A product (or operation sequence) layout is one of the three basic options for laying out facilities to produce goods or deliver services, the other options being a FIXED POSITION LAYOUT or PROCESS LAYOUT. A fourth alternative, the CELL LAYOUT, is actually a hybrid facility arrangement that combines some of the principles of fixed position and product layouts. As its name implies, a product, or operation sequence, layout is determined by the design of the product. In other words, it is where machines, equipment, and workplaces are arranged according to the sequence of operations required for a defined product. In this context, the product could be the complete end product, a subassembly, or a component part.

Product layouts usually take the form of lines with unidirectional flow. Although cell layouts are also based on the design of products, they differ in that the operation sequence and flow direction can usually be varied.

There are two basic types of product layout. First, there is the assembly type, where at each workstation materials are added and resources applied to produce discrete end products. Second, there is the analytical (or ‘‘disassembly’’) type where a single raw material input is separated into parts and subsequently processed. Examples of the second type are oil refining and abattoirs; in fact, Henry Ford revealed that his idea of building the Model T car using an assembly line came from seeing lines used in the Chicago meatpacking industry.

There is a third type of product layout, the transfer line, where there is only one material input at the beginning of the line and its form is modified, usually by machining processes, as

it stops at each workstation. However, this is conceptually similar to the assembly type and can be designed in the same way.

Some of the advantages of product layouts are that they require relatively infrequent setups, involve low work-in-progress levels, have minimum material movement, need lower labour skills, and can be easily automated. They gained great popularity in the early part of the twentieth century after their possibilities for improving efficiency were demonstrated by Henry Ford. More recently, however, a number of problems have come to light. Among these are the ‘‘human’’ problems of recruitment difficulties, absenteeism, high turnover, and so on, and the ‘‘physical’’ problems of high capital cost, risk of stoppage (if one machine fails the whole line stops), and inflexibility (in terms of product variety and operation sequence).

The design of product layouts is very important because they are normally used in high product-volume situations where there is price competition in the marketplace. Efficiency is therefore a prime consideration and there is a need to minimize the amount of idle time at each workstation. The approach used in their design is usually termed LINE BALANCING, which as well as minimizing idle time seeks to spread it evenly across workstations. A further consideration is to minimize the system loss that results from differences between the operators’ work times and the fixed cycle time of the line.

A popular belief with product layouts is that they can only be used in connection with highly standardized products. This may have been true at one time, but now a wide variety of different products can be made using variations on the

basic product layout known as multimodel and mixed-model lines. One of the difficulties with building a wide variety of products on a line was the need to schedule the correct item of material to the correct workstation at the correct time. However, this can now be achieved relatively easily under computer control.

Bibliography

Bartholdi, J.J. and Eisenstein, D.D. (1996) A production line that balances itself. Operations Research, 44 (1), 21–35.

Bollinger, S. (1998) Fundamentals of Plant Layout, Society of Manufacturing Engineers in association with Richard Muther and Associates, Dearborn, MI.

Francis, R.L. and White, J.A. (1992) Facility Layout and Location: An Analytical Approach, Prentice-Hall, Englewood Cliffs, NJ.

Ghosh, S. and Gagnon, R. (1989) A comprehensive literature review and analysis of the design, balancing and scheduling of assembly systems. International Journal of Production Research, 27 (4), 637–670.

Gunther, R.E., Johnson, G.D. and Peterson, R.S. (1983) Currently practiced formulations for the assembly line balance problem. Journal of Operations Management, 3 (4), 209–221.

Heragu, S. (1997) Facilities Design, PWS, Boston.