A Review on Assembly Line Balancing Development

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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 effect. the focus of this paper is on improvement in the efficiency of assembly line through assembly line balancing techniques. the assembly line balancing is about evenly distribution of the work load among the workstations without violating the precedence and cycle time requirements.
Keywords: assembly line, work stations, line balancing.

Introduction
Line balancing means balancing the production line, or any assembly line. The main objective of line balancing is to distribute the task evenly over the work station so that idle time of man of machine can be minimized. 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.
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.
Assembly is a key production activity, to put it in place, it is often necessary to develop assembly lines. Assembly lines are production systems that include serially located workstations in which operations (tasks) are continuously processed. They are employed in various industries like the automobile, electronics, etc. Where the objective is to produce large series of the same (or similar) product.

Definitions of Related Terms

Line balancing
Line balancing is leveling the workload across all processes in a cell or value stream to remove bottlenecks and excess capacity. A constraint slows the process down and results if waiting for downstream operations and excess capacity results in waiting and absorption of fixed cost.

Single-Model Assembly Line
In early times assembly lines were used in high level production of a single product. But now the products will attract customers without any difference and allows the profitable utilization of assembly lines. An advanced technology of production which enables the automated setup of operations and it is negotiated time and money. Once the product is assembled in the same line and it won't variant the setup or significant setup and it's time that is used, this assembly system is called as single model line.

Mixed Model Assembly Line
In this model the setup time between the models would be decreased sufficiently and enough to be ignored. So this internal mixed model determines the assembled on the same line. And the type of assembly line in which workers work in different models of a product in the same assembly line is called mixed assembly line.

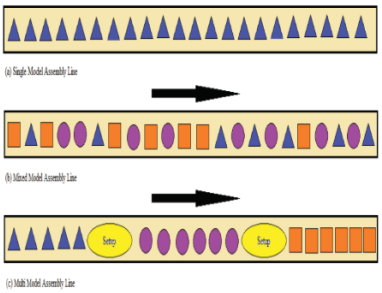

Fig1.mixed model assembly line

Multi Model Assembly Line

In this model the uniformity of the assembled products and the production system is not that much sufficient to accept the enabling of the product and the production levels. To reduce the time and money this assembly is arranged in batches, and this allows the short term lot-sizing issues which made in groups of the models to batches and the result will be on the assembly levels.

Assembly Line Balancing Problem

In assembly line balancing problem one is given with finite set of operation required to be performed, each operation has standard time and precedence requirement of operation which indicates the permissible order or sequence of operations. The problem is to assign operations to number of workstations in such way that satisfies precedence relationships and the cycle time requirement of operation and optimization of some measure of performance like efficiency and balance delay

Aim and Objective of Paper

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

Literature Review:

A classification of assembly line balancing problems was presented by boy sen and flie dner (2007) [1]. Assembly lines are special flow-line production systems which are of great importance in the industrial production and assembly lines even gained importance in low volume production of customized products. A classification scheme of assembly line balancing was provided for the ease communication between re-searchers and practitioners.

Integrating assembly planning and line balancing using precedence diagram was presented by Abdul-Hassan (2009) [2]. According to them, assembly planning and assembly line balancing are considered as two independent tasks. Assembly planning represents a fundamental step in the operation of a manufacturing system that involves product assembly while line balancing represents one of the biggest technical problems in designing and operating a manual assembly line. A methodology called Comsoal PLB (computer method of sequencing operations for assembly lines of assembly planning and line balancing) was developed to incorporate making decisions on process planning and production planning for assembly product.

Toksari et al. (2010) [3] works on assembly line balancing problem with deterioration tasks and learning effect. In this simultaneous effects of learning and linear deterioration were introduced into assembly line balancing problem. In many realistic settings, although the actual task time of a task is modeled as an increasing function of its starting time due to deterioration effects the produced worker develops continuously by repeated the same or similar activities

The objective of problem was to minimize the station number and a mixed nonlinear integer programming model was developed. A research work on assembly line balancing to minimize balancing loss and system loss was published by roy and khan (2010) [4]. Assembly line production is one of the widely used basic principles in production system. The main aim was to redefine the objective of the assembly line balancing problem and sequentially handle balancing loss and system loss

Modeling and solving constrained two-sided assembly line balancing problem via bee algorithms was presented by Tapkana et al. (2012) [5]. A fully constrained two-sided assembly line balancing problem was addressed in this research work. A mathematical programming model was presented in order to describe the problem formally. Due to the problem complexity, two different swarm intelligence based search algorithms are implemented to solve large-sized instances. Bees algorithm and artificial bee colony algorithm had been applied to the fully constrained two sided assembly line balancing problem so as to minimize the number of workstations and to obtain a balanced line.

Yoosefelahi et al. (2012) [6] published a work on type ii robotic assembly line balancing problem: an evolution strategies algorithm for a multi-objective model. The aim of the study was to minimize the cycle time, robot setup costs, robot costs and a procedure was also proposed to solve the problem. In addition, a new mixed-integer linear programming model was developed.

Tuncel and topaloglu (2013) [7] works on assembly line balancing with positional constraints, task assignment restrictions and station paralleling: a case in an electronics company.

A work on two-sided assembly lines balancing with assignment restrictions was presented by purnomo et al. (2013) [8]. Two-sided assembly line is a set of sequential workstations where task operations can be performed in two sides of the line. In this work a mathematical model was proposed for two-sided assembly line type ii. The aim of the model was minimizing the cycle time for a given number of mated workstations and balancing the workstation simultaneously.

Disscsuction

From the review of literatures it is found that assembly line balancing can be used almost all types of industries. From the literature survey following points are needs to be discuss:-

Experiments in line balancing show that optimal solutions for small and medium-sized problem are possible in acceptable time.

A new improvement in priority rule is discussed which shows that production cost is the result of both production time and cost rates.

Numerical experiments on a newly developed heuristic algorithm i.e. Variance algorithm shows better solution with more calculations ahead.

New cost reduction techniques are developed which focus precedence, conjoining tasks and increasing operation times; combined algorithms are tested for both solution quality and optimality verification, as well as to its computational efficiency.

Two-sided assembly lines with stochastic task times are considered for task time variation due to two sided assembly lines with stochastic task times

Future Scope:

From the literature survey following points are needs to be discussed:-

- A new improvement in priority rule is discussed which shows that production cost is the result of both production time and cost rates.
- Numerical experiments on a newly developed heuristic algorithm i.e. Variance algorithm shows better solution with more calculations ahead.
- Cost reduction techniques are developed which focus precedence, conjoining tasks and increasing operation times; combined algorithms are tested for both solution quality and optimality verification, as well as to its computational efficiency.
- For maximizing the production rate of the line robot assembly line balancing problems are solved for optimal assignment of robots to line stations and a balanced distribution of work between different stations.

Conclusion

From the study of assembly line balancing it is found that assembly lines are flow-line production systems, where a series of workstations, on which interchangeable parts are added to a product. The product is moved from one workstation to other through the line, and is complete when it leaves the last workstation. Ultimately, we have to work for assigning the workstations so that predetermined goal is achieved. This can be done by minimization of the number of workstations and maximization of the production rate as studied in the literature survey. It has been also observed that equipment costs, cycle time, the correlation between task times and equipment costs and the flexibility ratio needs a great attention.

References

[1] Nils Boysen, Malte Fliedner, Armin Scholl "A Classification Of Assembly Line Balancing Problems". Euro P Ean Journal Of Operational Research Vol.183, Pp.674–693, 2007.

[2] Bushra Basheer Abdulhasan "Integrating Assembly Planning and Line Balancing Using Precedence Diagram". Eng. & Tech. Journal , Vol.27, No.5, 2009.

[3] M. Duran Toksari, Selcuk K. Isleyen, Ertan Guner, Omer Faruk Baykoc. "Assembly Line Balancing Problem With Deterioration Tasks And Learning Effect". Ert Systems With Applications Vol.37, Pp.1223–1228, 2010.

[4] D. Roy, D. Khan "Assembly Line Balancing To Minimize Balancing Loss and System Loss". J. I Nd. Eng. Int. Vol.6 (11), Pp.1-5, Spring Issn: 1735-5702, 0 2010.

[5] Pinar Tapkan, Lale Ozbakir, Adil Baykasoglu "Modeling And Solving Constrained Two-Sided Assembly Line Balancing Problem Via Bee Algorithms". App Lied Soft Computing Vol.12, Pp.3343–3355, 2012.

[6] Yoosefelahi, M. Aminnayeri, H. Mosadegh, H. "Type II Robotic Assembly Line Balancing Problem: An Evolution Strategies Algorithm For A Multi-Objective Model". Journal Of Manufacturing Systems Vol.31, Pp.139–151. 2012

[7] Gonca Tuncel, Seyda Topaloglu "Assembly Line Balancing With Positional Constraints, Task Assignment Restrictions And Station Paralleling: A Case In An Electronics Company". Comp U Ters & Industrial Engineering Vol.64, Pp.602–609,2013.

[8] Sener Akpınara, G. Mirac Bayhan, Adil Baykasoglu "Hybridizing Ant Colony Optimization Via Genetic Algorithm For Mixed-Model Assembly Line Balancing Problem With Sequence Dependent Setup Times Between Tasks". Ap P Lied Soft Computing Vol.13, Pp.574–589, 2013.

[9] Hindriyanto Dwi Purnomo, Hui-Ming Wee, Hsin Rau "Two-Sided Assembly Lines Balancing With Assignment Restrictions". Ma The Matical And Computer Modelling, Vol.57, Pp.189-199, 2013.