



## **A Study on Basics of Assembly Line Balancing**

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**ABSTRACT:** Assembly Line production is one of the widely used production systems. The problem of Assembly Line Balancing deals with the minimization of the number of workstations, minimization of cycle time, the maximization of workload smoothness, The maximization of work relatedness It is used to assemble quickly large numbers of a uniform product. Originally, assembly lines were developed for a cost efficient mass production of standardized products, designed to exploit a high specialization of labour and the associated learning effects .In the another hand when we used assembly line balancing (ALB) this makes efficient flow-line systems available for low volume assembly-to-order production and enables modern production strategies like mass customization. Assembly lines are traditional and still attractive means of large-scale production. Since the time of Henry Ford, many developments have been taken place in production systems which changed assembly lines from strictly paced and straight single-model lines to more flexible systems with intermediate buffers. In this paper a basic study is done on assembly line balancing methods.

**Key words:** Assembly line balancing, work station.

### **I. INTRODUCTION**

Assembly line defines that manufacturing technique in which a product is carried by some form of mechanized conveyor among stations at which the various operations necessary to its assembly are performed. It is used to assemble quickly large numbers of a uniform product. Originally, assembly lines were developed for a cost efficient mass production of standardized products, designed to exploit a high specialization of labour and the associated learning effects .In the another hand when we used assembly line balancing (ALB) this makes efficient flow-line systems available for low volume assembly-to-order production and enables modern production strategies like mass customization. This in turn ensures that the thorough planning and Implementation of assembly systems will remain of high practical relevance in the foreseeable future and also assembly line balancing problem involves an assignment of various tasks to the workstations, while optimizing one or more objectives without violating restrictions imposed on the line. Various objectives are considered in 2ALB problems. In practice, it is often desirable to smooth out the workload assignments, and assign related tasks to the same workstation if possible.

Thus, we used line balancing technique to achieve:

- (i) the minimization of the number of workstations;
- (ii) the minimization of cycle time;
- (iii) the maximization of workload smoothness;
- (iv) The maximization of work relatedness.

An assembly line is a manufacturing process in which interchangeable parts are added to a product in a sequential manner to create a finished product. The assembly line was first used by Henry Ford and his engineers. Ford was also the very first to build factories around that concept.

Line balancing has been an optimization problem of significant industrial importance: the efficiency difference between an optimal and a sub-optimal assignment can yield economies (or waste) reaching millions of dollars per year. Decreased costs of production allowed lower prices of manufactured goods, better competitiveness of enterprises, and better exploitation of the markets potential.

There are many different types of assembly line systems some common variations include the classic automated intermittent and lean manufacturing models. These assembly line systems are often used for making different types of products. Assembly lines have some shared characteristics.

### Definition of Assembly Line Balancing (ALB)

There are number of ways by which Assembly Line Balancing may be defined. Various ways of defining ALB are discussed in this section. Assembly Line Balancing may be defined as assigning number of work elements to various workstations so as to maximize Balancing Efficiency (BE) or to minimize Number of workstations (N) or to accomplish any other given Objective function for a given volume of output without violating the precedence relationship. Another way of defining ALB is assigning the tasks to a minimum number

of workstations for a given cycle time and / or to reduce the probability of linstop page in a production line.

## II. MAIN TYPES OF ASSEMBLY LINES

There are many types of assembly line systems, some common variations include the classic, automated, intermittent and lean manufacturing models. These assembly line systems are often used for making different types of products. Assembly lines have some shared characteristics. Figure 1 summarizes the kinds of assembly systems.

There are many different types of assembly line systems some common variations include the classic automated intermittent and lean manufacturing models. These assembly line systems are often used for making different types of products. Assembly lines have some shared characteristics.

**1. Single model assembly line.** Single model assembly line is a type of assembly line in which assemblers work on the same product.

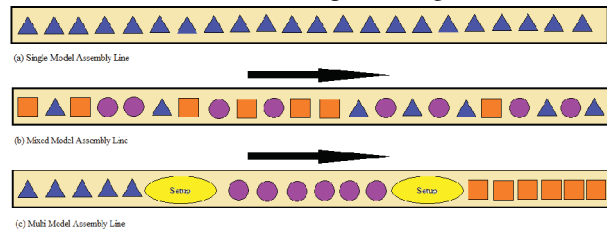
**2. Mixed Model assembly line.** In mixed-model production is the practice of assembling several distinct models of a product on the same assembly line without changeovers and then sequencing those models in a way that smoothes the demand for upstream components. Setup times between models could be reduced sufficiently enough to be ignored, so that intermixed model sequences can be assembled on the same line. In spite of the tremendous efforts to make production systems more versatile, this usually requires very homogeneous production processes.

The objective is to smooth demand on upstream work centers, manufacturing cells or suppliers and thereby reduce inventory, eliminate changeovers, improve kanban operation. It also eliminates difficult assembly line changeovers. The Mixed-Model Assembly Line (MMAL) is a more complex to balance in which several types of the products are assembled simultaneously on the line which considering to the shape of line.

**3. Multi Model Assembly lines.** Multi-product production supports process manufacturers where multiple or single components are run through a processing line which delivers multiple end items or finished products, including waste or by-products. Serial/Lot control for components and end items is available, as is a variety of costing and yield methods.

**4. Peaced and unpeaced assembly lines.** In peaced assembly systems a fixed time value restricts the work content of stations (SALB further assumes that the cycle time of all stations is equal to the same value). Assembly lines with this attribute are called paced, as all stations can begin with their operations at the same point in time and also pass on work pieces at the same rate.

In unpaced lines, work pieces do not need to wait until a predetermined time span is elapsed, but are rather transferred when the required operations are finished. This type of line control is often implemented if stochastic variations influence processing times.



**Fig. 1.** Assembly lines for single and multiple products. Assembly line balancing (ALB) relates to a finite set of work elements or tasks, each having an operation processing time and a set of precedence relations, which specify the permissible orderings of the tasks. One of the problems in organizing mass production is how to group work tasks to be performed on workstations so as to achieve the desired level of performance. Line balancing is an attempt to allocate equal amounts of work to the various workstations along the line. The fundamental line balancing problem is how to assign a set of tasks to an ordered set of workstations, such that the precedence relations are satisfied and some measure of performance is optimized.

The aim of assembly line balancing problems (ALBPs) is to assign activities to stations with respect to the precedence relationships and other constraints while some measurements of performance are optimized. In accordance with Ghosh and Gagnon [2], only two main types of measurements have been used in the ALBPs.

The first one is technical measurements such as cycle time, balance delay or total idle time, and minimizing the number of workstations.

The second one is economic measurements like profit maximization and cost minimization. In general, assembly line balancing problem occur when an assembly line has to be designed or redesigned. The assembly line problem was first introduced by Henry Ford in 1915, the father of modern assembly lines used in mass production.

### III. WHY WE USED LINE BALANCING

All factories that have a line such as traditional assembly line and new assembly line such as heuristic and U-type and also mixed model used a few technique such as genetic algorithms and fuzzy logic and also simulation method to improve a few parameter of line control in other hand manager like has a productivity and high yield in their factory and for this goal get help from previous technique to locate a machine ,employer ,assign employer to machine to select best choose for control and work by machine . In a few company one employer control 2 or more than 2 machines and this result is output of line balancing. In another word the company used line balancing for grow up the rate of production and decrease man power, idle time and buffer near machine, also used line balancing for produced more than 2 products

Assembly lines are the most important components of mass production systems. The improved labor productivity is their essential significance for manufacturers who have to produce high volume products in a fast and cost effective manner. An assembly line consists of several successive workstations in which a group of assembly operations (tasks) are performed in a limited duration (cycle time). The productivity level of an assembly line generally depends on balancing performance. Assembly line balancing (ALB) is the problem of assigning tasks to successive workstations by satisfying some constraints and optimizing a performance measure. This performance measure is usually the minimization of the number of workstations utilized over the assembly line.

### IV. ASSEMBLY LINE BALANCING TERMINOLOGIES

The important terminologies involved in Assembly Line Balancing are explained in this section.

**Workstation.** It is an assigned location where a given amount of work is performed. Normally a workstation is manned by one operator only. Sometimes, work stations are manned by several operators, e.g. aircraft production line.

**Minimum rational work element.** It is an indivisible element of work, or natural minimum work unit, beyond which assembly work cannot be divided rationally.

In an automobile assembly, fixing fuel pump, fuel tank, wheel drum etc., are some of the examples of minimum rational work element.

**Cycle Time (CT).** Cycle Time may be defined as the ratio between the effective time available per period and the production volume per period. Effective time available = (Time per period) X per period (%Utilization of period) the cycle time may also be interpreted in the following ways: It is the time between consecutive releases of finished assembly's frail the last station of the line. It is the time between consecutive releases of semi - finished products between any two adjacent stations. It is the maximum time allocated per station. The relationship between Cycle Time and duration of different work elements is explained with help of the following expression: where  $t_i$  = duration of "i" work element  $t_{max}$  = maximum work element duration from the above equation, we understand that cycle time (ct) must equal or exceed the maximum element time  $t_{max}$ , but, it cannot exceed the total work content time, ct, total idle time (tit) the difference between the time required by any station to complete its operations and the cycle time is called the idle time of that station. it essential to treat the minimization of the sum of all stations' idle time, namely 'total idle time (tit) as an objective while designing an assembly line.

### V. BENEFITS OF ASSEMBLY LINE BALANCING

The benefits of assembly line balancing may be classified into two categories as represented here.

#### Technical benefits

- Minimizing the number of workstations for a given cycles.
- Minimizing the cycle time for a given number of numbers of workstations.
- Minimizing the balance delay (or) maximizing the balancing efficiency.
- Minimizing the total idle time.
- Minimizing the overall facility or line length.

#### Assembly line Balancing Objectives

The main objective of line balancing is to distribute the task evenly over the work station and lime balancing aims at grouping the facilities or workers in an efficient pattern in order to obtain an optimum or most efficient balance of the capacities and flows of the production or assembly processes.

The aim of this is to minimizing workloads and workers on the assembly line while meeting a required output the most important objective of the assembly line balancing problem is to design an assembly line with the maximum balancing efficiency (be) or with the minimum balance delay.

The aims and objectives of the present study are as follows:-

- To reduce production cost and improve productivity
- To determine number of feasible workstation.
- To identify the location of bottleneck and eliminate them.
- To determine machinery and equipment according to assembly mechanism.
- To equally distribute the workloads among workmen to the assembly line.
- To optimize the production functions through construction of mix form of automation assembly and manual assembly.
- To minimize the total amount of idle time and equivalently minimizing the number of operators to do a given amount of work at a given assembly line speed.

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