Development of Resource Scheduling Algorithm for Flow Shop in Single Line with Reducing the Bottleneck and No Back Tracking

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***Abstract*- In any organization, the utility of production control is to increase productivity. Resources are being wasted if machines or people are ideal, because there is no work or if parts remain in inventory because a machine is not available. The role of production control is to reduce this waste by intelligently coordinating the availability of people, equipment and materials. Productivity improvements can be made through improved designs or more efficient production methods. Intelligent production on control can also improve the productivity of any manufacturing or service facility. In the present work an attempt is made to reduce bottleneck, develop scheduling algorithm and line balancing for efficient utilization of resources.**

***Keywords*: line balancing, bottleneck, resources, productivity, scheduling.**

1 INTRODUCTION

For reducing the ideal time of man and machine, scheduling algorithm has been developed. Scheduling is the allocation of the jobs to be processed on the corresponding machines, in a given time span, for a workshop consisting of several machines or production facilities including operative workers. A job is a product or part to be completed. For that a piece of raw material is converted into a finished part through a single or multiple stages, on which an operation is run, such as tuning, drilling, grinding setup etc. on a suitable machine operations or work elements arranged in a technological order. Development of an appropriate schedule and line balancing.

2. LITERATURE REVIEW

The manual methods are as follows :

I. Largest candidate rule
II. Kilbridge and Westers method
III. Ranked position weighted method

But these methods are generally used in mix type line balancing and these have many drawbacks such as:

- These have not considered the movement allowances between work elements or centers in the same station.
- There are no suggestions about the over time consideration.
- They have no considerations about bottleneck problem.

Hence to overcome these drawbacks scheduling algorithm has been developed.

3. OBJECTIVE OF THE STUDY

The housing shop problem of the company is studied as unidirectional flow shop for scheduling and line balancing. The objective is to achieve improvement in the production rate of the housing shop by reducing the bottleneck problem. There are several methods for solving the line balancing problem. These methods are heuristic approaches, means that they are based on logic and common sense rather than on mathematical proof.

4. DEVELOPMENT OF ALGORITHM

4.1 Assumptions assumptions for the algorithm are-

1. Worker can handle more than one work center but can't handle more than two work centers at a time.
2. Combination of two work center is called workstation and each workstation has one man. The combination of workstation is called group.
3. Pair of work center, depends on sum of indices.
4. Sum of indices should be nearer or equal to 1, if sum of indices is > 1, then overtime is provided.

5. Overtime can be provided to worker.
6. Overtime up to 15 minute should not be considered.
7. Overtime should not be more than 2 hours per shift.
8. Overtime charges rate will be 140% of wages.
9. Extra time is provided to each worker for movement between the work center. (refer appendix B-5)
10. Per day production of the company cannot more than 349 units due to bottleneck production rate.
11. Schedule maintenance is provided to machines for a shift in a week.
12. Sunday is off for whole plant.
13. Available time for each shift is 8hrs/day/month.

a. Working hour of the worker without overtime =8
b. Working hour of the worker with overtime =10
c. Index value one shows that the worker is engage in a shift without overtime.
d. Maximum time require for maximum movement is 120 minutes or 2 hours.
e. Minimum processing time without overtime is 6 hrs.(during the maximum movement)

Hence, minimum index value(I) = 6/8 = 0.75
And maximum index value(I) = 10/8 = 1.25

4.2 Hypothesis it is the algorithm shows several pertinent steps that may be helpful in designing.

Step1 : find out index value for each work center(w.c.)

$$\text{By, index value (I)} = \frac{\text{Cycle time for non optimal machine}}{\text{Cycle time for critical machine}}$$

Step2 : makes workstation(I) by adding index values of index values of any two work centers(I_i, I_j).

$$I = I_i + I_j \qquad I \neq J \neq 3 \qquad i, j = 1\ldots\ldots\ldots.9$$

$$\text{No. of maximum workstations} = {}^{Tc}C_{Mw} = \frac{Tc!}{(Tc - Mw)!\, Mw!}$$

Where T_c = total no. of work centers. M_w = maximum no. of w.c. in each station

Step3 : identify the feasible pair.
By $0.75 \leq 1 \leq 1.25$

Step4 : find the movement time of worker between two work centers.

Step5 : add % of movement time value in the indices value of corresponding workstation.

Step6 : check all workstations are feasible or not, and move the infeasible pairs.

Step7 : all values of station arrange in ascending order.

Step8 : make the maximum possible groups by collecting the workstations, following sub steps are :

I. Select the minimum value of workstation.
II. Select next maximum value of workstation except previous work station's work center.
III. Repeat step(II) up to select all wok centers for a group.

For making other possible groups sub step(II) and (III) are used.

$$Z_{g,k} = \min\sum(I_i + I_j) \qquad i, j = 1,2\ldots\ldots\ldots\ldots\ldots.9$$

$i, j = 1$; $i, j \neq 3$; $i \neq j$; $k = 1,2,3,4$; $g = 1,2,3$;
where, i,j = work centers

I_i = index value of corresponding I work center.
K = workstation
g = group of work stations.
$Z_0 = 0$ (no work stations)
$I = I_i + I_j = I_j + I_i$
$Z_{g,5} = 13 = 1$, (for k = 5, bottleneck machine)
$Z_{g,k-1} < Z_{g,k}$

step9 : identify the feasible groups
by $0.75 \leq I_i + I_j \leq 1.25$ where $(I = I_i + I_j)$

step10: identify the best group
(i). according to the minimum overtime
(ii). According to the minimum movements.

4.3 Hypothesis Testing Result

In the study reported in this paper, certain attempts have been made to investigate the effect of bottleneck, resource scheduling and line balancing. A bottleneck resource is any resource whose capacity is equal to or less than the demand placed upon it. Resources that are near 100% utilization are the bottleneck operations. Due to different capacity of machine flow of material through a system is not balance. For proper utilization of man and machine, line balancing and the scheduling algorithm has been developed and Comparison is done between the results of existing method and proposed method. Analysis of all the data reflects the best combination of workstations for a housing shop. It is based on minimum overtime and minimum movement between the work centers in the work station.

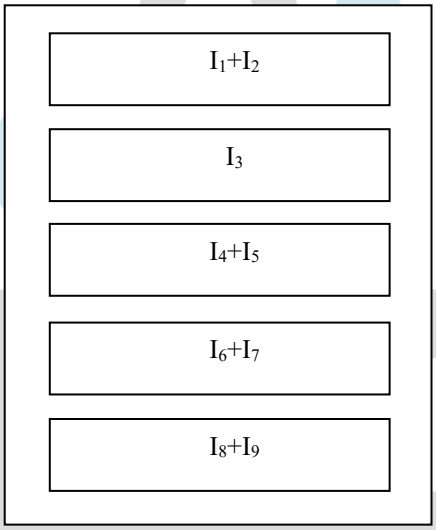

Fig. 1 Best combination of workstations for a housing shop

Table 1. Compare the result of existing method and proposed method.

S. no.	Factors	Existing methods	Proposed methods
1.	Required workers /day	21	15
2.	Scheduling process	Not follow	Follow
3.	Max. production/day	≤321	Equal to 349
4	Production rate	0.611 units/hr/labor	0.969/hr/labor
5.	Transportation work	Consuming more time	Avoid
6.	Maintenance	It provides corrective maintenance(after the time of breakdown and interruptions)	Scheduled maintenance is provided(at fixed time interval as like once in a week) and preventive maintenance provides after 3 months so breakdown and other interruptions are minimized

7.	Utilization of workers	Utilization is not in proper way (scheduled)	Utilization of workers in fixed schedule.
8.	Worker satisfaction	Due to unscheduled production so workers don't feel more satisfaction.	This is a scheduled production so worker shall feel more satisfaction.
9.	Utilization of machine (production)	According to the available raw material and capacity of machines	According to the capacity of bottleneck machine.
10	Inventory	More inventory stores due to different capacity of machines	Very less inventory stores because quantity produce according to lower capacity (bottleneck) machine.
11.	Overtime	Overtime provided without pay	Overtime provides with pay.

5. CONCLUSION

This is the time of globalization and every company wants to expand their delimitation. Market competition is very high and for the survival of the company, high production rate is required. For high production rate it is required to reduce the constraint of production line. These constraints are called bottleneck. The production capacity of the plant depends upon the production capacity of the bottleneck machine. The bottleneck machine pays an important role in the industry and in today's scenario production rate is very important. Maximum production of the company is equal to the bottleneck production. It can be reduced by reducing the existing allowances, breakdown time and the ideal time of the man and machine by using skilled labor. This paper basically focused on :

1. How we can reduce bottleneck.
2. Scheduling algorithm has been developed for the line balancing and efficient utilization of resources.
3. Hence, performance of the company will increase.

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