# Facility layout essay

Operations Management FACILITY LAYOUT KRISHNA MURARI FACILITY LAYOUT A layout is the physical configuration of departments, workstations, and equipments in the conversion process. it is arrangement of physical resources used to create the product. Success of operations depends on the physical layouts of the facilities. Flow of raw material. Productivity and human relationship are all affected by the arrangements of the conversion facilities. Plant layout involves: i) planning and arranging facilities in new plant ii) improvements in existing layout to introduce new methods. FACILITY LAYOUT

Layout decisions have long term consequences on cost and companies ability to serve the customers. Major objectives of layout i) Providing enough production capacity ii) Reducing material handling costs iii) Easy supervisions iv) Improvement in productivity v) Efficient utilisation labour vi) Increase in morale of the employees vii) Reducing accidents and hazards to personnel viii) Reducing congestion ix) utilizing the space efficiently and effectively. FACTORS AFFECTING LAYOUT 1. Material – materials need storage. Layout should cater to storage and transportation of materials. 2.

Product – Layout should suit to the nature of product and its method of production. i. e. aircraft manufacturing and car manufacturing layouts will be different. Sales also affects the layout. 3. Machinery – Size of machinery based on product, its volume and labour, affects the layout. 4. labour – Movement of workers, facilities for workers like canteen, toilet, restroom etc affects the layout. FACTORS AFFECTING LAYOUT 5. Location – Type of building depends on the soil condition. Location decides the transportation

and layout plan has to take care of this aspect. 6. Managerial policies – top management decides the layout objectives 7.

Type of industry CRITERIA FOR GOOD LAYOUT 1. Flexibility 2. Maximum coordination 3. Maximum visibility 4. Maximum accessibility 5. Minimum distance 6. Minimum handling 7. Minimum discomfort- proper light, ventilation etc. 8. Inherent safety 9. Efficient process flow 10. Identification – provision of space to workers. TYPES OF LAYOUTS The layouts are differentiated by the types of workflow they entail , and workflow in turn is dictated by the nature of product. Basic layouts are : 1. Process layout 2. Product layout 3. Grouping technology layout 4. Fixed position layout 5. Hybrid layout

Process layout These are appropriate for intermittent operations where work flow is not consistent for all output. Variable workflow occurs when variety of products or variation of single product are produced. This is also called as functional layout or jobshop layout. In this layout similar equipments are grouped and located at one place like lathe, drilling machines etc. Workers should be highly skilled. Intensive job instructions should be given to them and technical supervision is required. These layout are quick to change and adapt to the unique batches of the products. Process layout i) iii) iv) v) vi) 8) 9) 10) Advantages Greater Flexibility Better and more efficient supervision possible through specialization Breakdowns can be taken care by shifting the job to another machine Capacity of different product line can be expanded easily. Better utilisation of men and machine Disadvantages More work in progress More floor space More distances traveled by the product. Product layout It is appropriate for producing one standardized product, usually in

large volume. It is also called as flow –shop layout or straight line layouts. The machines are arranged according to the progressive steps by which the product is made.

Examples: Chemical, paper, rubber, refineries, cement industry. Product layout Advantages: ii) Mechanization of materials is possible and material handling cost can be reduced. iii) It requires less floor area. iv) It facilitates better production control v) Production bottlenecks are avoided. Disadvantages vii) Expansion of production line is difficult viii) There is difficulty in supervising ix) Breakdown of equipment disrupts production. the Product layout in Machining Piston of a automobile Casting ROUGH TURING LATHE CAM TURNING LATHE PINHOLE BORING MACHINE GROOVING MACHINE

CIRCLIP GROOVING MACHINE INSPECTION PACKING Grouping Technology Layout Grouping technology or cellular manufacturing layout is made for a single part family i. e. parts with common characteristics. In this layout dissimilar machines are grouped into cells and each cell functions like product layout. It reduces material handling cost and simplifies machine changeovers. It reduces in-process inventory and automate the production. But reduces flexibility. CARAVAN, BATON and MIXED CELLS BATON CELLS CARAVAN CELLS MIXED CELLS Operators are fixed but products move from station to station

Operator and product move from station to station Products move from station to station and operators move between stations Fixed Position Layout When due to size , shape and other characteristic constraints, the products

can not be moved, the machine and operators move around the product. Example -construction of a building, assembly of an aircraft or ship. Less investment is required in this layout and less transport cost as bulky materials are not moved. Hybrid Layout No single layout like process, product of fixed position layout is used in strict meaning, a combination of these layouts are used.

This is called a hybrid or combined layout. For example, in process layout, one section may use product layout like parts may follow process layout and assembly as product layout. (Used in aircraft manufacturing) DEVELOPING A PROCESS LAYOUT Various models like mathematical models, computer models and physical models are used. Mathematical models helps in analyzing and conceptualizing while compute models provide quick approximation. Physical model visualizes the layout. Graphic and Schematic Analysis Templates or two dimensional cutouts of the equipments drawn to scales are used.

These are moved about by trial and error within a scaled model of the walls and columns of the facilities. Computers can visualize and display layout and the electronic templates can be manipulated with a keyboard. Computer Models or CRAFT Many computer based layout models have been developed and come under category of CAD. CRAFT (computerized relative allocation of facilities technique) is one such program which can handle upto 40 work centers. The model considers various type of layouts and different material handling methods that a firm can use among the work centers.

The analyst provides initial layout, a matrix identifying the number of loads moved among work centers and matrix identifying the cost of transportation. After calculating the initial effectiveness, the CRAFT exchanges the location of pairs or triplets of work centers and by many iteration and evaluation final solutions printed out. Load Distance Model A facility using a process oriented layout produces diversified products in variable work flows and handles a relatively large amount of material. Since transport adds no value to the product, managers seek layout that minimizes unnecessary flow among the work centers.

Load distance model minimizes flow by considering the number of loads moved and the distance between each pair of the work centers. Load Distance Model In this model we minimize the Cost C as given below: n n C= ? ? Lij Dij K i= 1 j= 1 Where n = number of work center L ij = No. of loads moved between work centers I and j Dij = distance between the work centers K = Cost to move one load one distance unit. Load Distance Model Initial cost is calculated using the above following formula And then this is modified to reduce cost and process is repeated till there is no further scope to reduce the cost.

Limitation – due to additional complexities like electrical wiring, the work centers need AC, variety of materials handled, different in sizes of work centers etc, optimal layout can not be arrived and if number of work centers is very large it is difficult to use this technique. DEVELOPING A PRODUCT LAYOUT Organsiations which produces a large volume of single product benefit from a product layout. Henry Ford revolutionized the US economy by mass producing the automobiles. The design for developing a product layout

is partly established when each part of the product is designed and the different steps required to make it are determined.

The volume of production determines the most economical process and the process technology defines the sequence of steps which are performed in production. Finally the equipments are placed along a line in that sequence. DEVELOPING A PRODUCT LAYOUT Some Possible Line Arrangements : Straight line 1 Step 2 3 4 5 CUT MILL WELD GRIND PAINT U-SHAPED L-SHAPED DEVELOPING A PRODUCT LAYOUT Some Possible Line Arrangements : SERPENTINE SHAPE OR CONVOLUTED DEVELOPING A PRODUCT LAYOUT Some Possible Line Arrangements : Sub- Assy C Sub- Assy A Sub- Assy B Sub- Assy D Main Assembly line DEVELOPING A PRODUCT LAYOUT

Modeling The Product Layout Defining the layout problem: Fundamental problem – determining number of workstations and assigning task to these work stations to get desired output. Main Concerns are : Capacity, Sequencing and efficiency. Good design meet the following criteria: 1. They produce the desired output 2. They are feasible. 3. They are efficient DEVELOPING A PRODUCT LAYOUT Table 1: assembly line layout for Al window Work station (WS) 1 2. 3. Presiding WS 1 2 Task assigned Predecessors Task time/ unit None A A A 70 80 40 20 40 30 50 50 A: assy frame work B: installation rubber mould C: install frame latch D: install handle 4. 5. 6. 4 5 E: Install handle A F: install glass pane B, C G: Cover Frame screws H: Pack C D, E, F, G DEVELOPING A PRODUCT LAYOUT Capacity Adequacy : No. of units a layout allows depends on the station whose tasks take longest time. From Table 1. : Station 2 takes 80 sec. while Station 3 takes 60 sec (40+20). When every unit pass through station 2, it

takes 80 sec. This is bottleneck operation. A finish window will flow at end of the line at every 80 sec. This time is called cycle time. Available time = 8hrs/shift= 28, 800 sec. Maximum daily out put = 28, 800/80= 360 units If required out put is 320 units, this can serve. There is capacity adequacy.

But if required output is 361 unit ????? DEVELOPING A PRODUCT LAYOUT Line Efficiency : Layout has 6 stations. Each has one worker. Each worker works for 8 hrs. 320 units are to be made. For 320 units requirement, cycle time allowed is = time available/ no. of unit required = 28, 800/320 = 90 sec. Idle time = 20 at station1 + 10 at station 2+ 30 at station 3+ 20 at station 4+ 40 at station 5 + 40 at station 6 = total 160 sec. sec per unit Total time at 6 stations = 90 x 6 = 540 sec. Time utilized = 540-160 = 380 sec. Efficiency = (380/ 540) x 100 = 70. 4 % Line Balancing How can the cost of idleness be reduced? By reassigning the tasks.

So that more available employee time is used. If every station used up an equal amount of task time, no time would be idle time. The method of equalizing stations in this way is called line balancing. Steps are: 1. Define tasks 2. Identify precedence requirements 3. Calculate minimum no. of workstations reqd. 4. Apply an assignment heuristic to assign task to each work center 5. Evaluate effectiveness and efficiency 6. Seek further improvement Line Balancing In above problem: Theoretical minimum no. of workstation = time required per unit / time allowed per unit = 380 /90 = 4. 22 stations = 5 station as whole stations are possible.

Initial layout uses 6 stations. Task Assignment Longest –operation – time (LOT) heuristic is applied. The steps are : LOT 1: assign first task that takes

the most time to the first station. Maintain precedence requirements. Line Balancing LOT 2 : After assigning a task, determine how much time that station has left to contribute LOT 3: If the station can contribute more time, assign a task requiring as much time as possible. Maintain precedence relationship. Task with time are B(80), A(70), G(50), H(50), C(40), E(40), F(30), and D(20) By LOT1 , B is first task but it has to follow A, hence A is chosen as station1.

It has 20 sec extra From available time 90 sec (LOT2). Task D can be assigned with time 20 sec (LOT3). Again, With LOT1, station 2, B takes longest time, meets precedence requirements (A), it is assigned station 2. Left time 10 sec. (LOT 2) No task takes 10 sec. Hence no extra addition of work. Line Balancing Work station (WS) 1 2. 3. 4. 5. 6. Presidi Task assigned ng WS 1 2 3 4 5 A: assy frame work Predecess ors None Task time/ unit 70 80 40 20 40 30 50 50 B: installation rubber A mould C: install frame latch A D: install handle A E: Install handle F: install glass pane G: Cover Frame screws H: Pack A B, C C D, E, F, G

Line Balancing To station 3, we can assign C or E as choice of G and H will violate precedence requirements. We assign C with operation time 40 sec. Left out time 50 sec. E or G with operation time 50 sec. can be assigned. As G is preceded by C, G is assigned. At station 4, E or F can come by precedence requirement, but operation time is more for E (40 Sec) (LOT1) hence E will be assigned. Now left over time is 50 sec. hence F (30 sec) will be added to this work station. At station 5, left out task H will come. Hence, revised, window assy will be as given in table 2, Line Balancing Work station (WS) 1 2. . 4. 5. Eligible Task assigned Tasks A D B, C, E C, E E, F, G E, F F H

A D B C G E F H Predecesso Task time/ rs unit None A A A C A B, C D, E, F, G 70 20 80 40 50 40 30 50 Efficiency = total time / cycle x no. of work centers = 380/ 5 x 90 = 84. 44% (more than 70. 4 % initial efficiency ) Line Balancing Many other heuristics, like selecting the tasks having most successors can also be used. Several computerized heuristics are available. Different heuristics give different layout, managers use different heuristics before arriving at the final conclusion. Also some times, by task sharing, idle time is utilized.

Mixed Model line balancing When more than one products are produced Mixed Model line balancing is used. Mixed model lines involve multiple lot size, lot sequencing, different setup times for each lot, different workstation sizes along the line and task variations. This makes it very difficult to design a layout. In this design objectives are reducing idle time and increasing the efficiency. Optimal solution is not find inspite of using various techniques. DEVELOPING A CELLULAR MANUFACTURINGLAYOUT Steps: 2. Parts that follow a common sequence of steps are grouped into a family.

Computerized parts classifications and coding system are used, 3. Dominant flow patterns of parts-families are identified as a basis for location or relocation. 4. Machine and processes are physically grouped into cells. DEVELOPING A CELLULAR MANUFACTURINGLAYOUT Major problems in developing a cellular manufacturing layout are i) Developing and classification a coding scheme fro items of different shape, sizes, materials etc ii) Grouping parts in families to form cell groups on the basis of processing requirements and routings iii) creating physical layouts for positioning cells relative to each other.

JAPANESE APPROACHES AND TRENDS IN MANUFACTURING LAYOUTS

Japanese layouts are compact as apace is premium in Japan. Hence movement is less and space utilisation is more. Japanese layouts are used for flexibility and adaptability for various products. in comparison to US layouts form high worker and machine utilisation. Service facilities exist to bring together customer and organisation’s services. Features like easy entrance, well organized parking lots, well marked entries and exits, powered doors, escalators and lobbies for customers, create a convenience to customer and increase the business.

The layouts depend on degree of customer contacts. One case, it may be designed around the customer and other around the technology, process materials and production efficiency. Example Banks designed around customer and hospitals around the technology. Service facility Layouts Some are balanced between the two like restaurant. Retail Service Layout Due to rise in land prices, objective of the retail layout is to maximize returns per unit area. Super markets try to maximize the product exposure, bank try to provide comfort ambiance to customer.

Service escape – physical surroundings – consists of ambiance, spatial layout and functionality and signs, symbols and artifacts. Service facility Layouts Service facility Layouts Ambiance- all physical attributes of a place : noise level, lightening , temperature, colour, style of fixtures etc. These have significant effect on customers and workers. It determines the perception of the customer. Spatial Layout and Functionality – Grouping of merchandises and well designed circular paths are important features. Grouping of merchandise is done based on customers perception of related items.

Circular paths are made so that products can be visible to the customer. Service facility Layouts Sign, Symbols and artifacts These are more visible parts of service facilities. These provide directions, uniqueness, advertising of brand, differentiation of services etc. Example: In big super markets, different items at different floors are kept and sign and symbols are used to guide the customers. Decisions regarding these elements are taken based on type of the service. Low customer involvement proper information is provided by signs like in fast food restaurant.