Examples of plant layout and design

Hi, I'm Jack Greene. I sketched these layouts; most are real buildings which I have been in. Some I built, some I laid out or modified. Although none is perfect, the examples are full of sound principles, and represent actual, productive, operations. (Sound principles allow a smooth product flow; provide adequate space for equipment, people, processes, material, services and support, and inventory; utilize building space well; consider future technology and volume changes; accomplish the inevitable relocations with minimum interruption.)

They encompass a wide variety of facility characteristics, and of process characteristics. However, no example here is likely to fit your specific needs. None of these examples has buildings like yours or the same dimensions; the equipment and products and volumes won’t match. (There won't be an answer elsewhere on the internet either, for your specific parameters.)

To discuss how to achieve a productive layout for Your specific challenges, circumstances, timing, and budget, call at no cost at 843-422-1298 or e-mail. Let’s talk; outline your situation and objectives. I'll suggest ideas and options. Now, for the only commercial you will get: JPR can help when you need hands-on assistance with layout and facility planning; guidance or formal training, another pair of experienced hands and eyes or simply to talk out an issue.

By the way, layout can often be performed remotely, with internet, Zoom, cameras, phone. JPR has today a sophisticated international project underway remotely.

This is the most popular page on jacksonproductivity.com. Thanks for your interest, and I hope you'll see an example or spark an idea that leads to a workable layout for you.

Meantime, JPR has plenty of guidance on line. See http://jacksonproductivity.com/layout.htm, for our
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Jackson Productivity Research Inc.
Productivity is Our Middle Name

http://jacksonproductivity.com 843-422-1298 jack@jacksonproductivity.com
A 1 Straight Line Flow
Flow is essentially straight line, although it adapts to building design.
A 2  U Shaped Flow
In and out of the same dock

- Receiving
- Shipping dock
- Shipping
donk
- Raw Materials Stores
- Finished Goods Stores
- Support
- Operating offices
- Admin offices
- Building amenities
- Maintenance
In a building designed for distribution, to adapt to another use
Many of these facilities are empty and available. They are characterized by multiple docks and doors. Take advantage of the docks to improve process flow for your operation.
To place permanent equipment and avoid later interference
Position fixed, hard to relocate, functions and equipment along a wall that will not be used for later expansion. Place equipment outside as well as inside exterior walls.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hoppers</td>
<td>Liquid waste disposal</td>
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<tr>
<td>Bins</td>
<td>Rest rooms</td>
</tr>
<tr>
<td>Tanks</td>
<td>Fire sprinkler risers</td>
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<tr>
<td>Solid waste</td>
<td>In power</td>
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<tr>
<td>Water tower</td>
<td>In gas</td>
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<tr>
<td>Dust collection</td>
<td>Water softening</td>
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<tr>
<td></td>
<td>Water purification</td>
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<tr>
<td></td>
<td>Blow-out walls</td>
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<tr>
<td></td>
<td>Plating, degreasing</td>
</tr>
<tr>
<td></td>
<td>Motor control centers</td>
</tr>
<tr>
<td></td>
<td>Process using mezzanine</td>
</tr>
</tbody>
</table>
5 Distribution center
A DC will have many docks, and many storage racks. Straight line or U-shaped flow will depend on dock location. Reduce travel by careful location of materials in racks; warehousing programs will help.
Cellular flow

An approach in which manufacturing work centers (cells) have the total capabilities needed to produce an item or group of similar items. Smooth flow both between and within cells.
### Modular work flow

Modular work centers consist of similar equipment or capabilities, and products move among multiple work centers before they are completed. With or without conveyor lines.

<table>
<thead>
<tr>
<th>Saw module for all products</th>
<th>Products A, B, C are routed to the module if work is to be performed there; on a dedicated or a multi-product CNC module machine. Different product, different flow.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lathes module for all products</td>
<td></td>
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<tr>
<td>Mill module for all products</td>
<td></td>
</tr>
<tr>
<td>EDM module for all products</td>
<td></td>
</tr>
<tr>
<td>Coating module for all products</td>
<td></td>
</tr>
</tbody>
</table>
A 8 Clean room for sterile or aseptic liquids
Characterized by material pass thru, employee change rooms, sterilization.
With or without conveyor lines.

Container: In line sterilize Fill line one, HEPA filters Out conveyor To
Wash: Spatial or physical separation Inspection
Area, bulk: In line sterilize Fill line two, HEPA filters Out conveyor and/or
or: Spatial or physical separation Sterilizing
In Line: In line sterilize Fill line three, HEPA filters Out conveyor and/or
Spatial or physical separation Packaging
In line sterilize Fill line four Out conveyor

People, Material, Equipment: Pass thru

Lower Room Class: Employee Gowning
Area: Equipment Sterilization
Area: Bulk Material
Sterilize

Most rigorous room class

Rigorous room class
Clean room for devices, semiconductors
Characterized by material pass thurs, employee change rooms, superior HVAC
Usually involves conveyors

- Parts
- Wash
- Area, bulk or and
- In Line

- Assembly line one — Out conveyor — To Inspection
  - Spatial or physical separation

- Assembly line two — Out conveyor — and/or Sterilizing
  - Spatial or physical separation

- Assembly line three — Out conveyor — and/or Packaging
  - Spatial or physical separation

- Assembly line four — Out conveyor
  - Spatial or physical separation

Most rigorous room class

- Most rigorous room class

Lower Room Class

- Lower Room Class
- Employee Gowning Area
- Equipment Clean up Area
- Bulk Material Entry
- People Equipment Material

Rigorous room class
Primary Conveyor, fed from other conveyors, from above

Detail is driven by the product components and sequence of steps and assembly.
A 11  **One product, with several components, not conveyorized**  
This example shows kitting, sub assemblies, final assembly, test, pack, ship in a U shape.
A 12 Cell and modular elements in the same layout
Not an uncommon arrangement, especially when equipment has accumulated over time.
With or without conveyor lines.
A 13  Electronics fab and test
Integrated manufacture; subassembly, fab, assembly, and test in clean rooms. Because parts are small, materials handling moves many parts at one time.
A 14 Integrated plastics product
Molding, sub-assembly, tumbling barrels for smoothing, assembly, through distribution

Ramps, this DC was built without land fill for cost purposes.

DC administration

To DC

Assembly

Raw material stores

Plant admin and operation offices

Building amenities

Plastics Injection Molding
From dedicated cells into modular packaging lines
A typical layout; in this example specialized product filling flows into general purpose inspection and packing.
Model and prototype shops, pilot plant

These operations will have both specialized and general purpose machines. They will be called on to produce any product, with as little subcontracted as possible. If associated with production operations, these shops should be able to match or simulate all production equipment.

Specialty shops will depend on the charter of the organization, and may contain one or more of the following:

- Metal working, classic
- Metal working, Cad Cam
- Electrical
- Electronic
- Sheet metal, cut and form
- Sandblast
- Chemistry
- Assembly
- Wood working
- Plastics working, layup
- Composites working, layup
- Welding
- Plating
- Paint
- Multi-layer printing
- Signs, printing
- Plumbing
- Hydraulics
- Instrumentation
- Fill
- Package
- Label
- Exact measurement
- Optics

Design and engineering offices, Cad Cam equipment

Model and prototype shops are not the place for Just in Time material delivery, no matter what the black belts say. The predictability of work, the horizon, is not long enough to allow lead times. Don’t discard but keep on hand a wide variety of materials. The shop will be called on to produce and modify on short notice and the next model or prototype may well be able to use materials or subassembly from the retained inventory. Reliable local sources if any can allow a smaller inventory.

Layout of machines should concentrate on fitting them into the space with regard to safety and material handling, because the flow of materials will likely be unpredictable and irregular. If possible leave ample access space for material, and for new equipment and technology.
Multi-story building, utilize vertical flow
Where possible, utilize vertical flow to move product.
A practical handling system is necessary to place material on the upper floor to start.

**Upper Level**

1) Product
   - Weigh and Mix, drop to lower

2) Sub-assembly or
   - Parts preparation, feed to lower
     - via chute, dumbwaiter, slide.

3) Raw materials, where they can be placed to the upper floor readily.
   - Feed to lower via chute, dumbwaiter or slide.

**Lower Level**

- Product Package
- Product Fill
  - Fed from Above

- Product assembly
  - Fed from above
  - Test, pack

- Product assembly, fill, package
  - Fed from above
Multi-story building, two elevators

Except for the fact that material must use an elevator, flow can be productive. Many options are possible.

1) An elevator can be used to receive, or to ship, or to do both.

2) The floor can serve one department or product line, or multiple entities.

3) The floor can receive from, or feed, another location.

1) Flow can U-shaped, in and out the same elevator.

2) Flow can be straight line, essentially from one elevator to the other.

3) Or both, for different products.
3 Multi-story building, one elevator
The area near the elevator will be busy, and should be kept open.
Careful layout will be useful to maintain productivity.

1) The elevator will be used to receive and ship.

2) Flow can only be U-shaped, in and out of the same elevator, unless vertical feed is possible through chute, slide, or dumbwaiter.

3) The floor can serve one department or product line, or multiple entities. Use will depend on size and ingenuity of layout applied.

Flow can only be U-shaped, in and out of the same elevator, unless vertical feed is possible through chute, slide, or dumbwaiter.

Cross flow is possible.
Multi-story building, services on another floor
The operations floor can be effectively laid out because services and amenities are on another floor.
In this example, services are located on only a partial floor, under manufacturing.
Outside storage, liquid and dry bulk materials
Outside storage is often practical. Outside containers do not take up plant space, and they can be filled by truck easily. Be sure that permanent containers do not block future plant expansion.
C 2 Outside storage, large components and product handling
Large weather-proof components sometimes can be kept outside.
Be sure that permanent containers do not block future plant expansion

Horizontal racks for long components

One corner of the production building.

Horizontal storage of tall sections

Temporary trailer
C 3 Constrained by adjoining property
Placement of permanent equipment is key when building expansion is blocked in some directions. Locate permanent equipment along the sides that are already blocked.

Street

Place permanent equipment along these walls. Docks, utilities, plating, elevator and stairs, liquid waste disposal, rest rooms, fire sprinkler risers, water treatment, motor control centers, mezzanines

Street

Property available

Leave these walls available for expansion.

Property available for expansion
Unconstrained by adjoining property

Placement of permanent equipment is key when building expansion is blocked in some directions. Locate permanent equipment along the sides that are already blocked.

Initial building
Place permanent equipment along no more than two walls, or centrally.

Available for
Expansion

Probably locate docks first considering street access, grade levels, appearance, and distances. Then plan interior layouts accordingly.

Available for expansion
### Details of dock characteristics

Plan general location of access roads and docks considering street access, grade levels, appearance, and distances. Then consider

<table>
<thead>
<tr>
<th>Paved area characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access from roads; route, distance and elevation change</td>
</tr>
<tr>
<td>Turning radius of semis; in, out, to park</td>
</tr>
<tr>
<td>Back into docks, think like a trucker; they want to back clockwise</td>
</tr>
<tr>
<td>Don't block future property use and plant expansion.</td>
</tr>
<tr>
<td>Non-dock parking for semis</td>
</tr>
<tr>
<td>Employee parking</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dock characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Security plan</td>
</tr>
<tr>
<td>Internal flow to plant and stores</td>
</tr>
<tr>
<td>Number of docks</td>
</tr>
<tr>
<td>Dock height, door size</td>
</tr>
<tr>
<td>Space between docks</td>
</tr>
<tr>
<td>Man doors, stairs</td>
</tr>
<tr>
<td>Enclosed? Weather protected?</td>
</tr>
<tr>
<td>Truckers check in desk</td>
</tr>
<tr>
<td>Formal trucker lobby, restroom</td>
</tr>
<tr>
<td>Ramps for access of lift trucks</td>
</tr>
<tr>
<td>Battery charge and/or propane tank stores</td>
</tr>
</tbody>
</table>

| Plant |