the steps that go into making a product or service is to have a sense of the end result. Understanding every step of the process helps to know the starting point, the ending point, and everything that happens in between. Rather than check only the final product, EVERY step is checked along the way. Should a problem occur, quality assurance means stopping the process and fixing it. Quality is eliminating problems in the process.

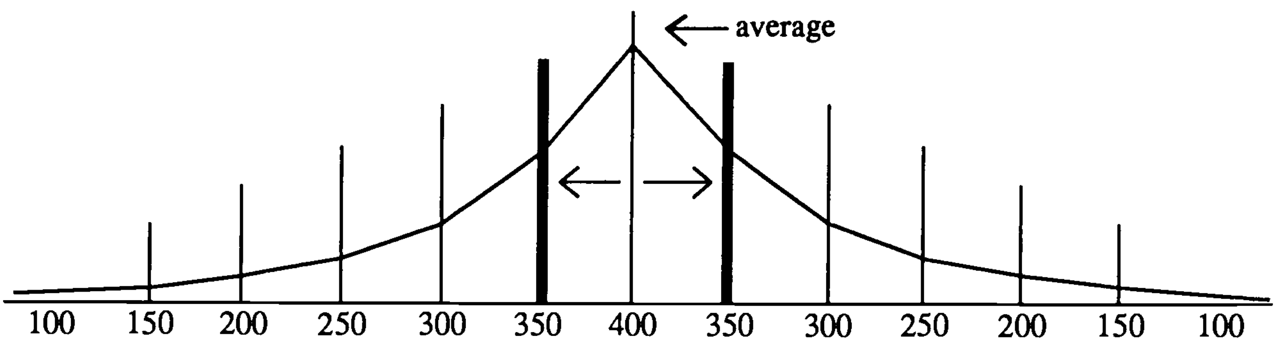
MEANING OF CONTROL

How do manufacturers know when there is a problem in the process? They can predict or foretell, over a period of time, how a process operates under normal conditions and circumstances. This is done by gathering statistical facts and finding an average. An average is found by adding the total number of facts and dividing that figure by the number of observations.

For example, a supervisor wants to know the daily average number of products made on machines "A" through "G".

DATA	A	250		
	B	250	400	
	C	475	7)2800	DAILY AVERAGE
	D	400		
	E	350		
	F	500		
	G	475		
		2800		

In the example above, add the total number of products made (2800) by the number of machines (7) that produced the product. The average represents the "normal distribution" of a product or where the average amount of data normally falls. Normal distribution is often illustrated on a bell-curved diagram like the one below.



NORMAL
DISTRIBUTION

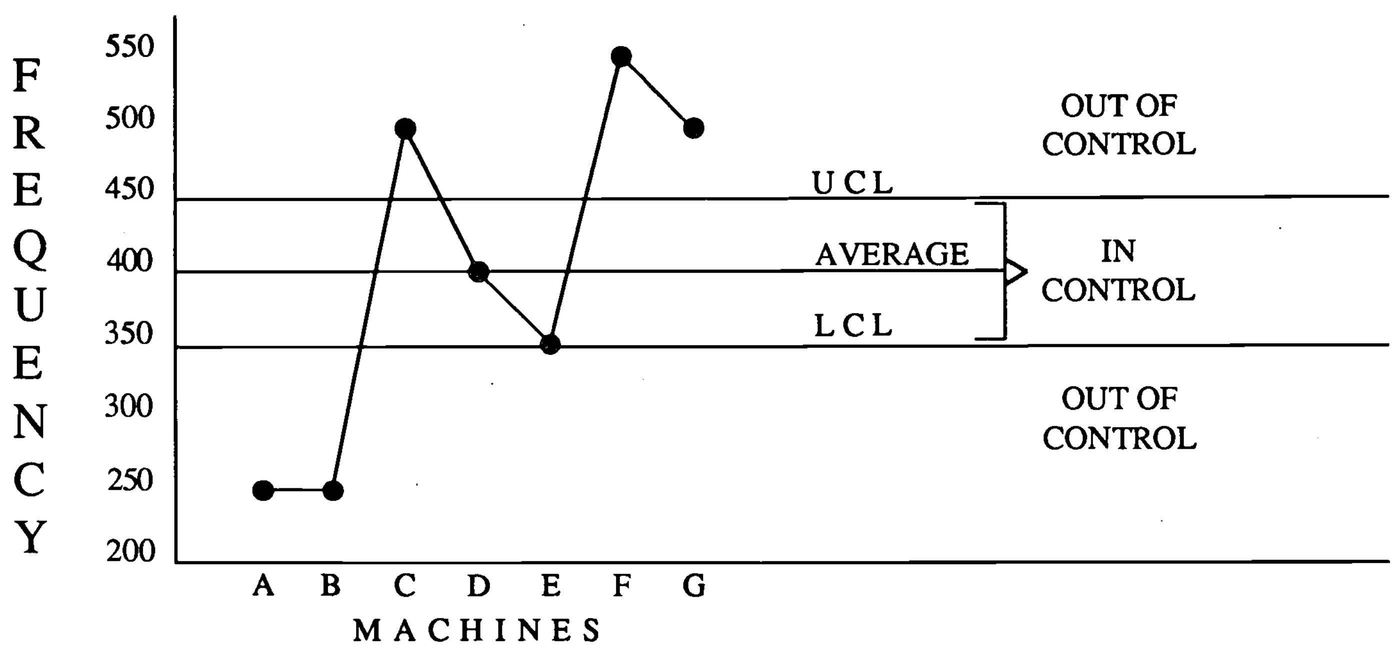
To promote quality performance, standards are established for each step in the process. Standards are guidelines for making judgments about the quality of the product. They help create error-free defects and determine whether a product is fit for use.

A STANDARD IS A TYPE OF RULE THAT SERVES AS A BASIS OF COMPARISON.

When a product conforms to the standard, the product has quality. The closer the product comes to meeting the standard, the greater the quality. The quality is improved by continually raising the standard. A problem occurs when the product deviates from the standard. However, because nothing is perfect all the time, fall outs from the standards are bound to occur. These fall outs are called standard deviations or variables. The focus of quality assurance is to reduce the causes of variations.

A deviation is something that is different from the standard. Deviations, or variables, are caused by multiple factors such as defective materials, broken equipment, delays, human error, weather, lack of efficiency, poor environment, etc. Since nothing is perfect, there must be variables that are acceptable. These are called tolerances and reflect standards that manufacturers "tolerate" or accept. Tolerances are acceptable variables.

Acceptable variables establish the minimum and maximum value of a product. The minimum is called lower control limit (LCL) and the maximum is called upper control limit (UCL). The statistical tool that is used to determine if a process is "in control" or "out of control" is, obviously, a control chart. The control chart below shows the relationship between the average (400) and the standard deviations (350 and 450). As you will note, the statistics show that machines A, B, C, F, and G are out of control. The task is to bring non-acceptable variations under control.



STEPS OF STATISTICAL PROCESS CONTROL

1. STUDY THE PROCESS

2. DEVELOP UNIFORM STANDARDS

3. DEVELOP ERROR-FREE PROCESS TO ELIMINATE AND PREVENT ERRORS

4. REDUCE CAUSES OF VARIATIONS

5. BRING VARIATIONS UNDER CONTROL

6. BEGIN ALL OVER AGAIN

CHARACTERISTICS OF GOOD STANDARDS

What are some of the features that go into good quality standards? Consider the following points. Standards should:

1. meet and exceed customer expectations and satisfaction
2. come as close as possible to error-free defects
3. be planned and agreed upon by all persons concerned (employees, customers)
4. be supported by management
5. be communicated effectively and taken seriously by all persons concerned
6. be workable and understood by all
7. be followed and changed as needed (outdated, not working, better idea)
8. be measured and compared against the end result
9. be part of the total organizational plan for improvement
10. be part of an educational program on how standards can be implemented and continuously improved
11. be celebrated or rewarded when achieved.

VOCABULARY

1. PREDICTABLE	-	TELL IN ADVANCE
2. VARIATIONS	-	SOMETHING DIFFERENT FROM OTHERS OF THE SAME TYPE
3. DISTRIBUTION	-	SPREADING OUT OVER AN AREA TO DETERMINE VARIATIONS
4. NORMAL DISTRIBUTION	-	NATURAL SPREADING OF VARIATION WITHOUT OUTSIDE INFLUENCE
5. MEASURABLE	-	SOMETHING TO ESTIMATE VALUE BY COMPARING IT WITH A STANDARD
6. AVERAGE	-	A TYPICAL AMOUNT OR RATE
7. TOLERANCE	-	PERMITTED VARIATION IN AN OBJECT, OR A LIMIT IN VARIATION
8. SEQUENCE	-	CONNECTED SERIES
9. STANDARD	-	MEASUREMENT TO DETERMINE QUALITY
10. ESTABLISH	-	BRING ABOUT

STATISTICAL TOOLS

CHECKLIST

FISHBONE

FLOW CHART

HISTOGRAM

CONTROL CHART

RUN CHART

PARETO CHART

SCATTERGRAM

CHECKLIST - CHECKSHEET

MEANING - THE CHECKLIST IS A SIMPLE TOOL THAT SHOWS HOW OFTEN AN EVENT IS HAPPENING. IT HELPS TURN OPINIONS INTO FACTS.

- IT IS A STRUCTURED FORM THAT MAKES DATA EASY TO READ AND ANALYZE.

USAGE - RECORDS DIFFERENT CONDITIONS LIKE PATTERNS OF ERROR, OPERATIONS AS THEY OCCUR, DAYS PRODUCTION, INVENTORY, ETC.

EXAMPLE 1

ERRORS	TALLY	TOTAL
Late Deliveries	𝍸 ||	7
Damaged Goods	||	2
Incomplete Orders	𝍸 𝍸 𝍸	15
TOTAL:		24

EXAMPLE 2

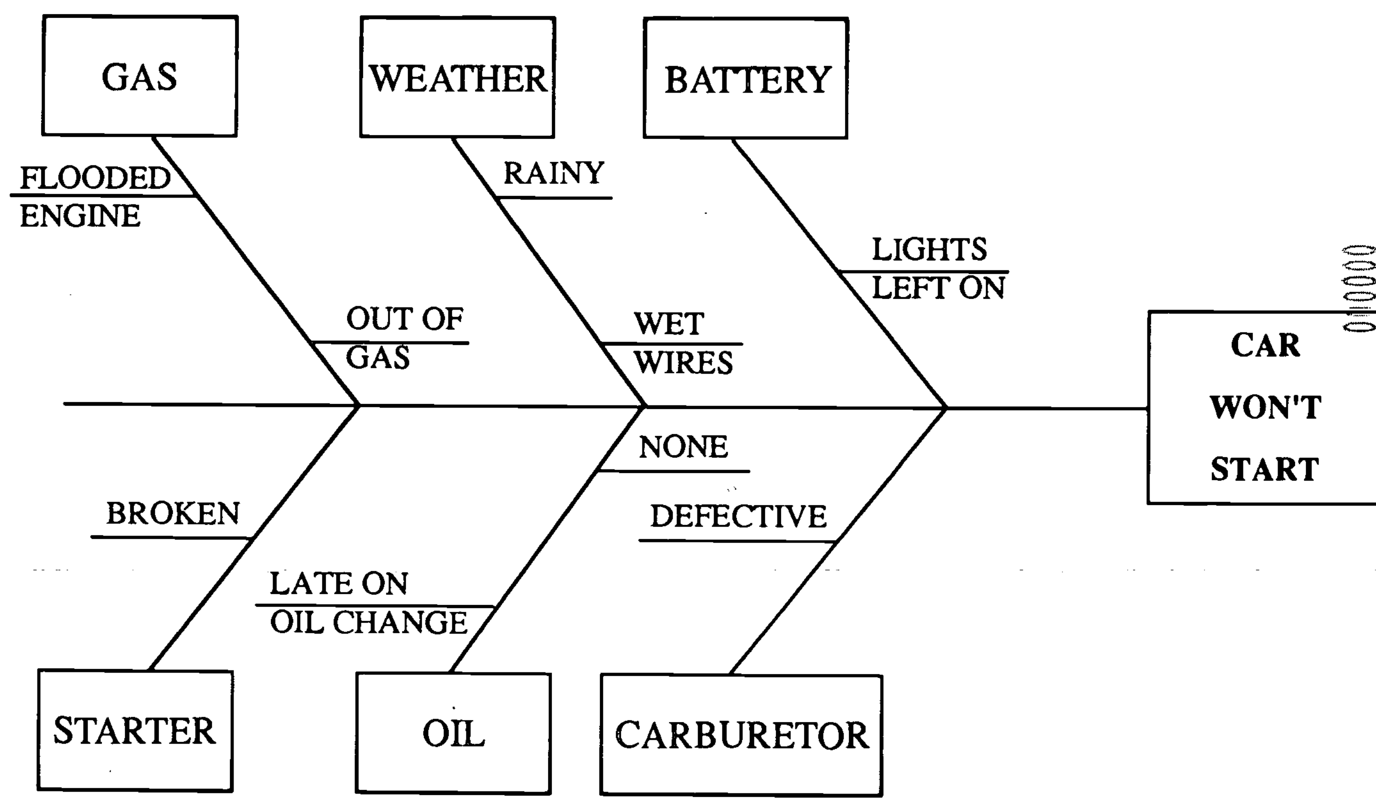
	Bill	John	Mary	Sue	Pat	Jim
MON	✓		✓	✓		✓
TUES	✓	✓				✓
WED	✓		✓		✓	
THURS	✓			✓		
FRI	✓			✓		✓

CAUSE AND EFFECT DIAGRAM - FISHBONE DIAGRAM - ISHIKAWA

MEANING - A SCHEMATIC DIAGRAM SHOWING ROOT CAUSES AND EFFECTS OF A SPECIFIC PROBLEM.

- A DIAGRAM THAT SHOWS THE CAUSES OF AN OUTCOME OR EVENT.

USAGE - USEFUL IN IDENTIFYING THE PROBLEM AND ITS SOURCE.



FLOW CHART - PROCESS CHART

MEANING - A PICTURE THAT SHOWS STEPS IN A PROCESS.

- A PICTURE USED TO PLAN STAGES OF A PROJECT.

- A PICTURE DESCRIBING A PROCESS BEING STUDIED.

USAGE - HELPFUL IN UNDERSTANDING HOW THINGS ARE DONE.

- HELPFUL IN IDENTIFYING PROBLEMS OR SIMPLIFYING THE PROCESS.

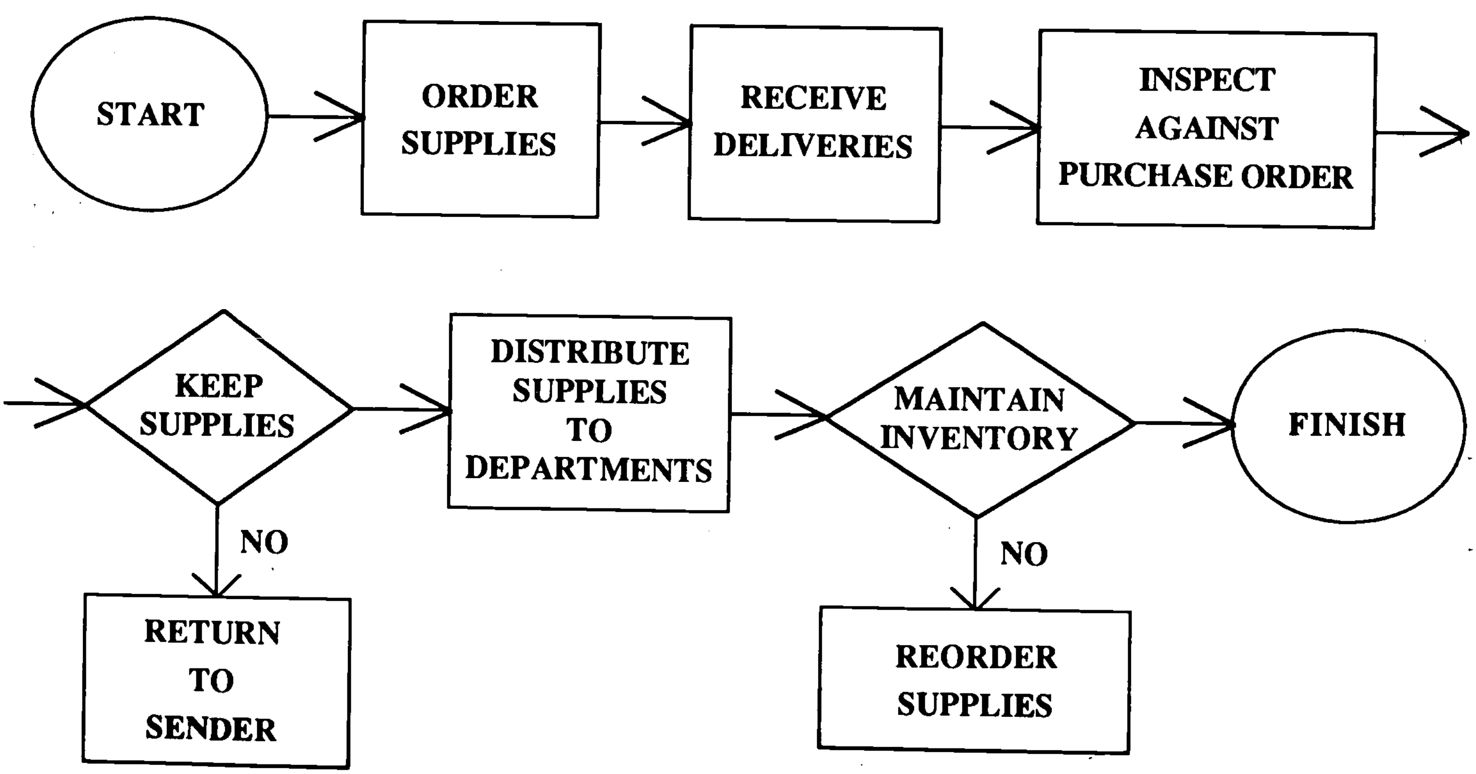
- HELPS ELIMINATE UNNECESSARY STEPS.

- SHOWS HOW THINGS SHOULD BE BY COMPARING THEMTO HOW THEY ACTUALLY ARE.

SYMBOLS - CIRCLE ○ = START AND FINISH

RECTANGLE ▭ = STEPS IN THE PROCESS

DIAMOND ◇ = DECISIONS TO BE MADE



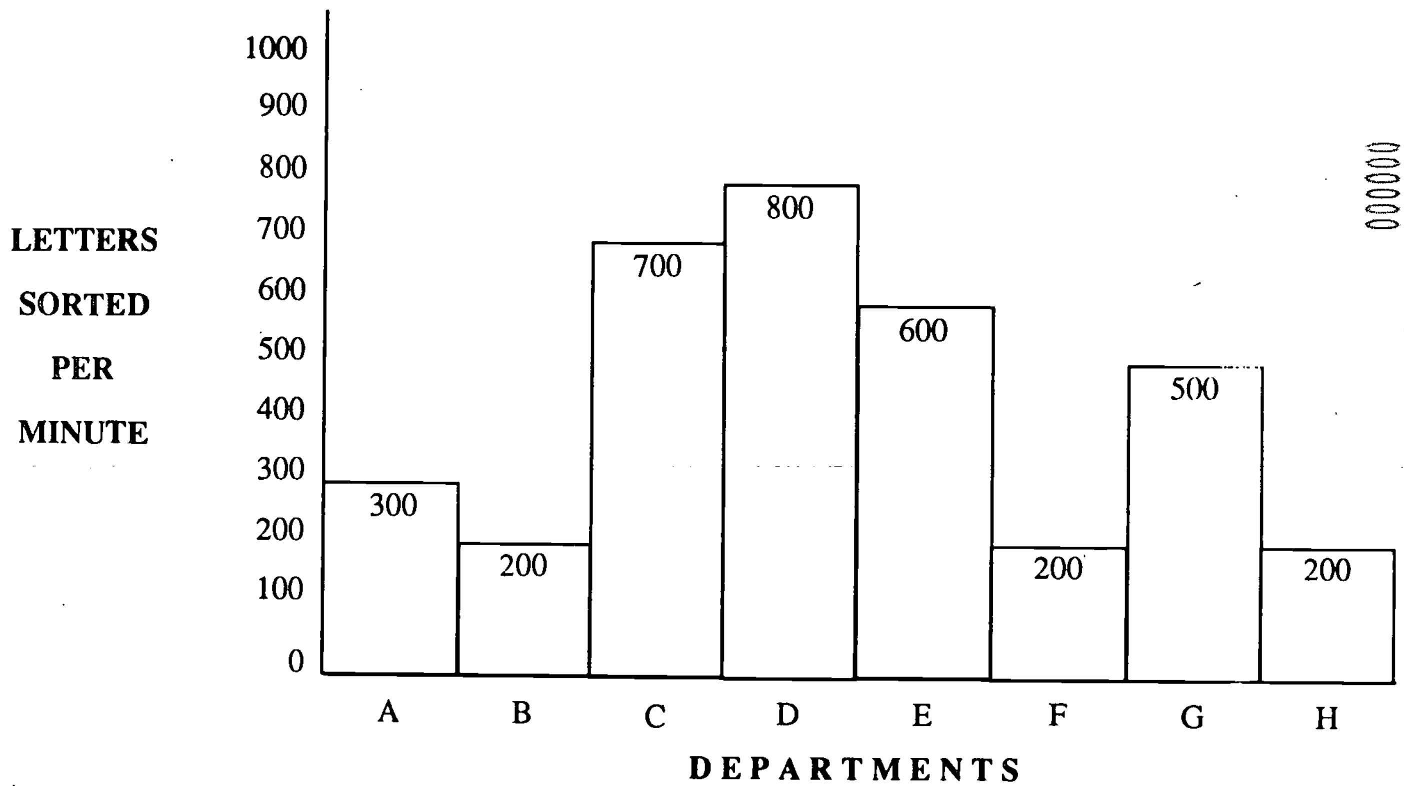
HISTOGRAM

MEANING - "HISTO" MEANS STORY, "GRAM" IS PICTURE OR GRAPH.

- A PICTURE STORY THAT SHOWS DISTRIBUTION OF WHATEVER IS MEASURED.
- A GRAPH OF DATA DISTRIBUTION.
- GIVES A CLEAR PICTURE OF VARIATIONS IN DATA.

USAGE - SHOWS MEASUREMENTS OF CATEGORIES AND HOW THEY COMPARE TO EACH OTHER.

- WHEN DISTRIBUTION IS OUTSIDE THE DESIRED LIMITS, IT SHOWS WHERE THE PROBLEMS ARE.

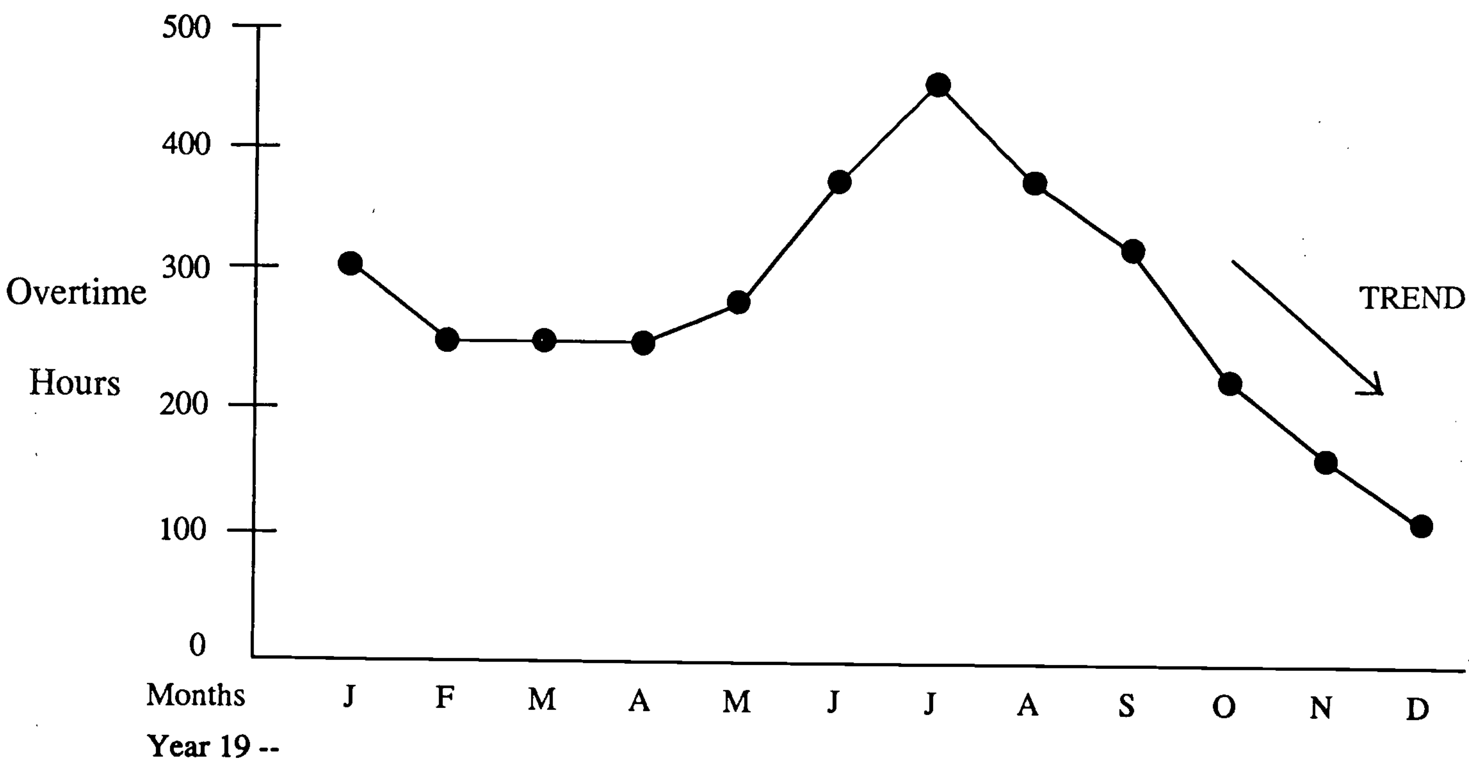


RUN CHART - TIME PLOT

MEANING - GRAPHIC DISPLAY OF DATA GATHERED OVER TIME

SOMETIMES CALLED TREND CHART

USAGE - CHECKS MEASUREMENTS TO DETECT CHANGES IN TRENDS, SHIFTS, OR PATTERNS OVER A PERIOD OF TIME

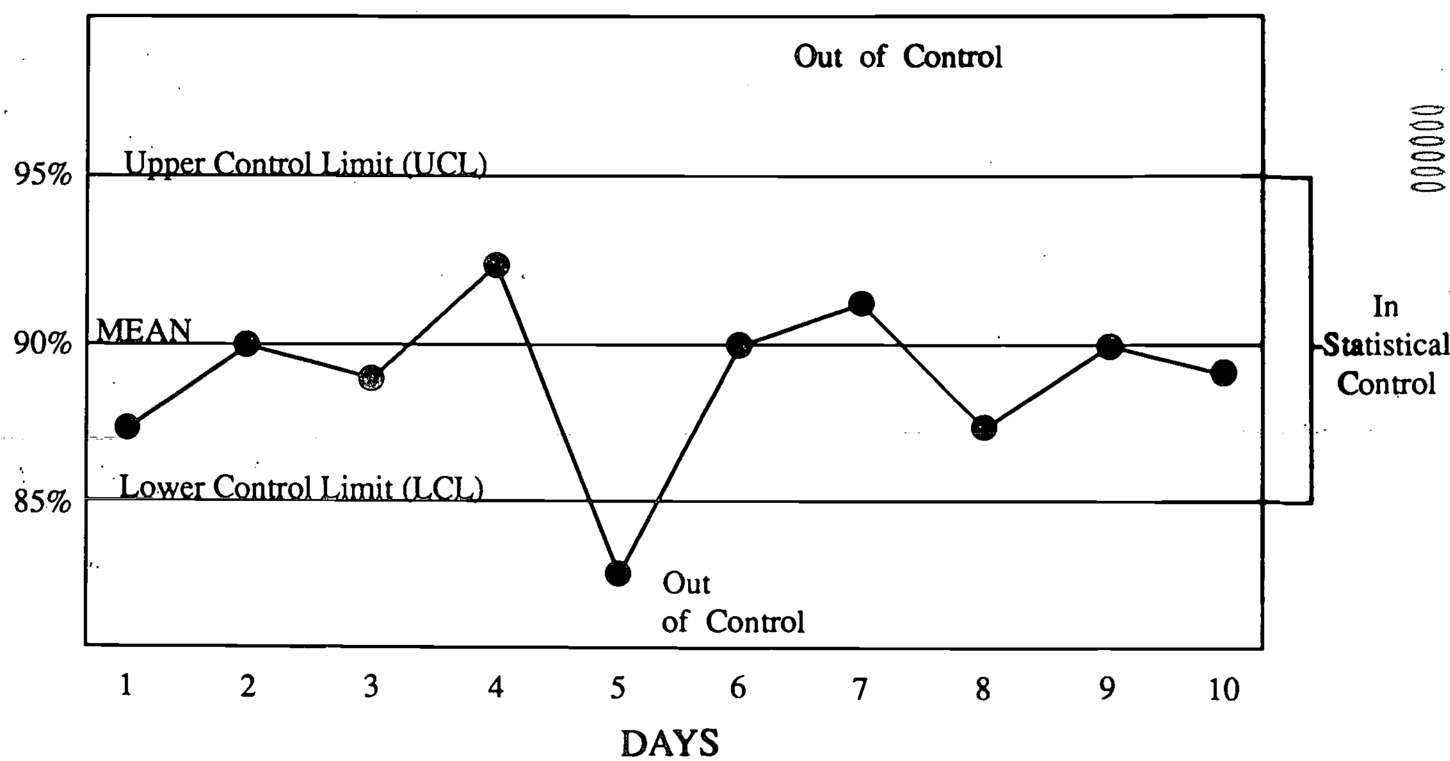


28.

CONTROL CHART

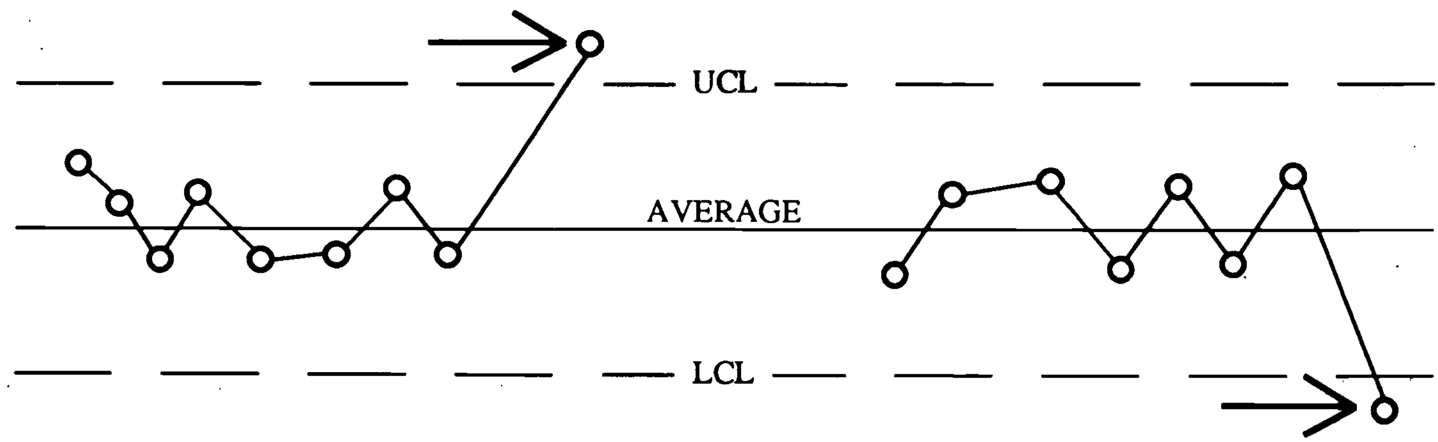
MEANING - A STATISTICAL TOOL THAT MEASURES WHETHER A PROCESS IS "IN" OR "OUT" OF CONTROL.

- SHOWS CHANGES IN THE PROCESS BY COMPARING THE AVERAGE (MEAN) WITH ESTABLISHED UPPER CONTROL LIMITS (UCL) AND LOWER CONTROL LIMITS (LCL).
- A PROCESS IS "IN" CONTROL WHEN ALL POINTS ARE BETWEEN THE UCL AND THE LCL.
- A TYPE OF RUN CHART WITH UCL AND LCL.

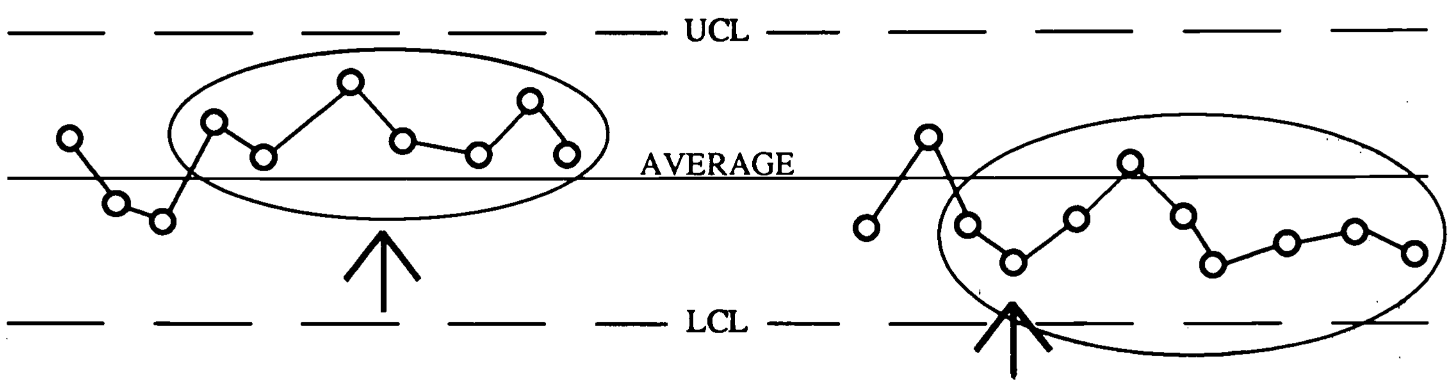


A CONTROL CHART ALSO SHOWS VARIATIONS, SHIFTS, AND TRENDS.

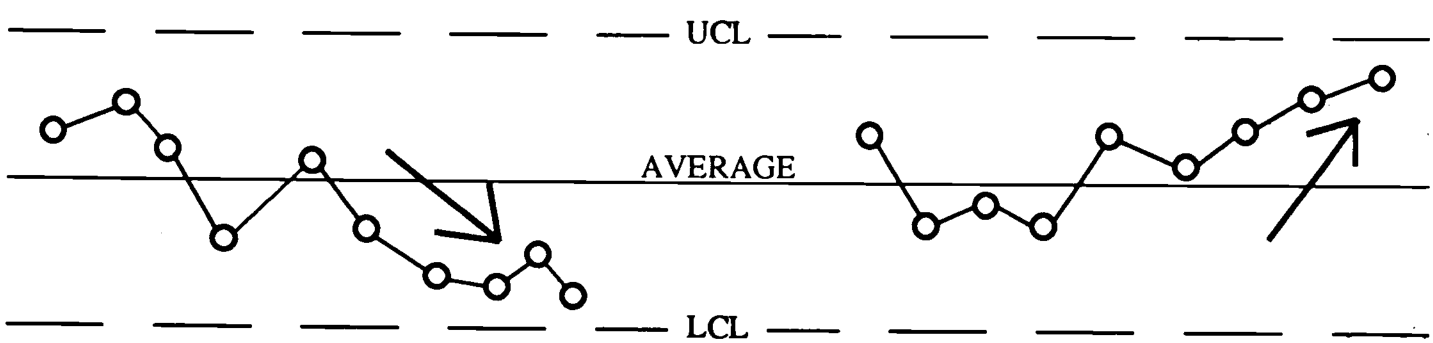
EXTREME VARIATIONS - CHANGE IN CONDITION



SHIFTS - CHANGE FROM ONE ARRANGEMENT TO ANOTHER



TRENDS - A STYLE TOWARD A CERTAIN DIRECTION



PARETO PRINCIPLE

The Pareto Principle is a basic belief that 80% of problems can be traced to 20% of causes. In other words, a few causes (20%) are responsible for the majority of of problems (80%).

A FEW ARE RESPONSIBLE FOR THE MANY

Two examples of this concept are: (1) a few companies sell most of the computers and (2) few Americans have most of the wealth.

Within the 20% of causes, only a vital few are important enough to study. Most causes have a small effect and don't happen often enough to be concerned with correcting.

The Pareto Principle concentrates on the important few causes (20%) where most good can be done without distraction from the lesser causes. The most important cause is the one most responsible for the problem.

CONCENTRATE ON THE "VITAL FEW" WHICH HAPPEN MOST OFTEN

AND

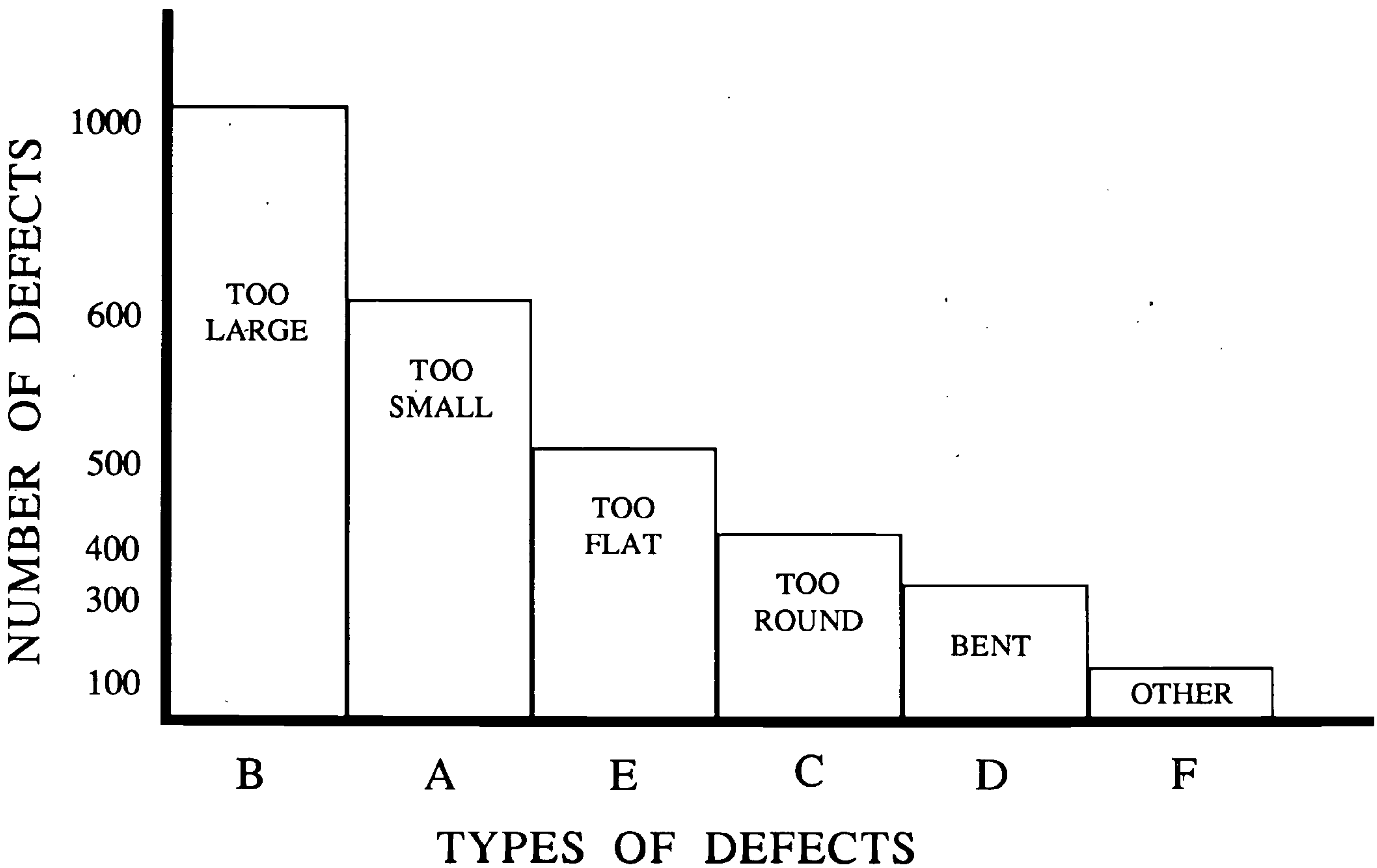
GIVE LESS ATTENTION THE "TRIVIAL MANY" WHICH RARELY HAPPEN.

To bring anything under control, concentrate on the vital 20%. The Pareto chart is the tool used to identify the few categories that account for most of the problem and the one that get the best payback.

PARETO CHART

MEANING - THIS TOOL IS A SERIES OF LINES OR BARS THAT RANK PROBLEMS IN THE ORDER OF THEIR IMPORTANCE FROM LEFT TO RIGHT. THE HIGHEST BAR ON THE LEFT REPRESENTS THE BIGGEST PROBLEM.

USAGE - THE PARETO CHART HELPS DETERMINE THE ORDER IN WHICH PROBLEMS SHOULD BE SOLVED.

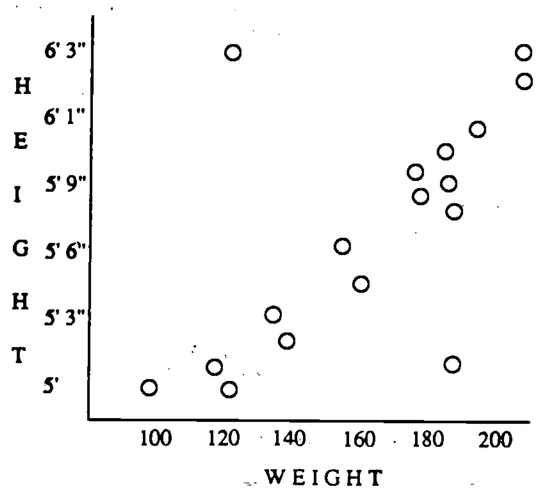


32.

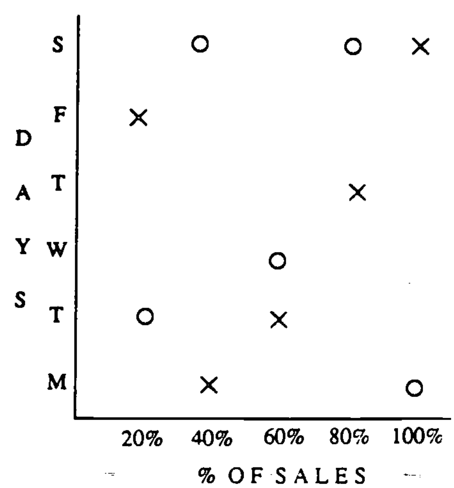
SCATTERGRAM - SCATTER DIAGRAM

MEANING - A TOOL THAT SHOWS THE RELATIONSHIP BETWEEN TWO CHARACTERISTICS. THE SHAPE TELLS IF THE FACTORS ARE RELATED AND THE STRENGTH OF THAT RELATIONSHIP. IF ONE CHARACTERISTIC INCREASES WITH THE OTHER, THERE IS A CLOSE AND STRONG RELATIONSHIP. IF CHARACTERISTICS ARE SCATTERED, THERE IS LITTLE ASSOCIATION.

USAGE - THE SCATTERGRAM IS USED TO TEST POSSIBLE CAUSE AND EFFECT.



Weight and height are strongly related.



Salespersons
Bill X
Mary O

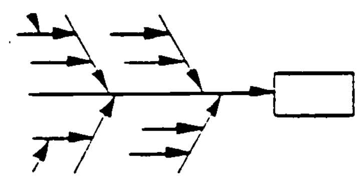
There is no connection between % of sales and days of the week.

SPC CHARTS

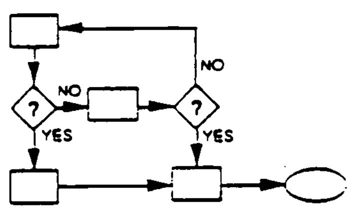
CHECKLIST — **SHOWS HOW OFTEN SOMETHING HAPPENS**

	1/2	1/3	1/4	Total
1	III	II	I	6
2	I	I	I	3
3	~~IIII~~		II	7
4	I	II	III	6
5	I	I	~~IIII~~	7

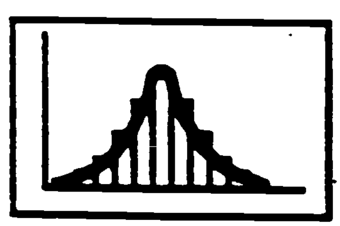
FISHBONE — **SHOWS CAUSE AND EFFECT OF PROBLEMS**



FLOW CHART — **SHOWS STEPS IN A PROCESS OR PROJECT**

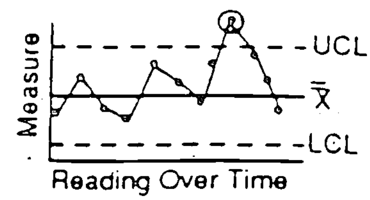


HISTOGRAM — **DISPLAYS VARIATIONS IN DATA**



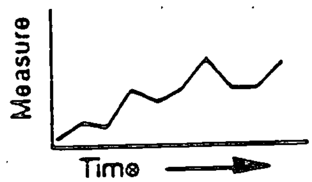
CONTROL CHART

SHOWS IF A PROCESS IS IN OR OUT OF CONTROL



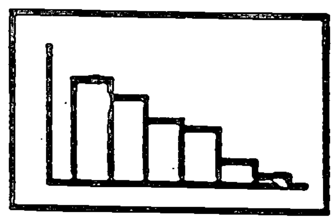
RUN CHART

SHOWS CHANGES IN TRENDS AND PATTERNS OVER A PERIOD OF TIME



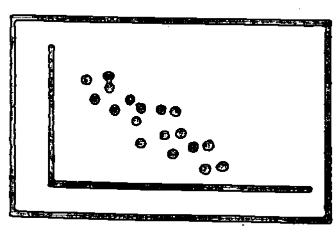
PARETO CHART

RANKS PROBLEMS IN ORDER OF THEIR IMPORTANCE



SCATTERGRAM

SHOWS THE RELATIONSHIP BETWEEN TWO FACTORS



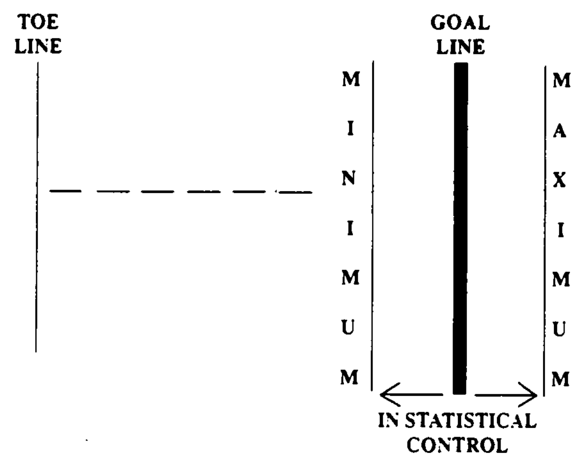
COIN TOSSING EXERCISE

STAND ON THE TOE LINE AND TOSS TEN COINS AS CLOSELY AS POSSIBLE TO THE GOAL LINE.

LAND THE COIN AS CLOSE AS YOU CAN WITHOUT LANDING SHORT OF THE MINIMUM LINE OR BEYOND THE MAXIMUM LINE.

SELECT AN APPROPRIATE STATISTICAL TOOL AND RECORD YOUR SCORES.

ANALYZE WAYS TO IMPROVE YOUR SCORE.



DICE GAME

The purpose of this exercise is to find normal distribution. The instructor divides the class into groups. The group is given a pair of dice which each member of the group will throw a designated number of times. As a group, illustrate the appropriate chart and show the normal distribution.

WORKING PROBLEMS

The GR2A has a yield goal of 95% with the upper control limit set at 100% and the lower control limit set at 90%. The following data have been accumulated over the past 13 weeks.

WEEK	YIELD
14	90%
15	92
16	94
17	91
18	88
19	93
20	89
21	91
22	89
23	95
24	88
25	86
26	85

Plot a control chart. Look at any trends. Upon looking into the trend, the following data were gathered:

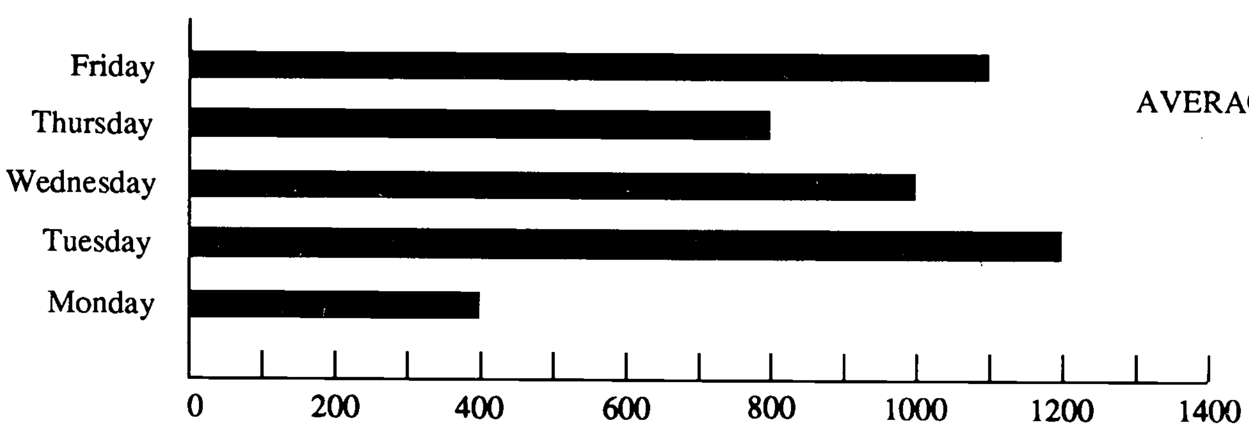
Week 24	10 functional failures 5 misinserted components 2 missing components 1 NPF
Week 25	21 functional failures 3 wrong orientation 3 misinserted components 1 missing components
Week 26	30 functional failures 7 misinserted components 4 missing components 2 wrong orientation

Make a Pareto chart using the above data. From the Pareto chart, what problem would you address first to increase your yields?

Construct a Pareto chart for the data below. What does it reveal? If E 27, E 28, E 31 and E 32 are all the same part, how does this change the Pareto chart? On a separate piece of paper, re-draw the chart.

LOCATION	QUANTITY
E 31	5
E 10	1
E 15	15
D 4	3
C 55	4
E 27	8
E 9	2
E 16	3
E 11	1
D 9	9
E 32	9
E 28	1

Find the average of the facts given in the chart below.



AVERAGE _____

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