CHAPTER 6
PROCESS SELECTION AND FACILITY LAYOUT

KEY IDEAS

1. **Process Selection.** Process selection involves making choices concerning the way an organization will produce its products or provide services to its customers. It has major implications for capacity planning, layout and work methods.

2. **Process Types.** Managers can select from five different types of processes: job shop, batch, repetitive, continuous and projects. *Job shops* are used to produce a low volume of each of a large variety of products or services. Equipment flexibility must be high to handle the high variety of jobs.

   *Batch processing* involves less variety, less need for equipment flexibility, and higher volumes of each type of product. *Repetitive processing* has even less variety, less need for equipment flexibility, and higher volume. *Continuous processing* has the lowest variety, the lowest need for equipment flexibility, and the highest volume.

   Job shops and batch processing are classified as intermittent systems, meaning that output frequently switches from one product or service to another. Repetitive and continuous systems are classified as continuous processing because there is little or no switching from one product to another.

   *Projects* are used for non-routine work that is intended to meet a given set of objectives in a limited time frame. Job variety is high, volume is usually low, and equipment flexibility needs can range from low to high.

3. **Product Profiling.** Process selection can involve substantial investment in equipment. Mismatches between operations capabilities and market demand and pricing or cost strategies can have a negative impact on the ability of the organization to operate effectively. Hence, it is highly desirable to assess process choices relative to market conditions prior to making process choices in order to achieve an appropriate matching. *Product profiling* can be used to avoid any inconsistencies by identifying key product or service dimensions and then selecting appropriate processes. Key dimensions often relate to the range of products or services that will be processed, expected order sizes, pricing strategies, expected frequency of schedule changes, and order-winning requirements.

4. **Layout Types.** There are three fundamental types of plant layout, respectively corresponding to the three different types of production operations situations.

   a. A product layout implies that a single product or else a single type of product, for example, automobiles, is manufactured on an assembly line, with the production tasks assigned to workstations along the line.

   b. A process layout involves the movement of batches of goods between departments via forklift truck, moving belt, or some other type of conveyance.

   c. A fixed-position layout is appropriate for a large end item such as a house or airplane, where all material is assembled to a major structure or product at a specified site.

5. **Product Layouts.** A product layout such as the assembly lines associated with automobile factories is a good idea when it is justified by the volume. The advantages of product layout are that it involves continuous flow of the work in process, minimum work-in-process inventory, maximum specialization, low material handling costs, efficient utilization of labor and equipment,
and systematized routing, purchasing, accounting and inventory control. The disadvantages are
dull repetitive jobs, inflexibility and susceptibility to frequent shutdowns.

6. **Process Layout.** A process layout allocates floor space to work centers so as to sustain a logical
flow of semi-finished goods, and minimize transportation and inventory costs. It is more flexible
than product layout in the sense that a variety of products can be made without incurring
extensive changeover costs. It also makes better use of the specialized skills of employees, so
that incentive pay systems can be effective in enhancing productivity. Process layout is
appropriate when each type of product or semi-finished goods has low volume, but there are
potentially high costs for unused equipment, excess inventory, slow or irregular movement, and a
need for extensive production control paperwork.

7. **Fixed-Position Layout.** A fixed-position layout is appropriate for large construction projects or
for assembly of very large products such as airplanes, which are difficult to move. An example
of a fixed position service system is a subway, which is an economical way to move large masses
of people.

8. **Assembly Line Balancing.** An assembly line is balanced to smooth the flow of semi-finished
goods, and to achieve the best possible utilization of both the labor force and the plant. The work
is subdivided into groups of tasks, and each group is performed at some specific location along
the line called a workstation. A workstation might be a single employee, or possibly a small
cluster of employees, if the services of more than one person are required for the tasks.

9. **Cycle Time.** The cycle time is the span of time that a unit of product is at a workstation. In
balancing the line, we determine both the cycle time and the number of workstations, based on
the number of units of product to be produced in a working day, the total of the times of the tasks
needed to make one unit of the product, and the amount of effective clock time available in a day,
after allowing for rest periods, breaks and planned shutdowns of the line.

10. **Length of Cycle Time.** The minimum cycle time is generally accepted to be the time required
for the longest task. The maximum cycle time is the sum of the task times for a single unit of
product, which represents the total amount of time required to build one unit of product. The
actual cycle time of an assembly line is generally somewhere between these two extremes.

11. **Theoretical Minimum Number of Workstations.** The minimum number of workstations in the
product layout is the quotient of the sum of the task times for a single unit of product divided by
the cycle time, rounded to the next highest integer. This is a theoretical result- it only guarantees
that there exists no design with fewer workstations… it does not guarantee there exists a design
with exactly that number of workstations.

12. **Designing the Line.** Line balancing requires the assigning of tasks to workstations:
a. Consider precedence; make sure that all jobs are done in a logical sequence.
b. Try to keep all stations busy all of the time by filling up the cycle time with tasks. Do not
assign a station more tasks than it has time to perform.
c. Heuristic rules are used to select tasks for assignment when there is more than one to
choose from. The greatest positional weight rule, one of several heuristics for assigning
tasks to stations assigns tasks according to the greatest sum of remaining task times to a
free station. Other heuristics are: most following tasks, most preceding tasks, and
greatest sum of task times for tasks that precede.

13. **Designing Process Layouts.** Measures of effectiveness guide decision makers to satisfactory,
but not necessarily optimum decisions on process layouts. The simplest approach involves
ranking of departments or work centers according to workflow (Distance x Number of loads
carried), and assigning work center locations so as to minimize the total intraplant transportation
costs.
14. **Closeness Ratings.** Closeness ratings is an alternative approach to process layout planning that allows for subjective opinions that consider multiple criteria on the closeness of work centers to one another. Work centers are rated in pairs on a six-point closeness scale from A (absolutely necessary) to X (undesirable). First the A’s are paired, and then the X’s are separated; then the E’s (very important) are paired, etc., until all centers are accounted for.