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Improving Facility Layout Design

A good plant layout can do wonders for a manufacturer's throughput, labor efficiency, safety, production capacity and floor space utilization.



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Most companies that I encounter underestimate the value of a good facility layout design, or fail to consider the costs associated with a poor one.

Given that this topic is a very large one and has been the subject of many books, the most I can hope for in a short article is to hit the high spots and hopefully spark an interest in exploring your facility's layout and the overall operational effectiveness of it. Also, for the purposes of this article, we will be talking mostly about manufacturing facilities, but the principles will apply to non-manufacturing facilities as well.

What are we talking about when we refer to a facility or plant layout? A plant layout is the actual location of the physical assets, machinery, aisles, work areas, raw materials, WIP, finished goods, walls, building columns, offices, rest rooms and the employees within the walls of the building.

Most companies have some type of a plant layout

drawing showing where these items are as viewed from an aerial or top view. This can be used for displaying escape routes (means of egress) or to be able to have a representation of their actual plant floor and its equipment, on paper, for use in planning or improvement analyses.

The plant layout and how your product flows through it is extremely important with regards to throughput, labor efficiency, safety, production capacity, floor space utilization, expansion options and the general reduction of wasted resources.

You want your product and your processes to flow as smoothly as possible from one side of the building to the other, from receiving to shipping, from where it comes in to where it goes out and so forth. This typically means operations should be aligned, as in manufacturing cells; WIP should be minimized, as in the just-in-time methodologies; and it should generally all be aimed toward the shipping dock or warehouse.

Plant layout is critical with regards to throughput, labor efficiency, production capacity, floor space utilization and safety.



Some examples of what I typically see include: shipping is located a long way from the end of the packing line; the stamping department is located 100 yards from the welding department; the next operation is located on the other side of the plant or in the next building; the assembly line is stocked with parts that come from the warehouse down the block, or some other inefficient arrangement. The goal of this discussion is to motivate you to take the initiative to identify and correct poor process steps as they relate to their flow through the building.

There are several different types or categories of layout projects such as: greenfield, relocations/expansions/consolidations, and changes to the current facility.

• **Greenfield layout projects:** These may be the least frequently encountered because it usually is the most expensive and has the longest lead time. It includes site selection and purchase and then the costs associated with the construction of a new building. Generally speaking, there are plenty of available buildings in industrial parks all over the country just sitting waiting to be occupied. Most companies go this route to save money and time.

The Greenfield approach is basically designing your production operation in the most efficient way, optimizing all of the production steps, storage locations, material handling, and support systems for maximum benefit and efficiency. This is done without any hindrances, constraints, or prior issues using a blank sheet of paper. Once that is done, you then construct the building around it. I often use a modified version of this approach when doing layout projects for clients, and it can be done on virtually any size layout project.

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• **Relocations / expansions / consolidations.** I frequently encounter layout projects in this category, such as:

a) Relocations / expansions: Relocations and expansions occur when a company has to move its operations from its current location to another building in another location. This can happen for a variety of reasons, such as expired lease contracts, financial reorganizations, or the fact that they have outgrown their current facility and need more space to expand operations or take on new business. Typically, they locate an existing building somewhere and then fit their operations into it. In this case, the building size and shape is already fixed, so the challenge is to take the existing operations and fit it into the new space in the most optimized way, allocating space for expansion and eliminating the poor, less-efficient aspects of the current layout.

b) Consolidations: Consolidations usually revolve around downsizing. This is where a company's operations must be reduced to fit their current level of sales. This could be as simple as the elimination of outside warehouses and bringing the product into the main building, or it could be a major consolidation project like consolidating five production facilities into one or two. Either way, it takes creative layout work and team collaboration to do this in a positive and productive way.

c) Changes to your current facility: By far the most common layout projects that I see occur within the existing facilities and specific departments of my manufacturing clients. These types of projects can be very simple, such as moving some things around to make space for a new machine, to much more complex, such as rearranging the entire facility to create space for a new production line or more storage. Most productivity improvement projects involve some type of layout work,

whether it be creating an as-is area layout to support operations analysis and material flow, or moving equipment around in order to accomplish Lean initiatives or other cost-reduction/throughput goals.

The Basic Steps

There are some basic steps that are required for any layout project from the simple to the very complex. Let me say that it is very helpful to use drawing programs such as AutoCAD, as it makes the process accurate, versatile and easily printable to any size. However, it can still be done with pencil and paper as it has been done for hundreds of years.

The first thing that is needed is an accurate, as-is, to-scale drawing of the area, department or facility being considered for the change. This is an important step for several reasons:

- It provides documentation for the way it was/is, because people forget how things really were and how much space or clearances were in certain areas.
- It provides an accurate square footage calculation that can be compared to the new design.
- It provides a visual representation so that important aspects of the current design are not forgotten during the development of the new design.
- It becomes the source for the equipment templates to be used in the new design. The equipment templates are the to-scale drawings of the machines, tables, racks, scrap containers, etc., which are needed when developing the new layout. If using a drafting program such as AutoCAD, you simply cut and paste them into the new area layout and then move them around.
- It depicts clearances and aisles that are currently in use so that those features can be considered in the new design.

The basic process is for someone to physically measure and draw the walls, col-

umns and equipment as they currently are and in their current locations. The better the accuracy, the better the end result. However, it must be said that the degree of accuracy and detail at this step is driven and dictated by the project goals and the level of accuracy needed to achieve them.

The second thing you need, if applicable, is an accurate, to-scale drawing of the area you are moving into. If the project involves rearranging the equipment that is located in the same area, then you will not need this step. However, it is very important that the current as-is drawing of the

“Layout design and floor space utilization are extremely important parts of the manufacturing process. Companies usually don't start out with a poor layout design – they simply evolve over time into what they are today, good or bad.”

new area is very accurate with regards to the location of the walls, columns, and the like that you will have to be working around. Also be sure to consider the ceiling, bar joists, or crane runway heights, as this can affect any racking, lighting or material handling devices you may want to use or install there.

The third step is the development of the layout options. As a consultant, I understand the value of the knowledge and experience of the employees who work there, whether they are engineers, supervisors or the operators themselves. With that in mind, I normally create several layout options, which I present to the company's team for their review. Usually there are options that I prefer, options that the company may prefer or may have mentioned already, and options that are probably not

a good idea but need to be shown so they can be quickly ruled out to save time.

Team review of the options typically results in the selection of one of the presented options, but many times valuable input is received, resulting in additional options or revisions to one of those presented. Ultimately, the best layout option is selected and agreed to by all.

The last step is taking the approved layout version and cleaning it up, adding additional labeling or notes and then any needed dimensions that may be required for implementation and clarification. Most of the time, implementation drawings are created and printed for maintenance. These drawings typically have some of the non-essential elements erased and include enough dimensions and instructions for the rearrangement to be accomplished.

Every layout design should be analyzed – prior to implementation – with an eye toward actual use, best practices, and a sanity check regarding Lean methodologies and waste elimination. Here are a few points to consider:

- Does this layout utilize point-of-use storage?
- Does it minimize material handling and reduce walking and reaching?
- Does it promote labor efficiency, smooth product movement and material flow?
- Does it provide for future expansion?
- Does it maximize the use of the floor space and the building cube?
- Are the aisles wide enough for the handling equipment and traffic, and are they clearly marked?
- Does it achieve the company's goals?

Layout design and floor space utilization are extremely important parts of the manufacturing process. Companies usually don't start out with a poor layout design – they simply evolve over time into what they are today, good or bad. If you are struggling with excess costs, excess handling, product storage issues or handling damage, poor labor efficiencies, overtime and need more space, it may be a good time to take another look at your layout and how things move through it.

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