Plant Location

- One of the key features of a transformation system is the efficiency with which the output is transferred to the recipients. Any consideration of this will include the determination of where to place the plant.
- Plant location meaning - the establishment of an industry at a particular place.
- The selection of appropriate location can be done in two stages:

(i) Evaluation of various geographic areas and the selection of an optimum area.

(ii) Within each area there is a choice of proper site which can be urban, sub-urban or rural.

- The fundamental object of location analysis is to maximize the profits by minimizing the total cost of production associated with the production process.
- **Total costs = Fixed costs + Operational costs**
- Fixed costs include expenditure on land, building, machines and other equipments etc. Operational costs are the expenditure incurred on inputs, transformation process and the distribution of output etc.
- The contribution of various factors to the total cost will vary form place to place

Plant Location

- The location of the plant can have a crucial effect on the profitability of a Project, and the scope for future expansion. It is difficult to set down rules whereby the problem of facilities location can be programmed but there are a number of factors which should be considered when selecting a suitable site. The principal factors which influence the choice of location are.

1. **Proximity to market:** Organization may choose to locate facilities close to their market, not merely to minimize transportation costs, but to provide a better service.
2. **Integration with other parts of the organisation:** If the new plant or facility is one of a number owned or operated by a single organization or group, it should be so situated that its work can be integrated with that of the associated units.
3. **Availability of labour and skills**. Certain geographical areas have traditional skills but it is very rare that a location can be found which has appropriately skilled and unskilled labour in the desired proportions or quantities.

Plant Location

4. **Availability of amenities:** A location which provides good external amenities is often more attractive than one which is more remote.
5. **Availability of transport:** It is important that good transport facilities are readily available.
6. **Availability of inputs**. A location near main suppliers will help to reduce cost and permit staff to meet suppliers easily to discuss quality, technical or delivery problems.
7. **Availability of services**

- Gas
- Electricity
- Water
- Drainage
- Disposal of waste
- Communications

8. **Suitability of land and climate**. The geology of the area needs to be considered, together with the climate conditions.

Plant Location

9. **Regional regulations:** It is important to check at an early stage that the proposed location does not violate any local regulations.
10. **Room for expansions**:
11. **Safety requirements**: Some production units may present, or may be believed to present, potential dangers to the surrounding neighborhood. Location of such plants in remote areas may be desirable.
12. **Site cost**: As a first charge, the site cost is important, although it is necessary to prevent immediate benefit from jeopardizing long term plans.
13. **Political, cultural and economics situation**:
14. **Special grants, regional taxes and import/export barriers**: Certain government and local authorities often offer special grants, low-interest loans, low rental or taxes and other inducements in the hope of attracting certain industries to particular locations.

Location evaluation methods

Location evaluation based on ranking the various weighted factors.

1. Examine the various factors and assign to them weights representing their importance to the situation being changed. The least important factors may be given a weighting of 1 and all other factors then expressed as multiples of this, as whole numbers.
2. Each of the locations is examined and ‘ranked’ for each factor, this ranking being carried out factor by factor, not location by location.
3. Each ranking is then multiplied by the appropriate weighting factor and the scores totalled for each possible location. These totals indicate the desirability of the possible locations compared with each other.

Factor	*Weight*	*Possible location*				
		A	*B*	*C*	*D*	*E*
Proximity	6	3 / 18	3 / 18	2 / 12	5 / 30	1 / 6
Integration	0	— / 0	— / 0	— / 0	— / 0	— / 0
Labour	9	1 / 9	5 / 45	4 / 36	2 / 18	3 / 27
Amenities	6	1 / 6	2 / 12	4 / 24	5 / 30	3 / 18
Transport	4	5 / 20	4 / 16	3 / 12	2 / 8	1 / 4
Inputs	4	4 / 16	1 / 4	2 / 8	3 / 12	5 / 20
Services	5	1 / 5	2 / 10	2 / 10	5 / 25	4 / 20
Land and climate	2	4 / 8	2 / 4	5 / 10	3 / 6	1 / 2
Regional regulations	8	5 / 40	2 / 16	4 / 32	3 / 24	1 / 8
Expansion	2	3 / 6	4 / 8	2 / 4	5 / 10	1 / 2
Safety	0	— / 0	— / 0	— / 0	— / 0	— / 0
Cost	1	5 / 5	1 / 1	2 / 2	3 / 3	4 / 4
Politics/ culture	0	— / 0	— / 0	— / 0	— / 0	— / 0
Special grants etc.	2	2 / 4	1 / 2	5 / 10	4 / 8	3 / 6
TOTALS		137	136	160	174	117

Plant layout

Plant Layout is the physical arrangement of equipment and facilities within a Plant. Optimizing the Layout of a Plant can improve productivity, safety and quality of Products. Un-necessary efforts of materials handling can be avoided when the Plant Layout is optimized.

- Plant layout techniques apply to the case where several physical means have to be located in a certain area, either industrial processes or services.

- The basic objective is to ensure a smooth flow of work, material, people and information.

- There are probably two levels at which layouts are required. In one, the various departments have to be sited, and in other the items of equipment within a department need to be located.

Criteria for a good layout

1. **Maximum flexibility:** A good layout will be one which can be rapidly modified to meet changing circumstances.
2. **Maximum co-ordination**: Entry into, and disposal from, any department or functional area should be in such a manner that it is must convenient to the issuing or receiving departments. Layout requires to be considered as a whole and not partially.
3. **Maximum use of volume**: Facilities should be considered as cubic devices and maximum use made of the volume available. This principle is particularly useful in stores, where goods can be stacked at considerable heights without inconvenience, especially if modern lifting devices are used. In offices, racking can be installed to minimize use of floor space.
4. **Maximum visibility**: All the people and materials should be readily observable at all the time; there should be no ‘hidden places’ into which goods or information can get mislaid.

Criteria for a good layout

5. **Maximum accessibility**: All servicing and maintenance points should be readily accessible. For example, equipment should not be placed against a wall in such a manner that necessary maintenance cannot easily be carried out.
6. **Minimum distance**: All movements should be both necessary and direct. Handling work adds to cost but does not increase value; consequently any unnecessary or indirect movements should be avoided.
7. **Minimum handling**: The best handling of material and information is no handling, but where it is unavoidable it should be reduced to a minimum by the use of whatever devices are most appropriate.
8. **Minimum discomfort**: poor lighting, excessive sunlight, heat, noise, vibration and smells should be minimized and if possible counteracted.
9. **Inherent safety**
10. **Maximum security**
11. **Efficient process flow**

Inputs to the Layout Decision

1. Specification of objectives of the system in terms of output and flexibility.
2. Estimation of product or service demand on the system.
3. Processing requirements in terms of number of operations and amount of flow between departments and work centers.
4. Space requirements for the elements in the layout.
5. Space availability within the facility itself.

Advantages of a good layout

- The overall process time and cost will be minimized by reducing unnecessary handling and movement.
- Supervision and control will be simplified by the elimination of ‘hidden corners’
- Changes in the programmers will be most readily accommodated.
- Total output from a given facility will be as high as possible by making the maximum effective use of available space and resources.
- A feeling of unity among employees will be encouraged by avoiding unnecessary segregation.
- Quality of the products or service will be sustained by safer and more effective methods of operation.

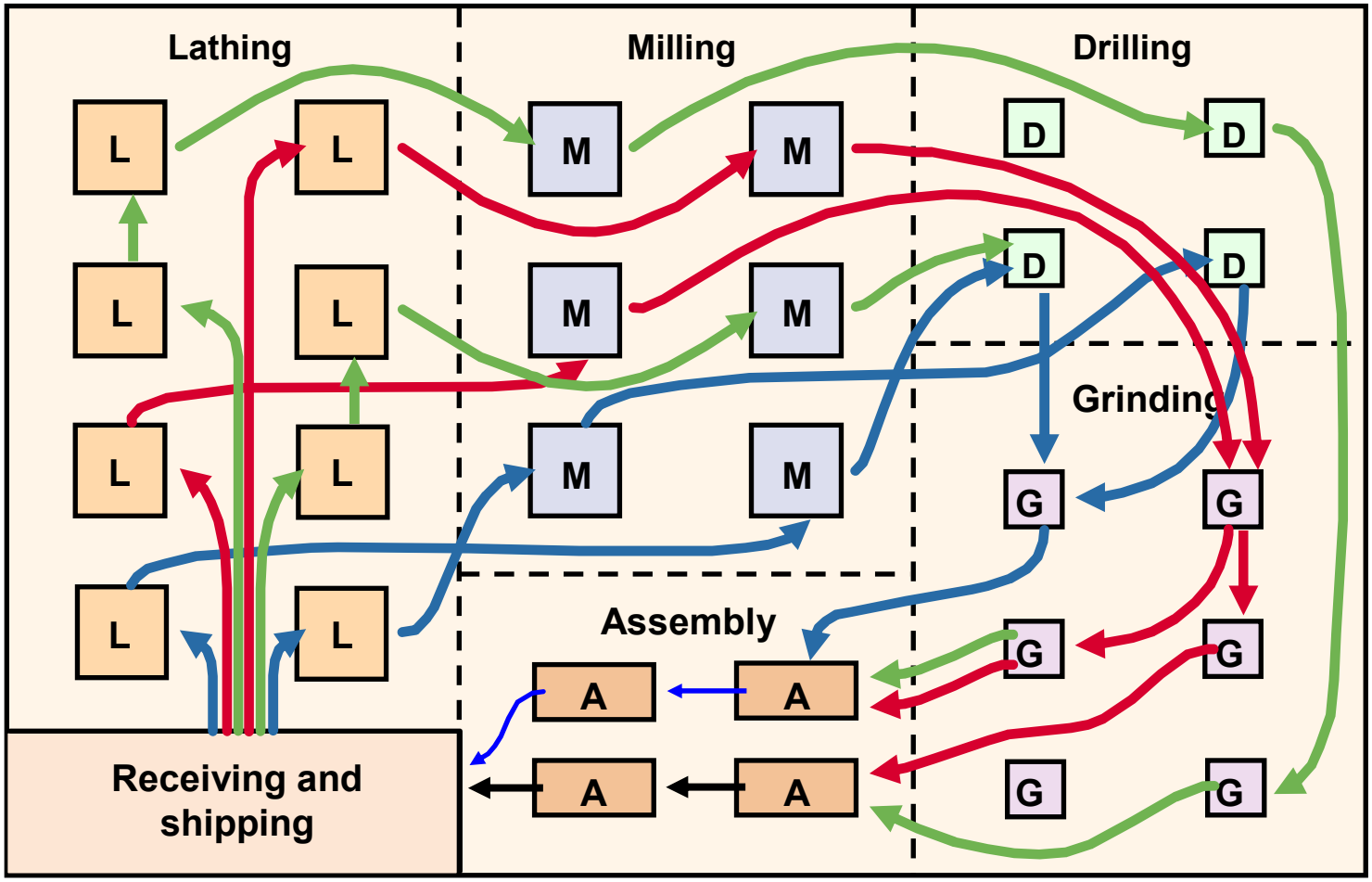
Types of Layout

- Process
- Product
- Cellular
- Fixed position
- Hybrid (mixed)

Process Layout

- Used when the operations system must handle a wide variety of products in relatively small volumes (i.e., flexibility is necessary)
- Designed to facilitate processing items or providing services that present a variety of processing requirements.
- The layouts include departments or other functional groupings in which similar kinds of activities are performed.
- A manufacturing example of a process layout is the machine shop, which has separate departments for milling, grinding, drilling, and so on.

Process-type layout



Characteristics of Process Layouts

- General-purpose equipment is used
- Changeover is rapid
- Material handling equipment is flexible
- Operators are highly skilled
- Technical supervision is required
- Planning, scheduling and controlling functions are challenging
- Production time is relatively long
- In-process inventory is relatively high

Process Layout

Advantages:

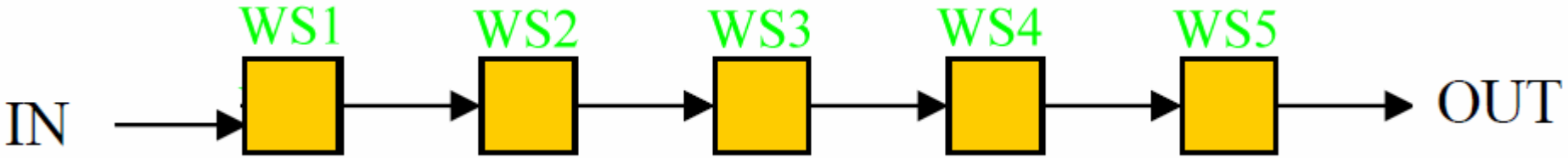
1. In process layout machines are better utilized and fewer machines are required.
2. Flexibility of equipment and personnel is possible in process layout.
3. Lower investment on account of comparatively less number of machines and lower cost of general purpose machines.
4. The diversity of tasks and variety of job makes the job challenging and interesting.
5. Supervisors will become highly knowledgeable about the functions under their department.

Limitations

1. Backtracking and long movements may occur in the handling of materials thus, reducing material handling efficiency.
2. Material handling cannot be mechanised which adds to cost.
3. Process time is prolonged which reduce the inventory turnover and increases the in-process inventory.
4. Lowered productivity due to number of set-ups.
5. Throughput (time gap between in and out in the process) time is longer.

Product (Assembly Line) Layout

- Product layouts are used to achieve a smooth and rapid flow of large volumes of products or customers through a system.
- A job is divided into a series of standardized tasks, permitting specialization of both labor and equipment.
- The large volumes handled by these systems usually make it economical to invest huge amount of money in equipment and job design.
- Operations are arranged in the sequence required to make the product. For instance, if a portion of a manufacturing operation required the sequence of cutting, polishing, and painting, the appropriate pieces of equipment would be arranged in that sequence.
- Product layouts achieve a high degree of labor and equipment utilization.



Characteristics of Product Layouts

- Special-purpose equipment are used
- Changeover is expensive and lengthy
- Material flow is continuous
- Material handling equipment is fixed
- Little direct supervision is required
- Planning, scheduling and controlling functions are relatively straight-forward
- Production time for a unit is relatively short
- In-process inventory is relatively low

Product Layouts

Advantages

1. The flow of product will be smooth and logical in flow lines.
2. Throughput time is less.
3. Simplified production planning and control systems are possible.
4. Less space is occupied by work transit and for temporary storage.
5. Reduced material handling cost due to mechanized handling systems and straight flow.
6. Perfect line balancing which eliminates bottlenecks and idle capacity.
7. Manufacturing cycle is short due to uninterrupted flow of materials.
8. Small amount of work-in-process inventory.
9. Unskilled workers can learn and manage the production.

Product Layouts

Limitations

1. A breakdown of one machine in a product line may cause stoppages of machines in the downstream of the line.
2. *Lack of flexibility*: A change in product design may require major alterations in the layout.
3. The line output is decided by the bottleneck machine.
4. Comparatively high investment in equipments is required.

Cellular Manufacturing (CM) Layout

- **Cellular manufacturing** is a type of layout in which machines are grouped into what is referred to as a cell.

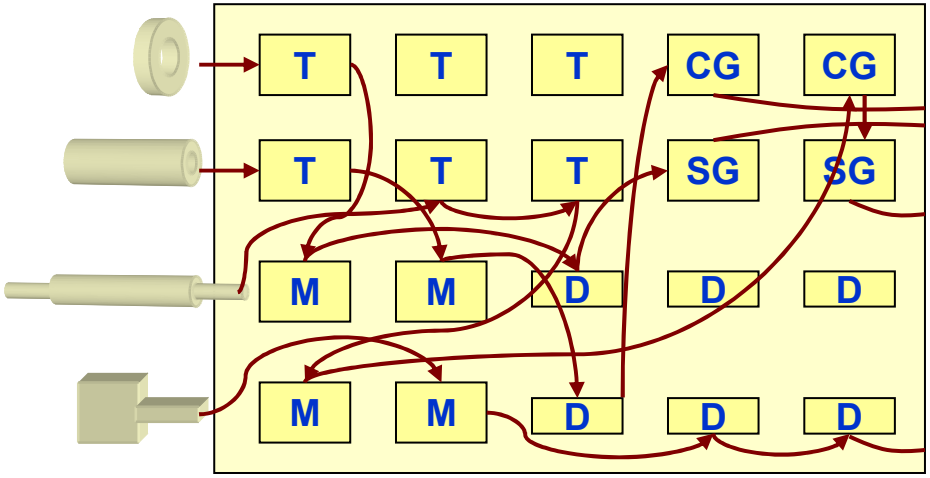
- Groupings are determined by the operations needed to perform work for a set of similar items, or **part families** that require similar processing.

- Cellular layout provides *faster processing time*, *less material handling*, *less work*-in-*process inventory, and reduced setup time.*

- Used when the operations system must handle a moderate variety of products in moderate volumes

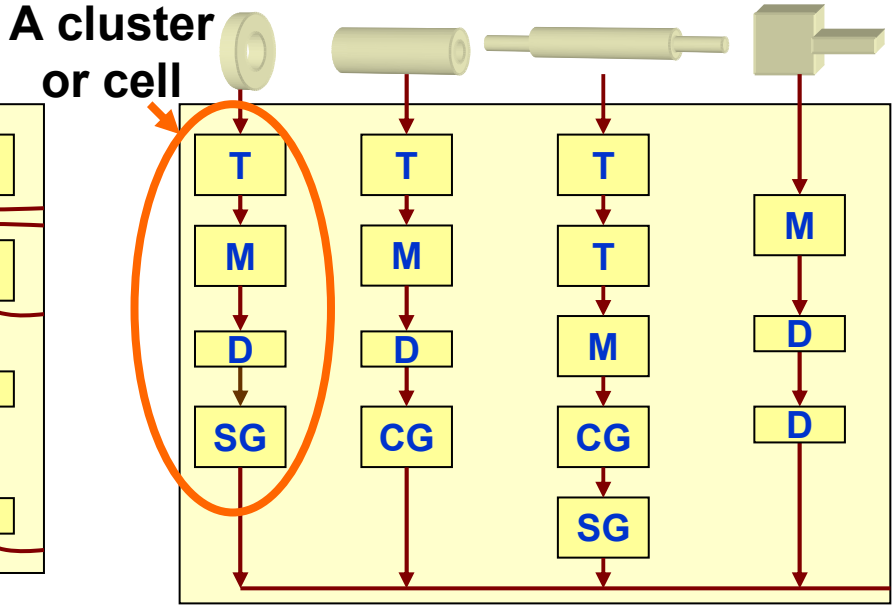
Cellular Layout

Process (Functional) Layout



Similar resources placed together

Group (Cellular) Layout



Resources to produce similar products placed together

Fixed-Position Layouts

- In fixed-position layouts, the materials or major components remain in a fixed position, and workers, materials, and equipment are moved as needed.
- Fixed-position layout is used when product is very bulky, heavy or fragile
- Fixed-position layouts are used in large construction projects (buildings, power plants, and dams), shipbuilding, and production of large aircraft and space mission rockets.
- Fixed-position layouts are widely used for farming, firefighting, road building, home building, remodeling and repair.

Hybrid (mixed) Layouts

- Actually, most manufacturing facilities use a combination of layout types.

- An example of a hybrid layout is where departments are arranged according to the types of processes but the products flow through on a product layout.

- For instance, supermarket layouts are fundamentally of a process nature, and however we find most use fixed-path material-handling devices such as roller-type conveyors both in the stockroom and at checkouts, and belt-type conveyors at the cash registers.

- Hospitals also use the basic process arrangement, although frequently patient care involves more of a fixed-position approach, in which nurses, doctors, medicines, and special equipment are brought to the patient.

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