OPERATIONS MANAGEMENT

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Stastical Quality Control

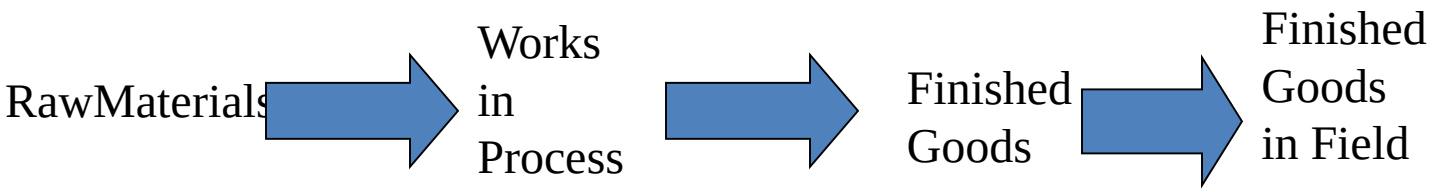
- Quality is some prescribed or desired characteristics present in raw material, semi-finished or finished goods.
- Control is the process of verification or correction of the product when the deviations in the quality are found to be more than expected.
- Quality control is of great value to both producer and customer
- SQC is applied by taking samples and drawing conclusions by means of some mathematical analysis.

Inventory control

It means stocking adequate number and kind of stores, so that the materials are available whenever required and wherever required. Scientific inventory control results in optimal balance.

Inventory

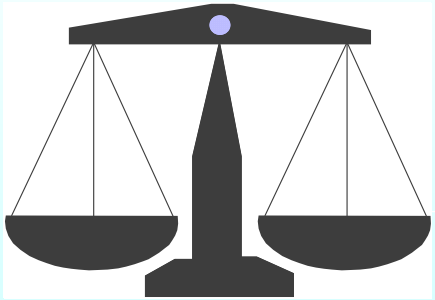
- Def. - A physical resource that a firm holds in stock with the intent of selling it or transforming it into a more valuable state.
- Raw Materials
- Works-in-Process
- Finished Goods
- Maintenance, Repair and Operating (MRO)


RawMaterials
Works in Process
Finished Goods
Finished Goods in Field

The following are the stages in the process of inventory control

- Formulate a clear-cut purchase procedure
- Classify, in a comprehensive manner, the items of inventory and codify the same
- Maintain store records to ensure continuous stock taking
- Maintain the costs of each order by determining economic order quantity(EOQ)
- Monitor each category of the stocks through ABC analysis
- Set stock levels for different items
- Replenish the stocks as and when required

ECONOMIC ORDER OF QUANTITY(EOQ)



PURCHASING COST

CARRYING COST

- EOQ minimizes the sum of carrying cost and ordering cost
- S = 2AO/C

  A = annual demand

  O = ordering/setup costs

  C = Carrying cost

  S = Size of order

ABC ANALYSIS

(ABC = Always Better Control)

- **This is based on cost criteria.**
- **It helps to exercise selective control when confronted with large number of items it rationalizes the number of orders, number of items & reduce the inventory.**

- **About 10 % of materials consume 70 % of resources**
- **About 20 % of materials consume 20 % of resources**
- **About 70 % of materials consume 10 % of resources**

ABC ANALYSIS WORK SHEET

	ITEM %	ITEM	ANNUAL COST [Rs.]	CUMMULATIVE COST [Rs.]	COST %
A	10 %	1	90000	90000	70 %
		2	50000	140000	
B	20 %	3	20000	160000	20 %
		4	7500	167500	
		5	7500	175000	
		6	5000	180000	
C	70 %	7	4500	184500	10 %
		8	4000	188500	
		9	2750	191250	
		10	1750	193000	
		11	1500	194500	
		12	1500	196000	
		13	500	196500	
		14	500	197000	
		15	500	197500	
		16	500	198000	
		17	500	198500	
		18	500	199000	
		19	500	199500	
		20	500	200000	

TYPES OF ABC ANALYSIS

FSN ANALYSIS

VED ANALYSIS

SDE ANALYSIS

HML ANALYSIS

- FSN ANALYSIS
- In FSN analysis material are classified based on the requirements
- Fast moving materials
- Slow moving materials
- Non moving materials

- VED analysis is done to identify critically of that raw materials on the production and other services.
- Vital spare parts
- Essential spare parts
- Desirable spare parts

SDE analysis is mainly used in procuring of raw materials . it states that particular raw material is easy or difficult to procure

Scarce

Difficult

Easily available

- HML analysis
- This is similar to ABC analysis but here the criterion is price
- High cost items
- Medium cost items
- Low cost items

STATISTAICAL QUALITY CONTROL

Quality is the determining factor the success of any product or service large resource are committed in every organization to ensure quality

Definition: It is defined as customer satisfaction in general and fitness for use in particular. Both the external consumer who buy the product and services and the internal consumers that is, all divisions or departments of the business organization are equally interested in the quality.

STATISTIACAL QUALITY CONTROL

Quality characterstics

a) Quality design: Quality of design refers to product feature such as performance, reliability durability, ease of use, serviceability b) Quality conformance:

b) Quality conformance means whether the product meets the given quality specification or not Inspection: The process of measuring the out put and comparing it to check whether it meets the given specified requirements or not, is called inspection.

SQL

Inspection Methods: The following are the methods of inspection based on merits

Incoming inspection: In this method, the quality of the goods and services arriving into the organization is inspected. This ensures that the material suppliers adhere to the given specifications with this defective material cannot enter into the production process. This focuses on the vendor‟s quality and ability to supply acceptable raw materials.

Critical point inspection: Inspecting at the critical points of a product manufacture gives valuable insight into the completely functional process. At the points of manufacture that involve high costs or which offer no possibility for repair or rework, inspection is crucial further operation depend on these results critical point inspection helps to drop the defective production, and thereby, facilitate avoiding unnecessary further expenditure on them.

SQL

3) Process inspection: This is also called patrolling inspection or floor inspection or roving inspection. Here the inspector goes around the manufacturing points in the shop floor to inspect the goods produced on random sample basis from time to time.

4) Fixed inspection: It provides for a centralized and independent where work is brought for inspection from time to time. This method is followed where the inspection equipment cannot be moved to the points of productions.

5) Final inspection: This is centralized inspection making use of special equipment. This certifies the quality of the goods before they are shipped.

SQL

The quality of the production process may be affected by chance cause or assignable cause.

Chance cause: such causes, which may or may not affect the manufacturing process are called chance cause, chance cause cannot even be identified. It is not possible to always maintain the given specification.

Assignable Cause: Assignable causes affect the quality of the production process. These causes can be identified and specified. Causes such as change in the labour shift, power fluctuations, or excessive tool wear are said to be assignable causes as they affect the quality of manufacturing process in different ways.

SQL

Elements of statistical Quality Control: The technique under SQC can be divided in to two parts a) Process control b) Acceptance sampling

a) Process control: Process control is a technique of ensuring the quality of the products during the manufacturing process itself. If a process consistently produces items with acceptable or tolerable range of specification. It is said to be statically under control. Process control is achieved through control charts. Process control aims to control and maintain the quality of the products in the manufacturing process.

Statistical control charts: A control chart compares graphically the process performance data to computed statistical control limits. These control limits act as limit lines on the chart control chats are the tools to determine whether the process is under control or not.

SQL

Confidence limits and control limit:

Confidence limit: It indicate the range of confidence level. A confidence level refers to the probability that the value of measurement or parameter, such as length of screw, is correct. Ex: If a component is required with measurement of 50 mm. across, then the buy accept all components measuring between 48 mm and 52 mm across, considering a five percent confidence level.

Control limits: Control limits are found in the control charts. There are two control limits 1) Upper control limit (UCL) and 2) Lower control limit (LCL). These are determined based on the principles of normal distribution

CONTROL CHARTS

TWO TYPES OF CONTROL CHARTS

1.Control charts for variables

2.Control charts for attributes

Control charts for variables: A variable is one whose quality measurement changes from unit to unit. The quality of these variables is measured in terms of hardness, thickness, length, and so on. The control charts for variables are drawn using the principles of normal distribution. There are two types of control charts for variables

X Chart

R chart.

X and R chart

X-bar and R charts are used to monitor the mean and variation of a process based on samples taken from the process at given times (hours, shifts, days, weeks, months, etc.).

X AND R CHART

For $\bar{X}$ charts:

$UCL = \bar{\bar{X}} + A_2 \bar{R}$

When $\bar{\bar{X}}$ = Mean of Means

$LCL = \bar{\bar{X}} - A_2 \bar{R}$

A_2= Constant

For R chart:

$UCL = D_4 \bar{R}$

$LCL = D_3 \bar{R}$

D_4, D_3 are constants

$\bar{R}$= Mean of sample ranges

n	A2	D3	D4
2	1.880	0	3.268
3	1.023	0	2.574
4	0.729	0	2.282
5	0.577	0	2.114
6	0.483	0	2.004
7	0.419	0.076	1.924
8	0.373	0.136	1.864
9	0.337	0.184	1.816
10	0.308	0.223	1.777

- The following data gives the reading of sample size 8 each in production of certain components ,Draw the control charts for mean and ranges and point out which sample if any are out of the limits

Sample	1	2	3	4	5	6	7	8	9	10
Mean	5.4	5.1	5.4	4.9	5.2	4.7	5.1	5	5	5.2
Ranges	0.4	0.7	0.7	0.8	0.9	0.6	0.5	0.6	0.7	0.6

R CHART

UCL=1.864X0.65=1.2116

LCL= 0.136X0.65 =0.0884

X AND R CHART

X CHART

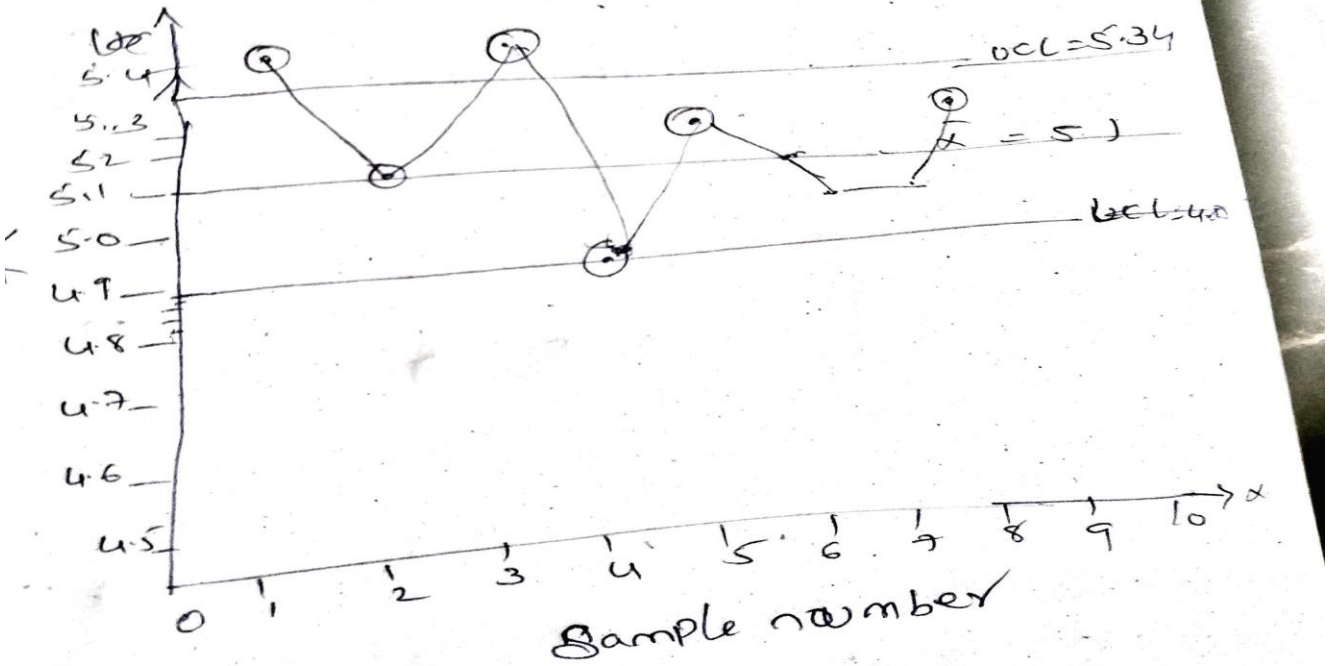
Mean of means=5.1

UCL=5.1+0.373X0.65=5.3434

LCL=5.1-0.373X0.65=4.8578

$$\bar{\bar{x}} = \frac{\sum \bar{x}}{k} = \frac{51}{10} = 5.1$$

$$\bar{R} = 6.5$$



- Control charts for attributes:
- The quality of attributes can be determined on the basis of Yes or No, Go or No go. In other words, in case of a mirror glass, even if there is one scratch it is not considered to be a quality mirror, in such a case quality is decided base on whether the mirror has any scratch or not. The control charts for attributes are
- C chart and
- P charts
- C Chart: C chart is use where there a number defects per unit. This control charts controls the number of defects per unit. Here the sample size should be constant. This calculate as below.
-
- UCL = $c + 3\sqrt{c}$ and
- LCL = $c - 3\sqrt{c}$
- Where the c = $\frac{\text{Total number of defects}}{\text{Total number of pieces inspected}}$

- P Chart: P Chart is used where there is date about the number of defectives per sample. It is also called fraction defective chart or percentage defectives chart. Here each item is classified on „go or no go‟ basis that is good or bad. Hence if the sample size is larger, the results could be better.
- UCL = $P+3\sqrt{P(1-P)/n}$
- LCL = $P-3\sqrt{P(1-P)/n}$

Where average defective (p) = Total no of defective found /Total no of pieces inspected

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SIXSIGMA

Six sigma is a set of practices developed by Motorola to systematically improve processes by eliminating defects. A defect is defined as nonconformity of a product or service to its specifications.

Six Sigma refers to the ability of highly capable processes to produce output within specification. In particular processes that operate with Six Sigma quality produce at defect level below 3.4 defects per million opportunities.

HISTORY

SIX SIGMA is a business management strategy which aims at improving the quality of processes by minimizing and eventually removing the errors and variations. The concept of Six Sigma was introduced by Motorola in 1986, but was popularized by Jack Welch who incorporated the strategy in his business processes at General Electric. The concept of Six Sigma came into existence when one of Motorola‘s senior executives complained of Motorola‘s bad quality. Bill Smith eventually formulated the methodology in 1986.

- Following are the two Six Sigma methods:
- DMAIC
- DMADV
- DMAIC focuses on improving existing business practices. DMADV, on the other hand focuses on creating new strategies and policies. DMAIC has Five Phases
- D - Define the Problem. In the first phase, various problems which need to be addressed to are clearly defined. Feedbacks are taken from customers as to what they feel about a particular product or service. Feedbacks are carefully monitored to understand problem areas and their root causes.
- M - Measure and find out the key points of the current process. Once the problem is identified, employees collect relevant data which would give an insight into current processes.

- A - Analyze the data. The information collected in the second stage is thoroughly verified. The root cause of the defects are carefully studied and investigated as to find out how they are affecting the entire process.
- I - Improve the current processes based on the research and analysis done in the previous stage. Efforts are made to create new projects which would ensure superior quality.
- C - Control the processes so that they do not lead to defects.

- DMADV Method
- D - Design strategies and processes which ensure hundred percent customer satisfaction.
- M - Measure and identify parameters that are important for quality.
- A - Analyze and develop high level alternatives to ensure superior quality.
- D - Design details and processes.
- V - Verify various processes and finally implement the same.

THANK YOU