Module: Facility Layout

Introduction

The purpose of this module is to introduce you to the principles and tools used to design, analyze and improve layouts in manufacturing and service facilities. Facility layout is a design process of determining placement of departments, workgroups within departments, workstations, machines, and stock-holding points within a facility in order to satisfy key requirements in terms of service, quality, delivery and cost.

Check Read this link from Apple to see a quick service example to get a quick glimpse of the principles and tools we are going to focus in this module: "Apple Testing Redesigned Genius Bar to Increase Capacity":

(link: http://www.macrumors.com/2012/07/02/apple-testing-redesigned-genius-bar-to-increase-capacity/)

There is a course and project based on Facility Planning and Design. This is the textbook for that course. Go and check it in Amazon.

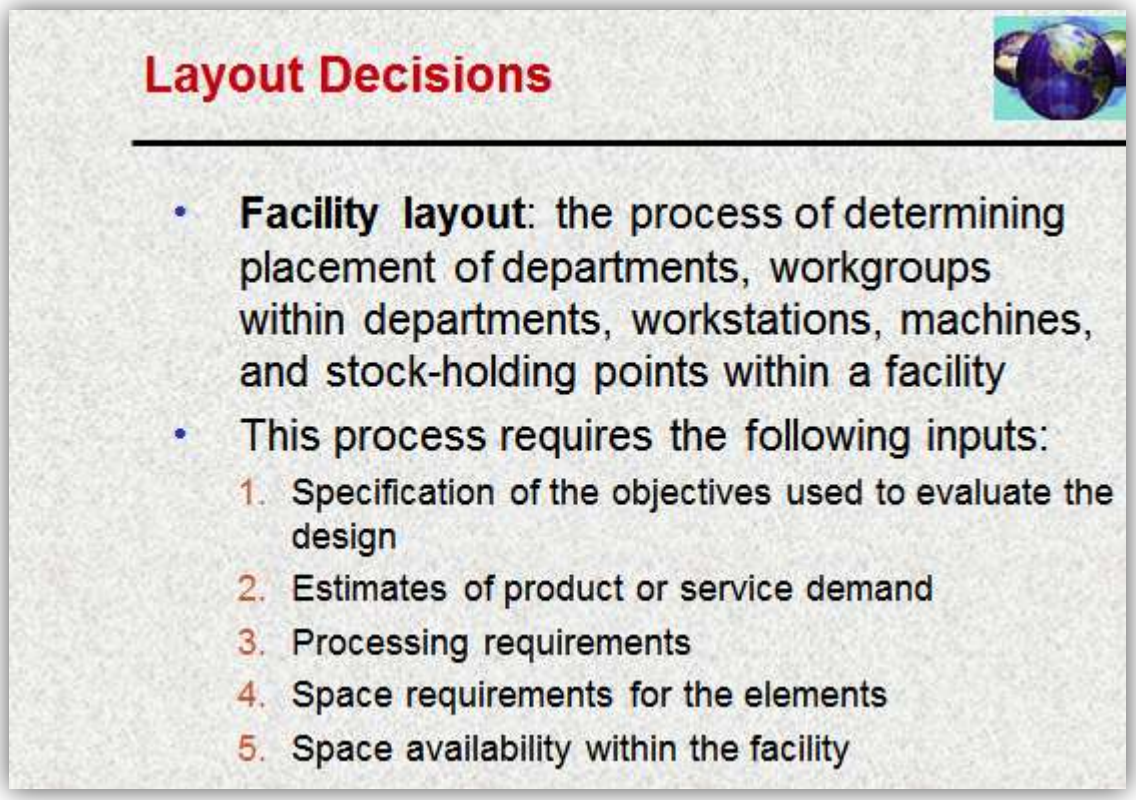
☑ Learning Goals /Outcomes (What you need to know)

Upon completion of this module, you will be able to:

1. **Formulate a facility layout problem statement considering service, quality, delivery and cost variables.**
2. **Recognize the different types of facilities layouts given different facility settlings**
    a. **Understand how production processes are typically organized and the trade-off between efficiency and flexibility offered by each design.**

Lessons (Course content –Break apart)

Subtheme 1: Introduction to Facility Layout



Let us think five minutes about the "Apple Testing Redesigned Genius Bar to Increase Capacity" case above: 1) What would be an objective of the Genius Bar section in an apple store? Where does demand comes from? How do you think about the space requirements? What do you think about space availability? Is there any other interesting facts or reflections on this case from Apple? (i.e, what happens to kid's area)

Additional reflection: Explain the facility layout problem at your home

Subtheme 2: Basic Layout Formats (Production and Service)

- Workcenter (job-shop or functional layout)
  - Similar equipment are grouped together

For example, a laboratory to test samples received in a hospital facility is normally organized following a functional layout. You will see similar equipment-tools-materials grouped together in the same space (rooms): testing of blood samples in one room or area, testing of special samples in a separate room or area.

- **Can you think of possible advantages and limitations of this type of layout?**

Swissturn-USA. Swissturn/USA is a Swiss screw machine job shop.

- Assembly Line (flow-shop layout)
  - Work processes are arranged according to the steps by which the product is made

Automobiles are mostly manufactured using assembly lines. Textile industries use assembly line, too. Do you think a Boing 757 is manufactured using an assembly line? (Nope!-We will review this type of layout below). Assembly lines require high demand for standardized products in order to be practical and efficient (Why?).

Manufacturing assembly line in China to make electronic products.

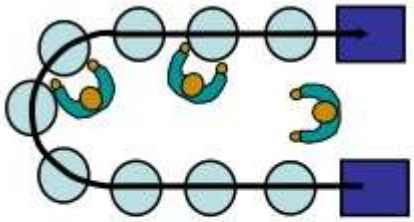
- Manufacturing cell
  - Groups dissimilar machines to work on similar products

Manufacturing cells are well-known models to assemble items that require increase flexibility because the production items might require higher levels of customization (i.e, computers with different configurations). Manufacturing cells are known to provide more challenging environments to operators and usually are designed so much less external supervision is imposed to the group of operators working in this type of layouts. Manufacturing cells are also known as Cell Layout or Group-Technology Layout. In the late 90's, Dell made significant efficiency and cost impact to the desktop and laptop production using manufacturing cell layouts. Dell made possible to order a laptop online and be able to select the configuration from multiple options to fit your need. The computer could be at your door within 1 to 2 weeks. Wao!! That was a real innovation to the business model back then.

Compare figures 1 and 2 below:

Current layout - straight lines make it hard to balance tasks because work may not be divided evenly

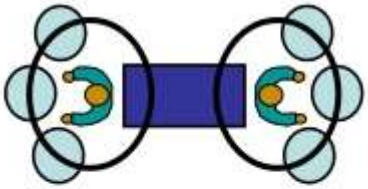
Figure 1. Current Layout: assembly line



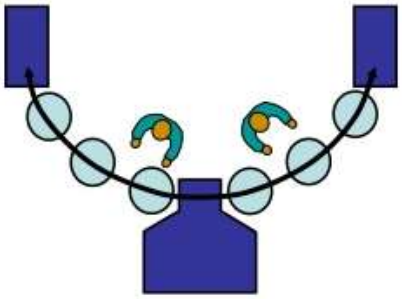
Improved layout - in U shape, workers have better access. Four cross-trained workers were reduced.

Figure 2. Improved Layout: manufacturing cell or Group Technology

Compare figures 3 and 4 below:



Current layout - workers in small closed areas. Cannot increase output without a third worker and third set of equipment.



Improved layout - cross-trained workers can assist each other. May be able to add a third worker as additional output is needed.

Figure 3 and 4. Current and Improved Layout using Cell Layout

- Project layout
  - Product remains at one location

Project layouts are also known as fixed-location layout (can you think why is that?). Project or Fixed location layout will be used where the item being manufactured can become bulky and difficult or costly to move from one station to the other. Can you think of big items being manufactured today? Yes! Airplanes, boats, buses, train vagons could be production items that will require crews, equipment and tools to move to the item instead of the item moving through several workstations or a production line.

Boeing Manufacturing Plant

Let's provide additional thinking on the Project Layout and the airline manufacturing industry. The following video shared in Youtube from Boeing can help you grasp how the above four type of layouts are evolving and probably you might never find a facility where you can only have one single type of layout. In the Boeing 737 video provided at Boeing Lean Manufacturing (http://www.youtube.com/watch?v=nhtdXOjoctI), you will

find an interesting perspective that the layout being used by Boeing is more focused on the lean thinking to provide continuous flow at the lowest cost while maintaining little inventory.

The Lean manufacturing principles and tools are applied to improve the productivity of the whole system by key lean practices:

1. **Parts, equipment and kits are staged at the point of use.**
2. **Airplanes are actually flowing in a huge manufacturing line and the pace of the line is regulated by customer demand. The line moves at a speed of 2 inches per minute.**
3. **Specialized equipment is staged or located near the point of use. Go check the material handling equipment and operators assembling and attaching the turbine to the airplane.**
4. **Pitch marks indicate progress relative to schedule.**
5. **Car kits contain the parts, standards, tools, chemicals, and standard work instructions required for a specific job. Employees looking for material and kits can make sure to travel less while reducing the effort. Kits are then delivered to the point of use just in time (Japanese and world class philosophy to delight customers by providing the real value when is needed in the right quantity-for work in progress).**
6. **Team members inform team leaders of problems more easily.**
7. **There is an "andon system" to indicate of problems and make sure there is a follow-up to the resolution (Andon is a manufacturing term referring to a system to notify management, maintenance, and other workers of a quality or process problem)**
8. **There are clear team roles and responsibilities as jobs must be synchronized making sure "things flow at a precise pace".**
9. **The enterprise information system (Pacer System) monitor constantly the progress again schedule.**
10. **There are standard operating procedures that must be in the right place at the right time in order to ensure mechanics and other support functions perform their job in a timely manner.**

Go check this amazing video from the manufacturing of Boing 737 and go back to think why it is less probable to have an airplane accident than to have a car accident.

Additionally, let's review the following figure to understand some considerations to provide for flexible layouts: