# LECTURE NOTE

# ABHOY MOHANTA
# PTGF MECHANICAL ENGG DEPT.

## SUBJECT: IE&M

# Industrial Engineering & management

## Plant engineering :→

### 1.1 Selection of Site of Industry :→

First, the costs of land, labour, materials, taxes, heat, light and power should be calculated and the costs of marketing from that place should be estimated.

Factors to Consider for your Site Selection :→

(a) getting suitable raw material

(b) Finished Products distribution to customers.

(c) Define your reason or purpose for situating your plan on the site.

### 1.2 Define plant layout :→

(i) Plant layout means the disposition of the disposition of the various facilities (equipments, materials, manpower.

(ii) Service of the plant within the area of the site selected previously.

(iii) Plant layout begins with the design of the factory building and goes up to the location and movement of a work table.

\* All the facilities like equipment, raw materials, machinary, tools, fixtures, workers etc. are given a proper place.

Describe the objective and principle of plant layout.

*(i) Material handling and transportation is minimized and efficiency controlled.

(ii) Effective utilization of Space

(iii) minimum movement of material.

(iv) Reduce Accidents

(v) Increase Productivity

(vi) Work stations are designed suitably and properly.

(vii) Plant maintenance is Simpler.

## Principle of plant layout

(a) Integration

(b) minimum movements and material handling

(c) Smooth and Continuous Flow

(d) Cubic space utilization.

(e) Safe and improved environments.

(f) Flexibility.

(a) Integration → it means the integration of production Centres facilities like working, workers, machinary, raw material, etc. a logical and balanced manner.

(b) minimum movements and material handling →

The number of movements of working workers and materials should be minimized.

(i) it is batter to transport materials in optimum bulk rather than in small amounts.

(c) Smooth and Continuous flow :→

Bottlenecks, congestion points and back tracking should be removed by proper line balancing techniques.

(d) Cubic space utilization :→

Besides using the floor space of room, if the ceiling height is also utilized, more materials can be accommodated in the same Room.

(e) Safe and improved environments :→

Working places - safe well ventilated and free from dust, noise fumes, odours. and other hazardous conditions decidedly increase the operating efficiency of the workers and improve their morale.

(F) Flexibility :→

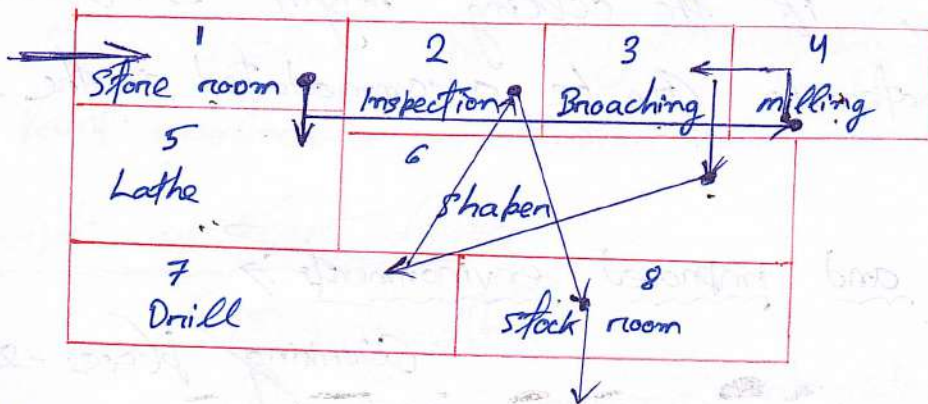In automotive and other industries where models of products change after some time :

① It is better to permit all possible flexibility in the layout.

1.4 Explain Process layout, Product layout and Combination layout.

① Process layout :→

(i) keep Similar machines and Similar operations in one place.

(ii) machines are arranged according to their function.



| 1 Store room | 2 Inspection | 3 Broaching | 4 milling |
| 5 Lathe | 6 Shaper | | |
| 7 Drill | 8 Stock room | | |

Advantages

① Batter utilization of available equipments.

② Workers are dealing with only one type of machines. So product quality will be batter.

③ Workers in one section are not affected by the operation carried out in another section.

④ wide flexibility exists as regards allotment of work to equipment and workers.

Disadvantages of Process layout

① for the same amount of production, the process layout needs more space

② Automatic material handling is difficult

③ Production Control becomes difficult.

④ Raw material has to travel a longer distance for being processed to finished goods.

This increases material handling and associated costs.

⑤ It needs more inspection and efficient co-ordination.

## ② Product Layout :-

ⅰ) Product layout is also known as line layout.

ⅱ) Various operations on raw material are performed in a sequence and machines are placed accordingly the production flow line.

ⅲ) mass production Huge number of same product Continuous Flow of Process.

Ex!-→ | Lathe | → | Drilling | → | milling | → | Grinding |

The machine will arrange according to the Sequence of operation.

### Advantages

(1) Less space required for the same volume of production.

② material handling is lessen.

③ Co-ordination will be better, production planning. and Control will easier.

④ Fewer skilled workers maybe do the work

### Disadvantages

① specified product determines the layout.

A change in product → major change in layout
Thus Flexibility in the layout is reduced.

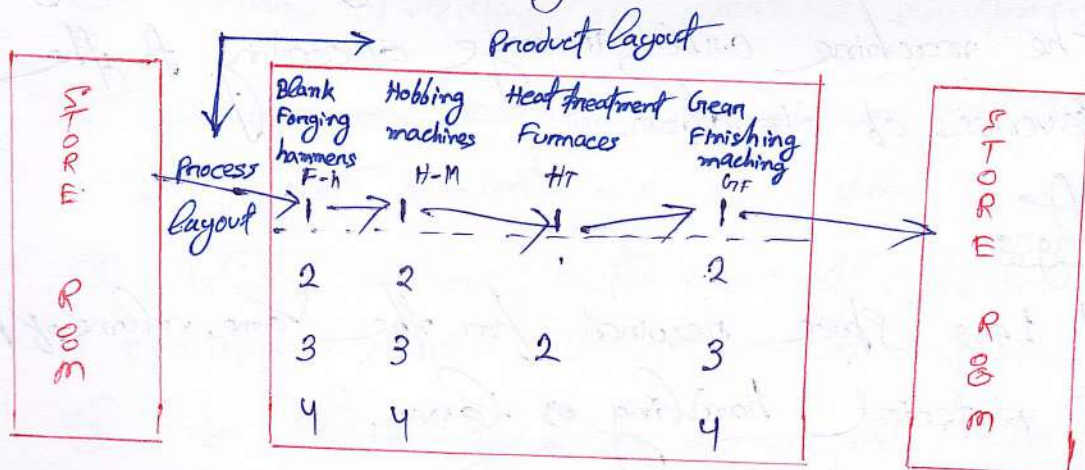2. Rate of production → output rate of the slowest machine.
This leads to excessive idle time of another machine if the production line is not balanced.

3. It is difficult to increase production beyond the capacities of the production line.

## 3 Combination layout

① A combination layout combines the advantages of both process layout and product layout.

② A combination layout is possible where the item is made in different types and size.



Product layout

| STORE ROOM | Process layout | Blank Forging hammers F-h | Hobbing machines H-M | Heat treatment Furnaces HT | Gean Finishing maching GF | STORE ROOM |
|---|---|---|---|---|---|---|
| | | 2 | 2 | | 2 | |
| | | 3 | 3 | 2 | 3 | |
| | | 4 | 4 | | 4 | |

Advantages!→
i) It combines the advantages of both Process and Product layout.

ii) Combination layout can be useful when a number of items are produced in the same sequence but in small numbers. No item justified for individual production line.

- Need for oven - time
- Need for subcontracting work.
- Temporary work shortages - workers require alternative work.

## 1.7.2 Break down maintenance

That repairs are made after the equipment is out of order and it cannot perform its normal function any longer e.g. an electric motor will not start a belt is broken, etc.

⇒ Under such conditions, production department calls on the maintenance department to rectify the defect.

⇒ The maintenance department checks into the difficulty and makes the necessary repaires.

⇒ After removing the fault, maintenance engineers do not attend the equipment again until another failure or breakdown occurs.

⇒ Breakdown type of maintenance involves little administrative work, few records and a comparative small staff.

### Typical Causes of Equipment Breakdown

(i) Failure to replace worn out parts
(ii) Lack of lubrication
(iii) Neglected cooling system.
(iv) Indifference towards minor faults.

### Disadvantage of Brake down

(i) Reduction of output
(ii) fasten plant deterioration.

# 3. Inventory Control

## 3.1 Classification of inventory :>

\* \* \*

\* __Inventory__ :> meaning : (Stock)

\* Definition :- Inventory is the collection of unsold products awaiting to be sold.

\* Inventory is the goods available for Sale and raw materials used to produce goods available for scale.

\* The three types of inventon include
* Raw materials
* Work - in - progress
* Finished goods.

## \* Types/Classification of inventory :>

(1) __Direct inventories__ :>

\* Direct inventories are those inventories that play a major role in the production and constitute a vital part of finished goods.

\* These inventories can be easily assigned to specific physical units.

\* Direct inventories may be categorized into four groups

(i) **Raw materials :→**

- Raw materials are the physical resources to be used in the manufacture of finished products.

* They include materials that in their natural or raw form.

(ii) **Semi-Finished Goods**

- Semi-finished goods are those materials which are not cent per cent (100%) complete in all respects i.e, some processing still remains to be done before the product can be sold.

(iii) **Finished Goods**

- Finished goods are complete products that are ready for sale or distribution.

⇒ For instance, in case of a hosiery factory. Sweaters, shawls etc. are finished products.

(iv) **Spare parts.**

- spare parts means duplicate parts of a machine.

**Indirect inventories**

* Indirect inventories include those items which are necessary for manufacturing but do not become component of the finished goods.

* They normally include petrol, maintenance materials, office materials, grease, oil, lubricants etc.

* These inventories are used for ancillary purposes to the business and cannot be assigned to specific physical units. These inventories may be used in the factory, the office or the selling and distribution divisions.

## 3.2 objective of inventory Control :-

* It enables business to control the inventory of items so that they are even out of stock.

→ **objectives**

① To Supply materials in time
② To give maximum client Service
③ To minimise investment on inventories.
④ To " losses.
⑤ To " idle time by avoiding stack outs
⑥ To avoid shortage of stock
⑦ To meet unexpected future demand.

## 3.3 Describe the functions of inventories ?

A manufacturing organization has one or more of the following functions (Purpose/meaning) of inventory in mind when it tries to set up a programatic and effective inventory management system.

→ To ensure organizations assembly like keep running on low carrying & ordering cost.

(i) To meet anticipated demand : (To meet the expectancy stocks, average demand)

(ii) To smooth production requirements (Create seasonal inventories to meet seasonal demand)

(iii) To protect against stock-outs (hold safety stocks to prevent the risk of shortages)

(iv) To take advantage of quantity discounts (supplies may give discount on large orders)

(v) To decouple operations (If target is to produce 100 AC's then inventory should be managed in a manner that it will permit you to perform this operation)

(vi) To permit operations (If target is to produce 100AC's then inventory should be managed in a manner that it will permit you to perform this operation)

(vii) To help hedge against price increases. (Purchase large order to evade future price increase or implement volume discount Rs 20 ban of AC turns to 100 by supplier.

(viii) To take advantage of order cycles. (buys more quanties than immediate-cycle periodic orders, on order cycles.

## Benefits of Inventory Control :→

(i) Reduces chances of going out of stock.

(ii) Increases profitability of an organisation.

(iii) Allows full advantage and economies operations of bulk purchases and transportation.

(iv) Releases more of capital for other operations.

(v) Leads to reduction in inventory levels.

(vi) Introduction of proper inventory control system helps in keeping the investments in the inventories as low as feasible.

(vii) Ensures availability of material by providing adequate protection against uncertainties of supplies and consumption of materials.

(viii) Even out the work loads on the shops in the face fluctuating demands.

(ix) Advantage of price discounts by bulk purchasing

(x) Adequate customer service.


## 3.5 Costs associated with inventory :→

① Item Cost :→

② Holding Costs -

③ Ordering Costs :-

④ Shortage Costs :-

* Inventory costs are all costs associated with ordering, holding and managing the inventory on stock of an operation on business. These inventory costs incl's include Ordering costs, holding costs, and shortage Costs.

Types of costs in inventory :→

① Ordering Cost

② Carrying Cost

③ Shortage on stock out Cost & Cost of Replacement

④ Cost of Loss, Pilferage, shrinkage and obsolescence

⑤ Cost of Logistics.

⑥ Sales Discounts, volume discounts and other related Costs.

## 3.6 Terminology in inventory Control

① **Demand** :-

Number of items required per unit time.

② Order Cycle :→

The time period b/w two successive order

③ Lead time

The time gap b/w placing a order & recieved time.

④ Safety stock :→ This is the buffer stock for overcome uncertainties.

⑤ Re-order level :→ when the stock level reaches re-order level new order issued.

⑥ Re-order quantity :→ This is the quantity of material to be ordered in ROL.
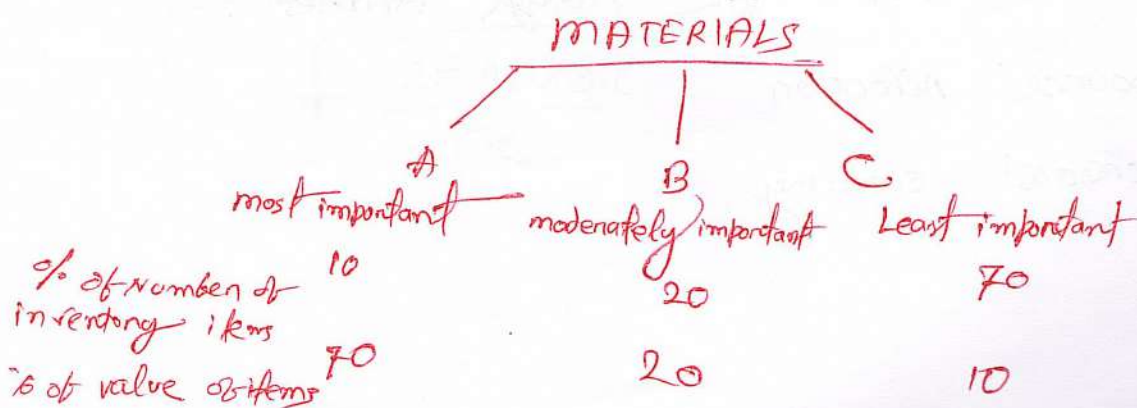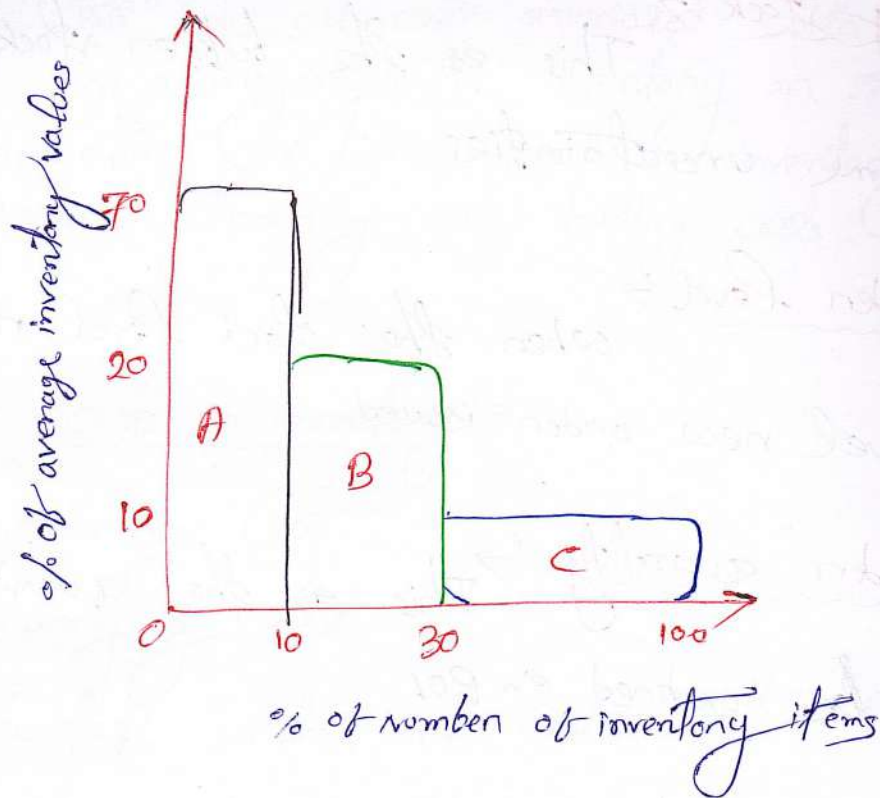
3.8  Define and Explain ABC analysis

What is ABC analysis ?

&ast; It is a technique of inventory control.

→ material resources that will be used in a project in course of time

&ast; ABC Analysis is based on PARETO LAW which says that in any large group there are " significant few " and " insignificant many "

MATERIALS

| | A | B | C |
|---|---|---|---|
| | most important | moderately important | Least important |
| % of Number of inventory items | 10 | 20 | 70 |
| % of value of items | 70 | 20 | 10 |

% of average inventory values

% of number of inventory items

| CATEGORY A | CATEGORY B | CATEGORY C |
|---|---|---|
| Accurate forecast | Approximate Forecast | No Forecast |
| Senior Level involvement | middle Level involvement | Junior level involvement |
| strict degree of control | moderate degree of control | Relaxed degree of control. |

## WHY ABC ANALYSIS

- Ensures Control over costly items
- Reduction in the storage expenses.
- Resource allocation
- Increased economy.

3.7 Explain and Derive economic order quantity for Basic model (Solve numarical)

① maximum **level**

→ [Re-order level + Re-order Quantity] -

[minimum (Consumption × minimum Re-order Period)

② minimum **level**

⇒ ordering level - [Average Rate of Cons × Re-order Period]

③ Re-order **level**

⇒ maximum usage Per Period × maximum Re-order Period

④ Avarage **level**

$$\frac{(\text{max. Level} + \text{minimum level}}{2}$$

⑤ Dangers level :—

A Level below which a Business may incur loss.

⑥ E.O.Q ⇒

$$\sqrt{\frac{2 \times A.D \times O.C}{C.C}}$$

**(9)** M/s Tubes Ltd are manufacturers of picture tubes for T.V. The following are the details of their operation.

| | | |
|---|---|---|
| Average monthly market demand | — | 200 Tubes |
| ordering Cost | — | Rs 100 per order |
| Carrying Cost | — | 20% P.a |
| Cost of tubes | — | Rs. 500 per tube |
| Normal Usage | — | 100 tubes per weeks |
| minimum usage | — | 5 " " |
| maximum usage | — | 200 " " |
| Lead time to supply | — | 6-8 weeks |

Lead time lagen

## Calculate :→

① E.O.Q, if the supplier willing to supply quarterly 1500 units at a discount of 5% is it worth accepting?

② maximum Level of stock

③ minimum level of stock

④ Re order level.

Sol => $E.O.q = \sqrt{\dfrac{2 \times A.D \times O.C}{C.C}}$

A Pra Sibblgen Ta → Anual demand of organisation

→ ordering cost

Caring Cost

$E.O.q = \sqrt{\dfrac{2 \times A.D \times O.C}{C.C}}$

$\Rightarrow \sqrt{2 \times \dfrac{5200 \times 100}{100}} \Rightarrow \sqrt{10400}$

obb. = 102 Tobes onder place

O.C, C.C kam
haba.

$A.D = \dfrac{2\,yon \quad \text{¼cntby}}{52} \times 100 = 5200$

## Total Cost

① Annual Demand × Cost

5200 × 500 → 26 L

② O.C => No of onder × Per onder Cost

$\dfrac{A.D}{E.O.q} \times \quad ''$

$\dfrac{5200}{102} \times 100 \rightarrow 5098$

③ O.C => $\dfrac{E.O.a}{2} \times$ Carrying Cost $\Rightarrow 5100$

Rs 26,0,198

* Cleculating total Cost
  if are are getting dis @5% 1500 crits

① 5200 × 500 = 26 L

② O.C $\Rightarrow \dfrac{5200}{1500} \times 100 = 346$

③ C.C $= \dfrac{3200}{2} \times 100 = \dfrac{75000}{2675346}$

$(\rightarrow 5\% \quad = 1337\ 67.3$

Total Cost $= 2541578.7$

accepted.

$\boxed{E \cdot O \cdot Q = 102}$

① **maximum level**

$\Rightarrow$ [Re order level + Re-order quantity] -

(minimum Consumption × minimum Rorder Period]

$\Rightarrow$ [1600 +102] - [50×6] $\Rightarrow$ 1702 -300 $= 1402$ unit.

② **minimum level**

$\Rightarrow$ ordering level - (Average Rate Cons × Re-order Period]

$= 1600 \rightarrow \dfrac{max + min}{2} = \dfrac{250}{2} = 125 \quad \dfrac{6+8}{2} = \dfrac{14}{2} = 7$

$= 1600 = [125 + 7) \Rightarrow 1600 - 875$

$= 725$ Units

③ **Reorder level**

maximum usage for Period × maximum Re-order Period

$\Rightarrow 200 \times 8 = 1600$ units.

# 4. Inspection and quality control

## 4.1 Define Inspection and quality Control.

**Inspection:→** (i) An item or Component or product which is manufactured is required to perform certain functions.

(ii) The act of chacking whether a component actually does so or not is called inspection.

(iii) In other words, Inspection means checking the acceptability of the manufactured product.

(iv)→ Inspection measures the avalities of a product or service in terms of predecieded standards. Product avality may be specified by its strength, hardness, shape, Surface, finish, chemical composition, dimensions,

**Quality:→**

Quality is a relative term and is generally explained with reference to the end use of the product.

Ex:- A gean used in a Sugancane Juice extracting machine through not of the Same material and without possessing good finish, tolerance and accuracy as that of a gean used in the head stock of a Sophisticated lathe may be considered

of good quality if it works satisfactorily in the juice extracting machine.

## Control :→

Control is a system for measuring and checking (inspection) a phenomenon.

→ It suggests when to inspect, how often to inspect and how much to inspect.

→ It addition it incorporates a feedback mechanism which explores the causes of poor quality and takes corrective action.

→ Inspection however, does not involve any mechanism to take corrective action.

**4.2** Describe planning or Needs of inspection

*① Inspection separates defective components from non-defective ones and thus ensures the adequate quality of products.

ⓘ Inspection locates defects in raw materials and flaws in processes which otherwise cause problems at the final stage. For example, detecting the parts not having broken tolerances during processing itself, will minimize the troubles arising at the time of

(iii) Inspection prevents further work being done on semi-finished products already defected as spoiled.

(iv) Inspection makes sure that the product works and it works without hurting anybody, i.e. its operation is safe.

(v) Inspection defects source of weakness and trouble in the finished products and thus checks the work of designers.

(vi) Inspection builds up the reputation of the concern as it helps reducing the number of complaints from the customers.

## (2) Different types of inspection :→

→ Roving, process, patrolling on floor inspection.

→ Fixed inspection.

→ key-point inspection.

→ Final inspection.

(i) Roving Inspection :→
The inspector walks round on the shop floor from machine to machine and checks samples of the work of various machine operations or workers.

(ii) **Floor Inspection :→**

Helps catching errors during process itself- i.e before the final production is ready, and

→ It is more effective and desirable because the work need not be transported to a centralized (inspection) place.

(iii) **Fixed inspection :→**

→ The work is brought at intervals for inspectors to check.

⇒ Fixed inspection discovers defects after the job has been completed.

⇒ Fixed inspection is used when inspection equipments and tools cannot be brought on the shop floor.

→ It is a sort of centralized inspection, the worker and the inspector do not come in contact with each other, thus it eliminates any chances of passing a doubtful product.

(iv) **Key-point Inspection :→**

→ Every product (more or less) has a key point in its process of manufacture.

A key point is a stage beyond which either the product requires an expensive operation or it may not be capable of rework.

⇒ Inspection at a key point segregates and thus avoids unnecessary further expenditure on poor and sub-standard parts, which are likely to be rejected Finally.

## (V) Final inspection :→

→ The final inspection of the product may check its appearance and performance.

⇒ many destructive and non-destructive inspection and test methods such as tensile, fatigue, impact testing, etc. and ultrasonic inspection, x-ray radiography, etc. respectively, are available for final inspection of the products manufactured.

⇒ Final inspection is a centralized inspection and it makes use of special equipments.

## (4.4) Advantages and disadvantages of quality Control?

Ans:-

| Advantages | Disadvantages |
|---|---|
| (i) quality can be monitored | (i) Takes responsibility away from operatives |
| (ii) Stops faulty products reaching the customer | (ii) Requires specialist/additional personnel |
| (iii) inspection takes responsibility | (iii) Problem only identified at end of process |
| (iv) often a robust system. | (iv) Work levels may be high |

## (4.5) study of factors influencing the quality of manufacturing?

Ans:-

equipment, Factony overhead, supples, woonkforce commitment, new materials, trainning, teams teamwonk product complexity, and cooperation.