Review Technique for Exploration of the Manufacturing Line for Improved Production

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Abstract: ***The Assembly line balancing is used to balance the workload to the different workstations. And these workstations are within assembly arrange in serially. The line balancing is the process in which task assign equally to the each station. The assembly line balancing is help us to increase the efficiency, product and reduces the cost. But there is some weakness in ALB. Like high workload (overburden) in some stages. In this condition the workload come to some workstation and output variation will increase. And the work will stop. For this kind of problem we will solve by the soft computing method. Like GA(Genetic algorithm) ,optimization, swarm behavior and Ant colony so on. The objective of this paper is to show the difference between the two methods, one delivers a precise answer but takes a very long time to operate in large problems while the other delivers an estimated answer in much less time.***

Keywords: Line Balancing; Optimization; minimum cycle time; reshuffling; estimated answer.

1. Introduction

In the development of product, ongoing global market continuously creates pressure to the manufacturer to compete with competitors amongst all over the world. Manufacturer needs to speed up the time to market and at the same time minimizes the manufacturing cost that will ensure that their products remain to be in a competitive level. Assembly is considered one of the important processes in manufacturing. [3]It consumes up to 50% of total production time and report for more than 20% of total manufacturing cost. In product conception and design stage, the aim of line optimization is to reduce the line costs by applying Design for Assembly, in short DFA approach in the product design. Besides reducing cost, DFA may also bring some additional benefits in the terms of increased quality, dependability and less manufacturing time. The approach shortens the product cycle and ensures a smoother transition from prototype to production. Assembly sequence and determination of optimum location of each resource. Solving the Assembly Sequence Planning (ASP) problem is crucial because it will determine many assembly aspects including tool changes, fixture design and assembly freedom. Assembly sequence also influences overall productivity because it determines how fast and accurate the product is assembled. An assembly line is a manufacturing process in which parts are added to a product in a sequential manner using optimally planes logistics to create a finished product much faster than with handcrafting-type methods. In its basic form, an assembly line consists of a succession of workstations, generally connected by the transportation mechanism such as a conveyor belt, through which the product units flow. Each workstation has repeatedly performs a sequence of tasks, in order to produce or manufacture a specific type of product. Tasks require a certain time to be processed and are related amongst one another according to the existing technological constraints.

During the stage of manufacturing processes, assembly optimization is focused on two major activities. The first activity is determining the optimum automation level in assembly. The purpose of this activity is to apply the appropriate automation level in assembly in order to balance the investment in automation and the output. The second activity in this stage is assigning the assembly tasks into workstations, such that workstations have equal or almost equal load. This activity is usually known as Assembly Line Balancing (ALB). [9]In this stage, research in the assembly optimization gives more attention on ALB problem rather than the optimization of automation level. It can be observe through the number of publication in optimizing both problems.

Originally, assembly lines were developed for a cost efficient mass-production of standardized products, designed to exploit a high specialization of labor and the associated learning effects. Since the times of Henry Ford and the famous T–model, however, product requirements and the thereby the requirements of production systems have changed dramatically.[2] In order to respond to diversified customer needs, companies have to allow for an individualization of their products.

When designing an assembly line, the following restrictions must be imposed on the grouping of work elements. a). Precedence relationship .b). The number of work elements cannot be greater than the number of work stations. The minimum number of workstations is one. c). The cycle time (amount of time available at each station as well as the time between successive units coming off the line) is greater than or equal to the maximum of any station time and of the time of any work element. The station time should not exceed the cycle time.

LB is a classic Operations Research in short form OR optimization problem, that have been tackled by OR over several decades. Many algorithms have been proposed for this problem. Yet despite the practical importance of the problem, and the efforts of OR that have been prepare to tackle it, little commercially software is available to help industry for optimizing their lines. In fact, according to the recent survey by Becker and Scholl (2004), there appears to be ongoing only two commercially available packages that show features of both, a state of an art optimization algorithm as well as an user-friendly interface for data management processing. Furthermore, one of those packages seems to be handling only the "clean" formulation of the problem that is Simple Assembly Line Balancing Problem, or can called as SALBP which leaves only one form of package available for industries such as Automotive. This situation appears to be paradoxical, or at least unexpected: given the huge economies LB can generate, one would expect several software packages vying to grab a part of those economies.

A. Targets and Objectives of the Present Study

The [1] targets and objectives of the present study are as follows

(i) 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.
(ii) To classify the whole assembly process into each unit and decide the automation possibility f each process, and if, automation assembly is not possible, decide criteria for manual assembly.
(iii) To determine machinery and equipment according to assembly mechanism.

Performance analysis of the assembly line

we have:

$$Cycle\ Time = \frac{Available\ time\ peried}{Output\ unit\ required}$$

$$Theortical\ minimum\ no.of\ workers = \sum T/CT$$

Since, Total time

$$\sum T = W_1T_1 + W_2T_2 \dots \dots \dots . W_yT_y$$

$$\text{Balance Efficiency} = \frac{\text{Theoretical min. no. of worker}}{\text{Actual no. of workers}}$$

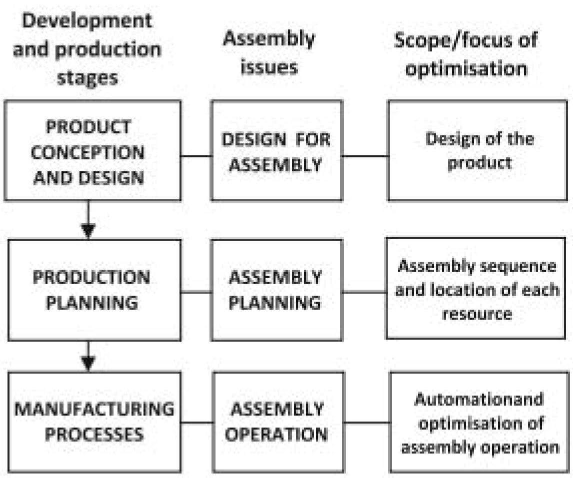

Figure 1: Assembly related issues in different product development stages

According to [10] geometrical characteristics of products and degree of complexity of assembly process, it can be determined whether the assembly processes has to be automated or not. Sometimes, manual assembly may be performed easily. There are some more factors or parameters, i.e. production volume, cycle time, investment cost, etc., may also influence upon the decision of automatic or manual assembly as to its economic consideration. Secondly, Manual assembly is performed, if part characteristics are weak in transporting, arrangement, feeding, joining areas. In the present work, it was analyzed that whether assembly process can be automated or not. [10] The processes that are determined by manual assembly are decided upon the method of transporting, arrangement, feeding and joining. [1]. An Empirical Investigation of Assembly Line Balancing Techniques and Optimized Implementation Approach for Efficiency Improvements Global Journal of Researches in relevant area.

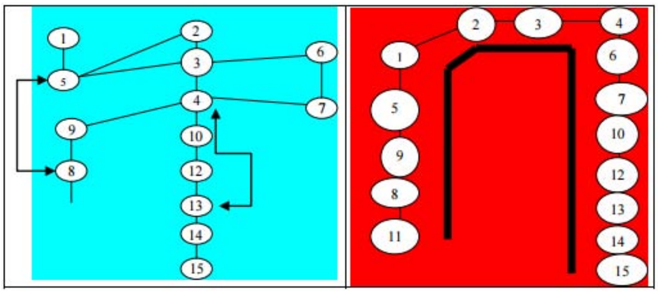

Figure 2: before line balancing Fig.3.after line balancing

2. Literature Review

[1] Dalgobind Mahto, Anjani Kumar "An Empirical Investigation of Assembly Line Balancing Techniques and Optimized Implementation Approach for Efficiency Improvements". On the basis of the reported case studies, it can be observed that Line balancing improves the product quality and productivity along with an improvement in line efficiency. Proper Line Balancing leads to the reduction of worker's movement and thereby assembly time and also minimizes the product cost. [2] M.A. Hannan, H.A. Munsur, and M. Muhsin " AN INVESTIGATION OF THE PRODUCTION LINE FOR ENHANCED PRODUCTION USING HEURISTIC METHOD". A new heuristic approach, the Longest Operation Time (LOT) method was used in the designing of new production line. After set up of the new production line, the cost of production and effectiveness in addition to the efficiency of the new line was computed and compared with all, those are existing at present. How much costs could be saved or minimized with the productivity, could be increased for the newly designed production line that were estimated and the production was found to have been increased by a significant amount of reduction in the overall value of production cost per unit. [4]Kana Yokoyama [1], Katsumi Morikawa2 and Katsuhiko Takahashi 3, " A Multi-Agent System for Mixed-Model Assembly Line Balancing". Under this paper, it can be proposed that a multi-agent system for mixed-model assembly line is used to balance the workload among the workers. Workers are considered as agents, and information exchange within the adjacent agents is to be allowed. Some mechanisms are also introduced for the enhancement of the performance of the agent system as taboo list and cooling. And controlling parameter of exchange stop was also considered to reduce the number of iterations. In the later on, it is necessary to analyze a method that is to be used as deciding parameters depend on the demand ratio. By analyzing setting method of parameters, we will be able to solve various types of mixed-model

assembly line balancing problem. We should also consider about some effects by changing the number of agents, some task time etc.[5] M. Chica, O. Cord´on, S. Damas, J. Bautista, J. Pereira.“ A Multi objective Ant Colony Optimization Algorithm for the 1/3 Variant of the Time and Space Assembly Line Balancing Problem”. The obtained results that the author has found out, yields to the MACS algorithm that is good to solve the problem, as Pareto sets of good quality with a number of different solutions have been achieved. Comparing the results of all MACS runs we notice that the algorithm works well than when we use 0.2 as a value for q0 parameter. Thus, there is a need to gain diversity in our problem to get better and efficient results. Several ideas and thoughts are used for future developments arise from this preliminary study performance of the considered MACS algorithm can be increased with some improvements like enhancing exploration using ants with different form of search behaviors (i.e., multi-colony);the comparison of the MOACO algorithm with more complex algorithms, for example, de-1460 Proceedings of IPMU’08 signing a new GRASP is used to solve this; selecting other MOACO algorithms in order to find out which the best one is; the solution of real-world of a multi objective problem instances, above all, data from a real Nissan industry plant, placed in the Barcelona (Spain).[6] Gunnarr Baldurrsson, “Assembly line Balancing”. Heavy data sets could take months or even decades to compute, which is useless in most of the situations. The benchmark problems this paper considers were given 900 seconds of processing time for each value of C and some Günther problems were even given more than an hour. All experiments timed out before reaching a feasible solution due to the computational intractability of the data sets. The tables turn when the heuristics are applied. Computing Günther for all values of C took 0.56 seconds, 0.82 for Killbridge and 74.59 seconds for Scholl and for both the heuristics combined values. The solutions obtained with the heuristics are good even if they are sub-optimal so the tradeoff between computational speed and reaching an optimal and accurate solution is generally acceptable. There can be many more constraints on ALBP that were not taken into consideration due to certain reasons. For instance there could be stochastic operation times and inventory constraints during the production. Then there all sorts of things as well as parameters are to be considered to the concerning of personnel selection, e.g. wages related to the tasks, or the physical layout of the workstations in order to minimize the time needed to move tasks betweens workstations. [7] Alexander Jensen Hjálmarsson, Viktor Ari Viktorsson, “Assembly line Balancing”. The MATLAB algorithm on the other hand delivers more steady and approximate solutions with less offsets than the GLPK in very much less time. The offsets rise slowly as the m’s rise, but not as dramatically as the GLPK algorithm. The downfall to the MATLAB algorithm is that it is only a heuristic method, that is, it does not deliver an exact form of solution. While the GLPK algorithm runs until it has checked all possible solutions to make sure that it has the best optimal solution, the MATLAB algorithm just uses the configured heuristic method until the all tasks have been completed. Therefore the MATLAB algorithm almost always has a small offset while the GLPK algorithm delivers an exact solution if given the time to do so.

3. Method

3.1 Heuristic Method

Heuristic Methods is a procedure that can find a good feasible solution for a given type of problems, but which is not necessarily an optimal or correct solution. Heuristic methods, or the ones that is based on the simple rule, have been used to develop good and correct solution to the balancing problem of assembly line. In spite of not obtaining the result in the form of optimal solution, the obtained solutions are very advantageous

3.2 (LOT) Method

The longest operation time (LOT) process is generally used in the research work. This is a line balancing heuristic that provides top assignment priority to the task that has the maximum operation time. The steps of lot are:

LOT1: To assign first, the task that takes the most of time to the first station
LOT2: After assigning a task, it is necessary to determine how much time the station has left to contribute.
LOT3: If the time contribution of station is more, assign it to task according to the requirement as much time as possible.

3.3 Optimization Method

In the previous researches such as ASP and ALB optimization shows that several soft computing methods were used. This shows that the numbers of papers are using different types of soft computing methods to optimize ASP and ALB problems for the last ten years. The three most dominant optimization methods which had been used earlier is about 70% of the summon research are Genetic algorithm, Ant colony optimization and Particle swarm optimization.

Solve problems, researchers may use algorithm that should terminate in a finite number of steps or iterative methods that converge into a solution on some specified class of problems, or heuristics that may provide approximate solution to several problems and their iterates does not need to converge it. Optimization algorithm is simpler, easier and designed for linear programming.

3.4 Genetic Algorithm

Genetic Algorithm is inspired by the evolutionary processes that are based on the natural evolution. This technique emulate the biological evolution theory.GA provides a method of searching process which does not need to traverse every possible solution in the feasible region to obtain a good and accurate result. Genetic Algorithm is a heuristic search that mimics the process of natural selection.

4. Conclusion

Maximum probability of given time completion and minimum designing cost and mixed-model for JIT system, it facilitates smooth functioning of various activities in a limited space. Exact line balancing reduces worker's movement and there by assembly time minimizes the product cost. Assembly line balancing conclusion promotes one piece flow. It is avoids excessive work load in some stages. It minimizes wastes (over-processing, inventory, waiting, rework, transportation) and due to which variation is reduced and leads to increase efficiency. It found the best feasible solution which could take some days. As small improvements in the performance of the system can lead to significant enhancement in the through puts of production Line balancing is to a workstation within an assembly line in order to meet the required production rate and to achieve minimum amount of idle time.

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