Layout plan. assignment

OPERATIONS MANAGEMENT: – PLANT LAYOUT The assignment summarises what is a plant layout, main objectives for designing a good plant layout, the various types of plant layouts, advantages and disadvantages of the respective layouts, what are various techniques used to design a plant layout, and importance of layout in every sector of business, be it manufacturing or services. All this is well explained with live examples from various industries depicting the relevance of each layout. FORD’S PLANT There has never been anything like the Rouge, Ford’s most famous car-making facility.

Located on 1100 acres along the Rouge River in Michigan, the complex at its heyday consisted of 29 factories, 50 miles of railroad tracks, and its own power plant and steel mill. The Rouge employed more than 1000, 000 people and produced a new car every 49seconds. Iron ore, coal, and other raw materials went in one end and came out the other as a completed automobile. Today, the Rouge employs about 7000 people and assembles the Ford F-150. Outside suppliers provide most of the components and subassemblies.

But great things are happening at this famous facility. Bill Ford has built a new assembly plant on the site, designed for flexibility and sustainable manufacturing. With flexible equipment and new processes, Ford’s able to ship 90% of vehicle orders the same day. By manufacturing three vehicle platforms and nine different models on a single assembly line, the line has 40% fewer workstations and teams of workers controlling “ their own piece of the world. ” The flexible manufacturing body shop consists of 16 work cells producing 300 standard parts.

Web connections on the plant floor enable workers to share information directly with suppliers, product engineers, and customers. A team leader, for example, can take a digital photo of a poorly fitting part, send it over the Web to a supplier, and get an engineering fix in minutes. Parts delivered directly to the assemble area cut inventory in half, to just 2 hours' worth and 10 hours offline. Adjustable wooden pallets at workstations can be raised and lowered to facilitate assembly tasks. Facilities make a difference. They can provide a competitive edge by enabling and leveraging the latest process concepts.

For example, factories that once positioned shipping and receiving departments at one end of the building, now construct t-shaped buildings so that deliveries can be made directly to points of use within the factory. Classrooms incorporated desks on wheels to be repositioned for different teaching styles and student interaction. Facility decisions affect how efficiently workers can do their jobs, how much and how fast goods can be produced, how difficult it is to automate a system and how responsive the system can be to changes in product or service design, product mix, or demand volume.

World-class companies recognize that long range capacity decisions and facility location decisions are among the most important of their strategic decisions. Development of an effective subcontractor network can lead to improved production technology, reduced capital investment, increased flexibility and capacity, and more stable employment levels. This means that production facilities in general tend to be smaller, more widely dispersed,

and located closer to customers. Facility layout greatly affects the performance of production systems.

World-class companies pour great effort into developing layouts designed to achieve competitive priorities for products in their business plans. Manufacturing, warehouse operations, service operations, and office operations share many layout objectives. Chief among these are provision for enough production capacity, low materials-handling cost, provision for the personal and safety needs of workers, low capital investment, and low production costs. World-class companies strive for flexibility in their layouts, allowing them to change production rates and to change to other products models quickly.

Their layouts are relatively small, compact, tightly packed with a large percentage of floor space used for production and a smaller percentage for inventory. WHAT IS A PLANT LAYOUT? Plant layout refers to the arrangement of physical facilities such as machines, equipment, tools, furniture etc. in such a manner so as to have quickest flow of material at the lowest cost and with the least amount of handling in processing the product from the receipt of raw material to the delivery of the final product.

A layout is the physical configuration of departments, workstations, and equipments in the conversion process. It is the arrangement of physical resources used to create the product. Plant layout has to be planned in such a flexible way so as to enhance the productivity, with minimum loss. It has to be planned in a way taking into consideration the inputs. Layout planning provides a set of tools and techniques that help an operations manager to

decide where to locate the resources and also to assess the impact of the alternative choices that he/she may have for locating the resources.

Typically, in case of manufacturing organizations, there may be over 100 machine tools that need to be located in the area so as to ensure efficiency and effectiveness in the work being progressed. Similarly, in case of service organization such as hospital, school, or a hotel, there are various resources to be physically located. We can identify these best possible locations for each of the machines or other physical resources that need to be located in bringing the maximum utilization of the space, resource and at same time low costs being maintained.

Layout planning provides a set of tools and techniques that help an operations manager to decide where to locate the resources and also to assess the impact of the alternative choices that he/she may have for locating the resources. Typically, in case of manufacturing organisations, there may be over 100 machine tools that need to be located in the area so as to ensure efficiency and effectiveness in the work being progressed. Similarly, in case of service organisation such as hospital, school, or a hotel, there are various resources to be physically located.

We can identify these best possible locations for each of the machines or other physical resources that need to be located in bringing the maximum utilization of the space, resource and at same time low costs being maintained. Layout planning in manufacturing and service organisations deals with the physical arrangement of various resources that are available

in the system with an objective to improve the performance of the operating system, thereby, providing better customer service.

A good layout design will ensure that a vast majority of jobs in a manufacturing system may have to travel shorter distances before completing their processing requirements. Similarly, in the case of service organisations, customers may have to walk shorter distances and spend less time in the system to complete their service requirement. This ensures that costs and the lead time of the processes come down. Whereas a bad or incompetent layout design will result in longer distances to be covered, before completing the process. This creates several problems in organisations and several key performance standards have to suffer.

The most significant and visible effect is the time taken to complete the process. Longer distances would mean more time to complete the process and more material handling in the case of manufacturing organisations, leading to higher material handling costs. Eventually, in both service and manufacturing systems, this leads to poor quality. This is a physical arrangement of equipment and facilities within a plant. Optimizing the layout of a plant can improve productivity, safety and quality of products. Unnecessary efforts of material handling can be avoided when the plant layout is optimized.

In cases like * Where heavy raw material is to be move. * Distances operators have to move. * Distances equipment has to move. * Types of handling Equipment needed. * Energy required moving items against resistance. Success of operations depends on the physical layouts of the

facilities. This enhances the productivity of the plant. Productivity and human relationships are all affected by the arrangements of the conversion facilities. Productivity is related to efficiency. It is a method to measure how an organization can convert inputs to final product.

So every firm in the industry aims for high productivity. One of which that is being considered is having an efficient plant layout. Every infrastructure requires having a layout. A layout is consisted of the detailed plan of the structure being constructed. It mainly emphasizes on the arrangements and flexible positions of the basic elements require in the plant. It serves as a guideline for the builders as well the owners to visualize and practically include all the proper allocation of space and equipments that will be used in the production of the plant.

Thus, this is the most important aspect of manufacturing process. For example, in our daily lives we see at our home taking the case of a simple ordinary kitchen, everything is well planned according to work, safety and minimizing time. We see our mother’s plan and put daily useable items like: spoons, knife, spices, etc. near to the stove as they need it all the time when they cook. Similarly in case of car keys people always keep them near to the main door such that it is easily accessible to everyone. OBJECTIVES OF A GOOD PLANT LAYOUT

The principle objective of a proper plant layout should be to maximize the production and minimize costs. This should be kept in mind while designing a layout for a new plant and even for making changes in the existing plant layout. To fulfil this goal, it should be planned with keeping the following

objectives in mind- * There should be proper utilization of cubic (i. e. length, width and height). The given space should be fully utilised. For example, conveyor belts can be run above head height and used as moving work in progress or tools and equipments can be suspended from the ceiling.

This can be applied in stores where goods can be stored at a considerable height without inconvenience * The waiting time of semi-finished products to be minimized. * Provide better and safer working conditions like well ventilated rooms. * The handling and transportation of the material should be minimised and efficiently controlled. To achieve this, the distances between different work areas as well as the number of times such movements occur per unit period of time will have to be considered. * Plan the layout in such a way that the worker movement is also minimized. Suitable spaces should be available to the production centres. * We should ensure that there is enough flexibility for changes in product design and for future expansion. It should be able to incorporate new equipment to meet technological requirement without major changes. * A good layout permits material to move through the plant at the desired speed with the lowest cost. * Productivity should be increased keeping in mind better quality and cost reduction. * Boosting up employee morale by providing employee comforts and satisfaction. The work should be arranged in such a way that there is no difficulty in supervision, coordination and control. There should be no ‘ hiding-places’ into which goods can be mislaid. Goods – raw materials and ready stocks – must be observed at all times. This will reduce the pilferage of material and labour IMPLICATIONS OF LAYOUT PLANNING For addressing the layout planning problem or the designing the structure of the

layout, it’s necessary to begin with a good understanding of the key factors that influence the layout design for specific organisations belonging to various sectors.

Different organisations have different ideas and views for dealing with their respective customers, so keeping all these small yet critical issues; we should minutely study every detail and then start designing. In more general case, the relationship between ‘ Volume-Variety-Flow’ provides crucial inputs to the layout designing problems. Variety and Volume are inversely related in any operating system. Thus, when variety is low, the volume of production is high. The typical examples are processes industry firms such as petrochemical manufacturers and mass manufacturers such as automobile components manufactures.

In these cases, the flow is highly streamlined. Raw materials move progressively through the system from one end of the process until it reaches the final assembly, testing and packing. Similar examples exist in service system also. In the case of a fast food joint with just a few offerings, the process could be highly streamlined. Customers may enter the eatery, place an order, and pay at the cash counter, move to the delivery counter, pick up their order, and move to the dining area. Finally, they may move to the disposal area to leave their used plates before exiting the system.

At the other extreme is a project shop. In a project shop the volume is typically one, examples include building of large-scale power projects, nuclear facilities, a multi-level flyover system for a large metropolitan city and so on. Resource requirements in these projects are vast, varied, un even

in demand and stretched over long periods. Therefore layout planning is a very different problem. Between these two extremes we have operating systems that vary in the volume variety dimension and therefore have varying flow implications. As variety increases the volume drops, leading to batch manufacturing firms.

Further increase in variety leads to reduction in volume as we find in the case of job shops and customised product and service providers. As this change happens, the flow of jobs and the demand placed on the various resources in the shop becomes more cumbersome, varied and hard to visualise. Therefore, the nature of the problem to be tackled during a layout planning exercise changes. In general, as the flow becomes more cumbersome, the type of layout may significantly influence the ability of the operations manager to effectively plan and control operations on the shop floor.

Variety| Very Low Variety| Medium Variety| High Variety| One-off Execution| Flow attributes| Stream lined below| Multiple flow paths| Disorganised flow| Jumbled flow| Volume attributes| High volume| Mid-volume| Low volume| One piece| Examples of operating systems| Process industry; Mass products/service provider| Batch manufacturing firms| Job shops; CustomisedProduct/Service provider| Project Shops| Types of layout used| Line layout; Product layout| Group technology layout| Process layout| Fixed position layout|

FACTORS AFFECTING PLANT LAYOUT While deciding to set up a plant/store a business should plan a layout first in order to avoid problems/confusions in

coming years. Thus there should be a balance between all the characteristics of a plant layout. The following factors that influence a plant layout are: * MATERIALS: Availability of raw material is one of the main factors which affect a plant layout in certain region. The layout of a plant should be made keeping in mind the kind of material used in for manufacturing process of the product.

In case of heavy material, crane or lift has to be used; in case of volatile raw material arrangement for special storage has to be done, etc. Thus our main factor is the size, shape, volume, and weight and physical-chemical characteristics of the raw material. Also the sequence and the order of the operations affect the plant layout as the volume of production may vary. * FACTORY BUILDING: The nature and the size of the building determine the floor space available for the layout. While designing the layout of the plant, special requirements like air conditioning, dust control, humidity control, etc. ust kept in mind. Especially in case of plant where chemical compounds/ gas have to be stored/used a special safety precautions and storage methods should be used. Thus building should be made keep in mind all the characteristics of the final / semi-final products. * TYPE OF MACHINERY: General purpose machines are often arranged as per process layout while special purpose machines are arranged according to product layout. For example special specific machinery is to be used for manufacturing bearing of ships rather than manufacturing bearing of a car/truck.

Thus it’s important to have the information about the process, machinery, tools and other important equipments, by which plant layout will be designed. As well as it is essential to know the size, shape, weight of the

machinery itself, in order make a provision for the space and quantity of labour to be employed. * HUMAN RESOURCE: Labour has to be organized for the manufacturing process for example, supervisor, guard, Inspection, cleaner, etc. Adequate arrangement should be made for cloakroom, washroom, lockers, drinking water, toilets and other important facilities for the employees.

Government laws also should be followed in case of labour, as they enforce to have a dormitory if the number of labour employed exceeds 100. All the norms should be taken care of. * ENVIRONMENT: Heat, Light, noise, ventilation and important aspects should be duly considered, example, in a chemical factory the waste is hazardous for the environment if not treated before it drained out. Also in case of paint workshops and plating sections should be located in another hall so that dangerous fumes can be removed through proper ventilation etc.

Adequate safety arrangements should be made and taken care of. Materials handling never add value to the product, so the waste material should be treated and disposed of. This eliminates the risk of blocking money. * WAITING TIME: As we know long manufacturing process of the product blocks the working capital of the firm. But in some case it has to be done, because some products need time to cool down or heat up, etc. therefore a special attention should be paid to provide space and place where this kind of activity takes place, without disturbing the normal routine process of the plant.

For example, in a shoe factory a long duration is required for shoe to take shape when they are put on the last, they has to pass through cooling machine as well as heating machine, which needs time to settle down and take the shape, giving each pair a same shape. * ANCESSORY SERVICES: There are certain services that support the production process and should be taken care of like related to labour, machinery, maintenance, security, etc. For safety purpose of the labour a plant should take all the safety measure which is regulated by the government like fire protection, supervision, camera, etc.

A special team should be form to take care for the machinery and its maintenance for proper functioning of the plant. * FUTURE CHANGES: Plant Layout is a dynamic rather than a static concept which means that if once done it is not permanent in nature rather improvement or revision in the existing plant layout must be made by keeping a track with new developments. But to make a plant dynamic it should be made flexible in the very first stage so that future changes or expansion can be easily made. It is convenient and important to forecast the future changes to avoid having inefficient plant layout in a short term.

Future amendments are done on account of following reasons : * Increase in the output of existing product. * Introduction of a new product and diversification. * Technological advancements in machinery, material, process, product design, fuel, etc. * Deficiencies in the layout unnoticed by the layout engineer in the beginning. TYPES OF LAYOUT A process is selected on the basis of: * Technical issues – basic technology used to produce a

service or good. * Volume or scale decision – using the proper amount of mechanization to leverage the organization work force.

The production process normally determines the type of plant layout to be applied to the facility. Layouts can be classified into the following categories: 1. Process or Functional Layout 2. Product or Line Layout 3. Fixed Position Layout 4. Group Technology Layout 5. Mixed Model Assembly Lines 6. Flexible Manufacturing Systems 1. PROCESS LAYOUT These are found primarily in job shops, or firms that produce customized, low – volume products that may require different processing requirements and sequences of operations. Process layouts are facility configurations in which the operations of a similar nature or function are grouped together.

In this type of layout the machines of similar type are arranged together at one place. We use this type of layout in batch production. it is preferred when the product is not standardized and the quality produced is small. The purpose is to process goods or provide services that involve a variety of processes. For example, Automobile sector, shoe manufacturing, machine shop, etc. In a machine shop, generally they have separate departments where general purpose machines are grouped together by function (e. g. milling, drilling, grinding, etc. in case of an automobile company, some parts are manufactured in the same plant and most of the other parts are purchased from outside. Basically, they assemble all the parts and make it to a final product. So here the work in progress car moves around to several bays where robots/employee fit in the respective units of the car. In case of a shoe factory, here they assemble leather, sole, laces, etc. and make it a single product. Like they first cut the leather, sew it, give it a shape, add sole

to it and then colour it. Here also shoe passes to several work stations where labour do their respective jobs.

This type of process is also called Functional Layout. Other common example of process layout is hospitals, library, bank, auto repair, etc. This kind of layout is a flexible layout, which is excellent for low to medium production quantity. Also this is excellent for medium to high production variation. In this kind of layout here work is complex, so the work force should be skilled and qualified. It is a time consuming process, as the product has to pass through various processes, so it has high work in process. Low production rate is biggest disadvantage of this type of layout.

Improving process layout involves the minimization of transportation cost, distance, or time. To accomplish this level, some firms use Muther Grid, where subjective information is summarized on a grid displaying various combinations of department, work group, or machine pairs. Here each combination represented by an intersection on the grid, is assigned a letter indicating the importance of the closeness of two (A = absolutely necessary, E = very Important, I = Important; O = Ordinary important; U = unimportant; X = undesirable). Importance is generally based on the shared use of facilities, equipment, worker or records, work flow, etc.

DESIGN OF PROCESS LAYOUT Design of a process layout involves a three-step process. The first step is to identify the number of departments required and the space requirements for each department. Since process layouts are made on the basis of functional similarity of the resources, this is a fairly straightforward decision. For example, in a machine shop, all the lathes are

grouped together to form a lathe shop, all the grinders are grouped to form the grinder shop there will also be separate departments for receiving final inspection and shipping.

Once these units are indentified it is possible to also estimate the sizes of each of these departments. The number of resources to be placed in the shop, dictates the size. The distance between the block in the shop floor in which the departments are to be located could also be measured. The information will be of use in the layout designs exercise. On the basic of these estimates the required data for the layouts problem could be gathered. The table given below: The second Step in the design process is to estimate the flow of material between departments and the cost of moving one unit across departments.

In a processes focused layout, jobs visit various departments before the processing is complete. Further, the production requirements of each job in each resource will vary. Therefore, consolidating all this information will indicate not only the load on each resource but also the quantum of inter-departmental flow. Inter-departmental flow is the sum of flows between two departments irrespective of the directions of the flow. For instance, an inter-departmental flow of 100 units between departments 1 and 2 may include 65 units of flow from department 1 and to department 2 and 35 units of flow from department 2 to department 1.

At the end of this consolidation exercise, one can arrive at a matrix of inter-departmental flows as indicated below for a sample of six departments. THERE ARE 2 APPROACHES TO LAYOUT DESIGNING 1. QUALITATIVE

APPROACH TO LAYOUT DESIGN: In the qualitative approach, some qualitative measure are used to decide which department is to be located next to another department. One simple method is to use the interdepartmental flow as the basis on which closeness between one department and another could be established.

However, often it is difficult to exactly quantify why two departments need to be close to one another or should not be located side by side. For example even when the interdepartmental flow of jobs between a heat treatment shop and quality control section maybe high. It is better not to locate them side by side. This is because the quality control system may use high precision gadgets for testing and calibration and locating the heat treatment shop alongside may call for costly measures for isolation particle impurities, pollution control and cooling of the high temperature ambience.

Similarly, it may not be desirable high tension testing facility in an electrical goods manufacturing industry, in the midst of other shops for safety considerations. Based on such criteria it is possible to conclude that qualitative measures for closeness requirements of a department which are with other departments. The qualitative measures link some criteria with some closeness required between two departments. Using the closeness rating between department’s layouts can be constructed. In the above table department 1 and 3 are to be located close to each other.

Similarly, should also be close to each other. Using this information an initial layout can be constructed accommodating all requirements may often turn out to be infeasible. However, alternative combinations ensure better

locations that improve the appropriateness of the layout. Therefore, one method is to begin with an initial layout. That is feasible and progressively checks the appropriateness of the new layout obtained. This may be done by selectively exchanging parts of the layout plans through swapping of a subset of locations among each other.

A pair wise exchange could be a systematic approach to enumerate the entire possible layout that one can get from an initial layout. Smaller layout can be analysed using visual methods and trial and error. However, if the number of departments involved is many then use of computer packages maybe inevitable for layout design. Computer packages like ALDEP CORELAP are used for qualitative design of process layouts. 2. QUANTITATIVE APPROACH TO LAYOUT DESIGN: The quantitative method in making layout designs uses certain measures for assessing the impact of the layout and seeks to arrive at the best method for locating the departments.

Since the basic purpose of a good layout design is to minimise excessive travel of jobs over long distances, let us use the material handling cost as the basis for designing an appropriate layout. Let Cij Denote the cost per unit of transporting a unit distance from department ‘ i ‘ to department ‘ j ‘ Fij denote the inter-departmental flow between department i and department j Dij denote the distance between department i and department j n denote the number of departments to be laid out The total cost of the plant in given by TC = i= 1ni= 1nF ijDijCij The interdepartmental flows, the distance between the blocks and cost nformation are gathered during a layout planning exercise. Therefore once a decision regarding which department will be located in which block is made, the total cost of the plan could be computed

using the above equations. For using the quantitative method it is required to have some logical and technical understanding of the type of organisation you are dealing with and then arrive at conclusions, so as to decide the best suitable plant layout for the respective organisation. The above equations can also be modelled as mathematical programming problem with the objective function of minimising the total cost of the plan.

The mathematical programming problem is one used for assigning the department to the blocks; subject to the constraint that one block can hold only one department. Further, the number of blocks assigned should be equal to the number of departments. Pittsburgh International Airport with its innovative ‘ X’ design facilitates a significant increase in airspace as it allows planes to approach the airport from any direction increases the airport’s ability to cope with demand. Good layouts can increase revenues, as well as save operating expenses.

PROCESS LAYOUT IN SERVICE INDUSTRY: A functional/process layout can promote skill, economy, conveniences, and comforts; on the other hand a non – functional layout can impede activities of all types, detract from quality of rare, and raise cost to intolerable levels. Hospital is the most complex of building type, and is the best example to be studied under process layout. Hospitals comprised of wide range of services and functional units. These include units like treatment functions like clinical laboratories, imaging, emergency rooms, and surgery, etc.

Hospitality functions like food, housekeeping, etc. It also involves various other functional areas well, so no one person can reasonably have complete

knowledge about all the functional areas of the institution. The main functions performed in a hospital are: * Bed related inpatient functions. * Outpatient related functions * Diagnostic and treatment functions. * Administrative functions. * Service functions * Research and teaching functions. Physical relationship between these functional areas determines the configuration of the hospital.

Certain relationship between the various functional is required, which is as follow: The above diagrams show the movement of communication of people, material and waste. Thus the physical configuration of a hospital and its logistics systems are inextricably intertwined. The transportation system is influenced by the building configuration, and the configuration is highly dependent on transportation. Now talking about the building attributes: Regardless of size, the location, budget, all the hospitals should have certain common attributes: Efficiency and Cost Effectiveness:

An efficient hospital layout should have: * High efficiency by minimizing distance of necessary travel between frequently used spaces. * Allow easy visual supervision of patients by limited number of staff. * Provide an efficient logistics system, which might include elevators, pneumatic tubes, box conveyors, etc. for effective handling of patients and their care. * Group or combine functional areas with similar system requirements. * Provide for adjacent functions such as locating the surgical intensive care unit adjacent to operating suite and likewise. Flexibility and Expandability:

Since medical needs and modes of treatment will continue to change, hospitals should: * Follow modular concept of space planning and layout. *

Use generic room sizes and plans it to the extent, rather than highly specific ones. * Use modular, easily accessed and easily modified mechanical and electrical systems. * Be open-ended, with well planned directions for future expansions. * Patients come to hospitals when they are sick and distressed so the hospital should try and give a positive and comfortable feeling to the patients by a healthy environment. Using cheerful and varied colours and textures, keeping in mind that some colours are inappropriate and can interfere with provider assessment of patient pallor and skin tone. * Should try and give ample natural light, gives positivity to everyone. * Providing view of outdoor scenes, painting with positive instinct so as that patient recover soon. Cleanliness and Sanitation: Hospital requires a lot of cleanliness, a lot of work force is required for this process. It’s not an easy task to clean and maintain cleanliness. Therefore hospitals must try a way out to clean it easily.

This is facilitated by: * Appropriate, durable finishes for each functional space. * Careful detailing of such features as doorframes, casework, and finish transitions to avoid dirty catching and hard to clean crevices and joints. * Adequate and appropriately located housekeeping spaces. * Special materials, finishes, and detail for spaces which are to be kept sterile, such as integral cove base. Controlled Circulation: A hospital is a complex system of interrelated functions requiring constant movement of people and goods. Much of this circulation should be controlled. Outpatients visiting diagnostic and treatment areas should not travel through inpatient functional areas nor encounter severely ill patients. * Typical outpatient routes should be simple and clearly defined. * Visitors should have a simple and direct route to reach

patient nursing unit without penetrating other functional areas. * Dedicated service elevators for delivers, food and building maintenance service. Security and Safety: In addition to general safety concerns of all buildings, hospitals have several particular security concerns: * Protection of hospitals property and assets, including drugs. Protection of patients, including incapacitated patients, and staff. * Safe control of violent or unstable patients. Emerging Issues: Apart from all the above layout design for a hospital, there are several emerging issues that influence the hospital design: * The decreasing number of general practitioners along with the increased use of emergency facility of primary care. * The increasing introduction of highly sophisticated diagnostic and treatment technology. * Requirements to remain operation in emergency or what so ever the case may be. Prevention and care towards sickness care, sanitation and cleanliness. * Need to balance increasing attention to building security with openness to visitors. * Emergence of palliative care as specialty in many major medical centres. Hospitals are among the most regulated of all building type layout. Like other buildings, they must follow the local – state building standards. A hospital has to get itself a license, that it is following all the regulations of FGI guidelines for design and construction of hospital. Advantages of process layout: * Greater flexibility in production. Better and more efficient supervision is possible through specialization. * Breakdown of any equipment, absenteeism of the workers and/ or non availability of certain materials can be easily handled by transferring work to another. Therefore, dislocation of manufacturing activities may be avoided. * The production capacity may be expanded easily as and when required. * Better utilization of men and machines is possible through this layout. * Lower

capital investment on account of comparatively less number of machines and lower costly of general purpose machines. Imbalance of work in one section does not affect the functioning of the other sections. * Greater flexibility in relation to the allocation of work to the workers and machines as well as the speed of processing. * New jobs with varying work content and different sequences of operations can be undertaken without any difficulty. It helps to make the assignment interesting to the workers by removing monotony. Disadvantages of process layout: * Production requires more time as work in process inventory has to travel from one place to another wherever the machine is available. This type of layout requires more floor space while material handling cannot be automated. Hence, this is costly * Competition of production requires more time, difficult scheduling and changing set ups as every job has different sequences of operations. Therefore the cycle time is more. * Time to time inspection has to be done, which results in delay in output as well as high cost of inspection * This type of layout needs a herculean task in coordinating the movement of jobs, especially in a large shop. Suitability: Product layout is useful under following conditions: . Mass production of standardized products 2. Simple and repetitive manufacturing process 3. Operation time for different process is more or less equal 4. Reasonably stable demand for the product 5. Continuous supply of materials Therefore, the manufacturing units involving continuous manufacturing process, producing few standardized products continuously on the firm’s own specifications and in anticipation of sales would prefer product layout e. g. chemicals, sugar, paper, rubber, refineries, cement, automobiles, food processing and electronics etc. 2. PRODUCT LAYOUT

Product layout is found in flow shops (repetitive assembly and process or continuous flow industries). Flow shops produce high-volume, highly standardized products that require highly standardized and ongoing processes. In a product layout, resources are lined up in a sequence based on the routing of the products. Here the machines and equipments are arranged in one line depending upon the sequence of operations required for the product. Therefore this kind of layout is also called Line Layout. The material moves to another machines sequentially without any backtracking or deviation i. e. he output of one machine becomes input of the next machine. It requires a very little material handling. It is used for mass production of standardized products. In theory, this sequential layout allow the entire process to be laid out in a straight line, which at times may be totally dedicated to the production of only one product or product version. The flow of the line can them be subdivided so that the labour and equipment are utilized smoothly throughout the operations. For example in a paper mill, bamboos are put into the machines at one end and paper comes out at the other end.

The raw material moves very fast from one workstation to other stations with a minimum work in progress storage and material handling. In this line layout process, the grouping of machines should be done keeping in mind the following general principles. * All the machine tools or other items of equipments must be placed at the point demanded by the sequence of operations. * Materials may be fed where they are required at the point, but not at one point. * Here in the line layout, all the operations like packing, testing assembling must be included in one line.

Two types of lines are used in product layouts * Paced * Unpaced. Paced lines are lines which can be used as some sort of conveyor that moves output along at a continuous rate so that workers can perform operations on the product as it goes by. For longer operating times, the worker may have to walk alongside the job as it moves until he or she finished and can walk back to the work station to begin working on another part. This is a clear example of how work is done in an automobile manufacturing company. On an unpaced line, a worker builds up queues between workstation to allow a variable work pace.

However, this type of line does not work well with large, bulky products because too much storage space may b required. Also, it is difficult to balance an extreme variety of output rates without significant idle time. A technique known as assembly – line balancing can be used to group the individual task performed into workstations so that there will be a reasonable balance of work among the workstations. Thus product layout efficiency is often enhanced through the use of line balancing. Line balancing is the assignment to tasks to workstations in such a way that workstations have approximately equal time requirements.

This minimizes the amount of time that some workstations are idle, due to waiting on parts from an upstream process or to avoid building up an inventory queue in front of a downstream process. The Advantages of Product Layout are: * In case of product Layout, it can generate a large number of products in a very short time. Also there is a flow of material is smooth and continuous manner. This helps the firm to keep the minimum cost per unit as production is done on a large scale. * In this line layout

process there is always less work in progress inventory, because the flow of material is continuous alone a line.

Therefore this enhances least blocking of capital in product manufacturing. * This layout is easy, systematic and in a line, which occupy less space in the plant as compared to the process layout plant even to manufacture same volume of products. * In case of Product layout, there is a high degree of labour and equipment utilization. * Automation in the material handling is cost effective, as the flow of material is well known. * On account of less waiting time ad less chances of congestion on the process, here the production per unit is done in less time. Requirement of skilled worker is less in case of line layout plan as a particular worker has to do a particular operation, which seldom changes due to standardized production line. * Total time per production, less work in progress, low per unit price, thus a firm try to achieve higher profit having an advantage of economies of large scale of production. The Disadvantages of Product layout: * The main problem faced in this layout is that the labour gets bored of doing the same-dull repetitive work. So they need to be motivated, because for those jobs can be quiet stressful and boring. Low incentive to labour, being the work repetitive there is low incentive plans for them, as product layout are hard to administer each individual working in the plant. * Product layout plants are inflexible and cannot easily respond to required system changes. Especially in case of changes in product or product design. * In product layout as the work is sequential, a single breakdown, absenteeism or due to maintenance can stop the production a point. Therefore whole line is stopped at a single fault

in the process. * As it is not flexible the change in any design of product or process the whole layout becomes obsolete.

PRODUCT LAYOUT FOR NOKIA Raw Material Supply from Suppliers: Most electronics components, from resister and capacitors to highly integrated circuits, are delivered by supplier on reels of tape, protected in circular plastic case. [1] The Foundation: A printed circuit board (soldering process): At the heart of Nokia phone is a slender strip of plastic covered with a latticework of basic circuit and settings for the installations of chips and other electronic components. Here, printed circuit boards enter the paste printing machine, which lays down a patterned layer of solder paste, made from a tin copper silver alloy.

The paste is later melted in an oven to bind electronic components to the board. [2] Providing the parts (Loading process): Reels of component are loaded into spindles. From there, they feed into automated “ pick and place machines” that grab individual parts off the tape and lay them precisely onto the printed circuit boards. Nokia uses mostly “ surface mount” components that lie flat on board. [3] Laying Down the basics (laying process): Circuit boards travel down a belt from one pick and place machine to the next, and by the time they reach the end of the line, all the basic components have been installed.

After the parts are in place, the board go to an oven for seven minutes, where solder paste is melted and gets attached. [4] Quality testing: The first quality test takes place after the basic component has been installed. [5] Configuring (software Installation Process): The boards are advanced

automatically on tracks into the “ flash and alignment” stage, where basic software is first installed into programmable components. [6] Assembly and configuring Process: A robotic aims lifts the board off the track and puts it into a bay.

There, the chips on the board are configured with low-level settings, such as what power level the phone will operate on. [7] Testing process: Then, a series of electronic tests are administered to ensure that the circuit board is perfect, all the parts work, and that they have been correctly installed. [8] Fixing camera and LCD displays: At this stage, the hand work begins, here; a worker plucks digital camera modules from a reel and installs them with tweezers onto assembled, tested, printed circuit boards. The expensive and fragile liquid-crystal display screens are also added by hand. 9] Protection covers fixing: A nearby worker performs another essential task by hand: sandwiching the complete printed circuit board between front and back frame adding covers. [10] Adding functionality: The last step in the production turns a generic phone into one customized to the exacting specifications of mobile phone users around the world. Later, the unique IMEI code is installed, also the phone goes to the department for the diagnostic tests, by installing software and battery. In the end, after the high tech assembly line the phone goes for final inspection (by human eyes).

Here only a tiny fraction of phones fails to pass this final test. Then it goes on a conveyer belt for the packing process. Finished Goods Storage : Lastly the phones packed into retail boxes are grouped territory wise and order wise in ware house. From there the Nokia phones are dispatched for end users. DESIGN OF PRODUCT LAYOUTS A product layout design essentially focuses in

estimating the exact number and the sequence of resources required in the manufacturing system for a targeted production level. Essentially, the layout design seeks to indentify the minimum number of resources required to meet a targeted production rate nd the order in which these resources to meet a targeted production rate and the order in which these resources are to be arranged. In the process it seeks to establish a balance among the resources are too arranged. In the process it seeks to establish a balance among the resources so that production is smooth. Therefore, the technique employed for this purpose is known as line balancing technique. There several examples of mass production systems in operating today. For example a two-wheeler manufacturer such as Bajaj Industries produces nearly 10, 000 two wheelers every-day.

Various sub-assemblies in the in the Bajaj plant need to be configured to match the production rate. Similarly, the final assembly stations also need to have the required number of resource at each station to meet the targeted demand. In such a scenario, much of control and scheduling boils down to appropriately arriving at a balanced flow of components on the shop floor. Let us consider a mass production system with multiple tasks. Each tasks ‘ i requires a finite time, denoted by ‘ ti’ and may have some procedures relationships with the other tasks. Further, the tasks require certain skills and resources such as machines and tools.

Line balancing is a method by which the tasks are optimally combined without violating precedence constraints and a certain number of workstations are designed to complex the tasks. If there are three work stations A, B and C, in which 7 tasks are performed in a manufacturing

system, then the workstation times are nothing but the summation of the task times assigned to each workstation. Let the workstation times be denoted as WA , WB and WC. Clearly, a balanced design is one in which the workstation times do not vary widely. In such a situation, the resources will be uniformly utilised and the flow of material will be even.

Further, there will be a good rhythm in operations. It is known that a maximum of three workstations times determines the interval between production of two successive component will come out of the system only every 7 seconds. This measure is known as the cycle time. Cycle time could be considered as the reciprocal of production rate. If in a period of 20, 000 seconds a shop produced 10, 000 pieces of a component, then the production rate is half per second. Conversely, the cycle time is 2 seconds. Cycle time could be actual or desired. If we compute on the basis of actual production, it represents the actual cycle time.

On the other hand, if we compute the cycle time on the basis of what we desire the production to be, then it is desired cycle time. Maintaining the desired cycle time requires better management and work practices. The expression for cycle time given below: Actual (desired) cycle time = Available TimeActual desiredproduction The problem of designing a balanced set of workstations suffers from the classical trade-off issues. If we combine more tasks into fewer workstations, we many require fewer workstations but the cycle time will be high, leading to reduced production rate.

At the other extreme, if the tasks are kept separate and as many work stations are designed, we may increase the production rate beyond what is

required at the risk of deploying more resources and workers with poor utilisation. Therefore, solving the ‘ line balancing’ problem calls for counterbalancing these opposing costs and striking the right trade-off between increased production and better utilisation of resources. The production rate, cycle time and the number of workstations are inter-related. Morever, the number of workstations has bearing on the average resource utilisation.

Using these measures it is possible to design an appropriate number of workstations. These relationships are indicated in the expressions below. Minimum no. Of work stations required = Sum Of all task timesCycle time Average resource utilisation= Sum Of All task timesNumber of workstations X Cycle Time FOR EXAMPLE A factory working in2 shifts each of 8 hours produces 24000 electric bulbs using a set of workstations. Using this information, compute the actual cycle time of the plant operation. There are 8 tasks required to manufacture the bulb. The sum of all tasks times is equal to 12 seconds.

How many workstations are required to maintain this level of production assuming that combining of tasks into those workstations is a feasible alternative? Available Time = 2x8x60x60 = 57600 seconds. Actual Production = 24000 electric bulbs Therefore, using equation 8. 2, we compute the cycle time for each bulb as 57600/24000 = 2. 4 seconds. This means that the factory is producing a bulb every 2. 4 seconds. No. Of Work stations required = 12/2. 4 = 5 Therefore, the tasks are to split among the five stations such that each workstations will have 2. 4 seconds as the sum of its task times.

DESIGN OF ASSEMBLY SHOP WITH 5 WORKSTATIONS We assign tasks to the five workstations on the basis of the following two criteria. a) The workstations times should not exceed the maximum permissible cycle time of 90 seconds. b) The precedence relationships among the tasks need to be honoured. For example Aircraft Boeing The average utilisation of the resources can be compared as below:- Average Utilisation = Sum of all task timesNo. Of work stations X Cycle Time = 380 /5×90 = 84. 4% DESIGN OF ASSEMBLY SHOP WITH 6 WORKSTATIONS We assign tasks to the six workstations using the same set of criteria as before.

Average Utilisation = Sum of all task timesNo. of work stations X Cycle time = 380/6×80 = 79. 2 ALTERNATIVE APPROACHES TO LAYOUT DESIGN Recently, layout design has been influenced by a few developments. First is the emerging competitive scenario. As the forces of competition increase, firms feel the need to be more customer focused,. Greater customer focus would mean an ability to respond customers' requirements faster, providing better quality products and services at an attractive cost and ensuring that the delivery commitments are met with 100 percent.

All these have a significant impact on layout design. As we have already seen, both process layouts and product layouts have certain limitations and are not efficient in delivering the above value proposition to the customers. Therefore, use of a GT Layouts is becoming increasingly popular. How Product Layout is better than Process Layout? Following are the reasons 1. Smooth Flow of production: Product Layout: This layout ensures steady flow of production with economy because Stoppage of work at different points of

production is eliminated and avoided due to proper arrangement of machines in sequence.

Process Layout: In this layout, flow of production is interrupted because the machines are not arranged in a definite sequence of operation. 2. Economy in manufacturing time: Product Layout: In this layout materials are fed at one end of the machine and the finished product is collected at the other end, there is no transportation of raw materials backward and forward and thus it shortens the manufacturing time. Process Layout: This layout takes longer time for production because the work necessary for loading the machines must be delivered to each department and after the processing the work is to be held for inspection. 3.

Mechanization of material handling: Product Layout Since the machines are arranged in sequence of operation, the continuous flow of materials in a line through quickly and economically. Process Layout In this layout there will be no definite channels through which all the work will flow. 4. Savings in material handling cost: Product Layout: In this layout product moves from one machine to other machine automatically hence no transportation cost is required till the completion of manufacturing process. Process Layout: Since there are not definite channels of work flow, it leads to. Materials are delivered to each department to process.

Materials may return to the same department more than one for processing and this makes back tracking of work which makes higher material handling cost. 5. Lesser Work-in-Progress: Product Layout: The work-in progress is minimum and negligible under this type of layout because the process of

production is direct and uninterrupted. Process Layout: Since there is no specific flow of work and the process of production is not direct, the work in progress is more than product layout. 6. Easy Inspection: Product Layout: Production process is integrated and continuous, defective practice can be easily detected and segregated.

This makes the job of inspection easy and economical Process Layout: Each department will have strict inspection responsibility before it goes to the next department for manufacturing process. So it’s not easy like product Layout. 7. Maximum utilization of available space: Product Layout: Under this type of layout machine are arranged in sequence of operations and it makes the maximum utilization of space available. Process Layout: Under this layout greater space is required for service activities; there is greater need for aisles, temporary storage at each department 8.

Effective Utilization of available resources: Product Layout: Effective utilization of men, machine and material because: * Minimum possible movement of worker from one place to other. * Lesser Wastage of materials. * Lesser work in progress. Process Layout: As in the case of product layout this is not possible because it doesn’t have definite channels of flow of work. 3. FIXED POSITION LAYOUT This layout is appropriate for products that are too fragile, bulky, or heavy to move, it generally remains stationary for the entire manufacturing cycle.

Equipments, workers, materials and other resources are brought to the production site. For example, ships are not produced on an assembly line. For services, other reasons may dictate the fixed position (e. g. , a hospital

operating room where doctors, nurses, and medical equipment are brought to the patient). Other fixed-position layout examples include construction (e. g. , buildings, dams, and electric or nuclear power plants), shipbuilding, aircraft, aerospace, farming, drilling for oil, home repair, and automated car washes.

Equipment utilization is low because it is often less costly to leave equipment idle at a location where it will be needed because it is used for limited periods of time. The workers are highly skilled at performing the special tasks. For instance, pipefitters may be needed at one stage of production, and electricians or plumbers at another. The wage rate for these workers is much higher than minimum wage. Thus, the fixed cost would be relatively low (equipment may not be owned by the company), whereas the variable costs would be high (due to high labour rates and the cost of leasing and moving equipment).

Advantages: * Easy for the products which are difficult to use. * Flexibility for change in design, operation sequence, labour availability, etc. , exists in this layout. * This layout is very cost effective when many orders of similar type exist in different stages of progress. * Large project type of jobs such as construction is suited in this layout. Disadvantages: * Space. For many fixed-position layouts, the work area may be crowded so that little storage space is available. This also can cause material handling problems. Administration. Oftentimes, the administrative burden is higher for fixed-position layouts as several operations are carried out simultaneously; there is possibility of confusion and conflicts among different work groups. 4. GROUP TECHNOLOGY LAYOUT Product layout is viable and feasible only in case of

the mass production systems. When the production volume is less, it may be difficult to justify the dedication of resources to every product on an individual basis. Therefore, organisations have been using process layouts in such situations.

However, since process layouts create more problems in production planning and control due to complex routing of various components on the shop floor, operations manager were looking for an alternative to the process layout. Whereas on the other hand, there has been an increasing trends towards more of variety, hence reducing the volumes. For example, The ABB ltd the industrial fans and blowers division, a multinational company operating in India, was manufacturing nearly 725 models of fans and blowers which reflect the variety in shapes/sizes of barely fans and blowers in the industry.

Reliance Industries Limited, India’s largest private sector company operating in petrochemicals, was planning to introduce several new grades of High Flow density Polyethylene (HDPE) and Low density Polyethylene (LDPE), with a view to entering five new markets of polyethylene in the year 1995-96. With this, the number of variations that they would handle at the polyethylene plant was likely to be over 40. Titan industries increased the number of its watch models from about 850 in 1993 to over 1200 in 1996 which is about over 100 models every year.

It is estimated that more than 70percent of manufacturing industries will have a mid-volume, mid-variety scenario. The Group Technology Layout provides an alternative method for configuring resources in organisations that have mid-volume, mid-variety product portfolios. GT is a philosophy that

seeks to exploit commonality in manufacturing and uses this as the basis for grouping components and resources. The implementation of GT is often known as cellular manufacturing. In cellular manufacturing, the available components are grouped into part families.

An appropriate measure for manufacturing similarly is too used to indentify part families. Corresponding to each part family, machine groups are identified and the layout is formed accordingly. The benefits of GT are many. Once the part families and the machine groups are identified, the layout ensures that each cell has only a certain number of components to be processed. In essence, it is akin to breaking a monolith structure into smaller, more manageable and independent units of production. Because of this, production planning and control become much simpler.

The components seldom travel outside the irrespective cells for processing. Therefore, material handling becomes easier and traceability improves. Moreover, employees are able to relate better to their workplace and make concerted improvements in the process. The new structure also helps to implement several other operations management practices such as small group improvement activities, Kaizen and Just-in-time manufacturing practices. Advantages of Group Technology Layout: * REDUCED MATERIAL HANDLING AND TRANSIT TIME- the movement of material is more direct and the travel time taken between operations is less.

In this type of layout, the material does not accumulate or wait for long to be moved. The worker of a particular cell carries the partially finished item from machine to machine than waiting for material-handling equipment. *

REDUCED SETUP TIME- as the processing of similar parts are done together, the adjustments required to set up a machine should not be that different from one item to the other. If the time taken to change over from one item to the other is less, then the changeover can occur more frequently.

And the items produced can be quickly transferred in small batches or lot sizes. * REDUCED WORK-IN-PROCESS INVENTORY- no bottleneck or significant build up of material occurs between workstations or machines because the flow of work is well balanced in the work cell with assembly lines. Due to the balanced flow, less space is required for storage of in-process inventory and the machines can be moved closer to save transit time and increase communication. * BETTER USE OF HUMAN RESOURCES- a typical cell has few workers who are responsible for completing a particular part or product.

The workers act as a self-managed team and are mostly satisfied with the work they do and are more quality conscious. The labour in a cellular manufacturing set up is a flexible resource. Workers are multifunctional and can be assigned to work within a cell or between cells depending upon the demand. * EASIER TO CONTROL- in a work cell, items of the same family is processed together in a similar manner. This significantly reduces paperwork necessary to document material travel, such as deciding where an item should be routed next, if the operations are being performed correctly, and the current status of the job.

The progress of a job can be verified visually rather than doing paperwork. * EASIER TO AUTOMATE- since automation is expensive, a company can rarely

afford to automate the entire factory at once. In cellular layouts, one cell can be automated at a time. Disadvantages of Group Technology Layout: * INADEQUATE PART FAMILIES- to form part families, there must be enough similarity in the types of items processed. Cellular manufacturing is more appropriate for medium levels of output and product variety. It is not always easy to form product families and to allocate machines to cells. POORLY BALANCED CELLS- it is more difficult to balance the flow of work in a cell than assembly-line balancing because items that require different machines or processing units may not fall under the same sequence. Thus the sequence in which parts are processed can affect the length of time a worker is required to spend at a particular stage of processing and delay his arrival to the next stage in his work path. Poor balance of cells can lead to inefficiency. Balancing is also important so that one cell is not overloaded while the others are idle. Severe imbalances can lead to high costs and disruption. EXPANDED TRAINING AND SCHEDULING OF WORKERS- it is expensive and time-consuming to train workers to do different tasks and also requires workers cooperation. Some tasks can be too difficult for certain workers to master. Although, there is flexibility in assigning workers their task in cellular layouts,