Use of Powerless Material Moving Facility for Assembly Line Balancing

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Abstract— Among various production systems assembly line production system is most widely adapted system. Basically assembly line is distribution of various activities among workstations utilizing man power and facilities for enhancing work distribution. Major problem related to assembly line balancing is uncertain distribution of activities as per capabilities of workstation and improper use of human resources. In this paper problem of line balancing in oil tank manufacturing has been discussed using power less material moving facility **(**PMMF**).**The paper basically aims at reducing bottleneck time by proper interlinking of machineries and thereby increasing productivity.

Keywords— Line balancing, moving facility, cycle time, bottleneck time, powerless, production system, interlinking, workstations.

INTRODUCTION

For any production system any assembly line consists of set of workstation arranged in one particular fashion interlinking each other with material handling device. It can be linear, circular, u shaped, ladder etc. The movement of material via assembly line begins with part or material fed at initial point with particular feed rate. Basically workstation is considered any point on assembly line in which task is assigned and performed on part. The work or task carried out can be brought out by manually operated machinery, computer controlled machinery, hydraulic equipments etc. In simple once the material enters the first station task begin to perform sequentially. The work piece is subjected to various tasks one after the other as per sequence assigned. The time taken to compute each task at each operation is known as process time. The time required for single work piece to undergo all the task from starting point to end point is cycle time.

The cycle time is predetermined by desired production rate in assembly line. Also the desired production rate is set so that end product is produced within stipulated time period. The concept of manufacturing assembly line was first introduced by Henry ford in early 1990's [1]. It was designed with an intention of increasing productivity by enhancing manufacturing method.

Certain conditions are to be followed for designing the assembly lines are as follows;

1) Number of workstations and number of work elements should suffice each other in quantity. Minimum number of workstation should be = 1

2) The process time should not exceed cycle time.

3) Interlinking of workstations.

LITERATURE REVIEW

The literature survey (Hadi Gokcen, Kursad Agpak , Recep Benzer " Balancing of parallel Assembly lines, 2005) states that productivity improvement in assembly line is important because it increases capacity and reduces cost so constructing parallel lines is one of the best methods which can affectively enhance assembly line balancing.

In April 2007, author Nuchsara Kreingkorakot and Nalin Pianthong studied assembly line balancing [2]. This study is focussed on assigning task to an ordered sequence relations among task are that the precedence relations among tasks are satisfied and performance measure is optimized. They also concluded that research has made significant algorithm development in solving simple problems.

In literature survey of Generalised Assembly line balancing problem (cf. Becker and Scholl, 2006) shows that relevant problems have been identified and modeled but development of sophisticated solution procedure has just begun. Then additional research is necessary to adopt state of the art solution concept like meta heuristics and highly developed algorithms of or SALBP to variety of GALBP.

In literature survey of SALBP (cf. R.B.Breginski, M.G.Cleto, J.L.Sass Junior Assebly line balancing using eight heuristics) shows that line balancing is a critical problem that affects productivity and cost of production [3]. It shows that methodology adopted for assembly line balancing in different countries do affect their respective productivity.

Assembly Balancing problems The problem of assembly line balancing is closely associated with distribution of activities among the workstations which ultimately tends to maximum utilization of human resources and facilities without disturbing the work sequence [1, 2]. Assembly line balancing problems are classified in 2 types-:

Production Rate & Task time The problem deals with production rate, assembly task, task time, etc. The problem statement clearly revels that number of workstations are required to be minimized. These constraints are taken into consideration while designing new assembly line[4]. Minimum number of workstation simply implies minimum labour cost, education in space requirement and optimum use if time[5,6]. It also handles modification in assembly line by adding workstation as per requirement.

Employee & Workstation Condition prescribed is fixed number of employee with fixed number of workstation. The aim is to minimize the cycle time. The contemplation of minimizing the cycle time is to increase production rate but with constraints applied. Generally type b problem occurs when organization wants to produce the optimum number of items by using fixed number of workstations without expansion.

In general “production rate and task time” problems occur more frequently but still if any industry or company having trivial methodology for assembly line balancing give rise to “Employee and workstation” problems.

Some of methods generally used for line balancing are enlisted below-:

- Moodie- young method.
- Ranked position weighed method.
- Hoffmans matrix.
- Immediate update first fit method.
- Powerless material moving facility method.

As per other methods mentioned of line balancing powerless material moving facility method for assembly line balancing B the best solution obtained for solving the problem of oil tank manufacturing system [7].In this powerless MMF method number of workstations are fixed but by aligning the material moving facility from one machine to other the productivity can be increased and thus it could be effective solution for the problem arising in manufacturing company

POWERLESS MATERIAL MOVING FACILITY METHOD (PMMF METHOD)

Steps followed in PMMF method are as follows-:

step1

- Analyse the current layout of workstation and flow of material through it.
- Draw the vague current layout and the material flow.

step2

- For each work station record the operation time and estimate cycle time respectively. Here the operation time includes loading time (time required for loading work piece on machine). Process time (time required for machining) and unloading time (time required to unload work piece from machine so it can be forwarded)
- Determine the time lost for transferring the material from one machine to other machine.

step 3

- Designing of conveyor according to tank dimensions and its physical properties and determine where conveyor is to be provided with proper slope so that it works on account of gravity as per the requirement and the conveyor is provided with proper adjustment of slope angle.
- According to layout and analysis done earlier determine No. of conveyors required so that the machines can be interlinked with each other in most effective method with maximum utilization.
- Now again analyse the time data that is time required for moving of job, compare the same with previously obtained data and then accordingly plot the productivity rate whether increased or decreased.
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CASE STUDY (VIRAJ ENGINEERING SERVICES, NASHIK)

Viraj Engineering services Nashik is manufacturing oil tank for hydraulic operated automobiles like earth movers, locomotives and etc. Viraj Engineering services is servicing excellence from past many years in manufacturing of oil tank and is proved to be best as the company by holding 2nd position in tank manufacturing industries. Initially there was no proper assembly line set up in the company but the modifications were brought about as per the requirement of customer time to time.

Company intends for mass production with maximum utilization of sources. Thus to achieve this objective Assembly line balancing is proposed by PMMF method. After monitoring time required for tank manufacturing and its assembly it was decided to set up material handling equipment to interlink the machinery [8]. So based on observations and requirement the conveyors were lined up between machineries and the aisel (gang way) was shifted. The study was again carried out to find out the total cycle time using PMMF method.

For final assignment of oil tank line balancing simple metallic roller conveyors were used. With the help of these conveyors line was balanced by achieving interconnection between all machineries [9, 10]. Initially 12 labourers were required 10 operators and 2 for material moving and now currently in total 11 operators are required for complete assembly that is 10 operators and only 1 for material handling there by eliminating 1 labourer [11, 12].

CALCULATIONS

Time calculations for manufacturing;

Total TIME

- Total task time :- (Before conveyor) **14 minutes 13 seconds**

Now Bottle neck time = 7 minutes ------ before conveyor

Therefore total lead time for 1 tank (before conveyor)

=14 mins 13 sec + 7 mins

= 21 mins 13sec

After this 21 mins 13 seconds another tank continues and is forwarded for complete assembly

So for 8 hours of shift we have 8*60=**480 mins**

Reducing lead time =480-21.13 =**458.87mins**

Also labourer consume time for tea break that is 40 mins

So eliminating this time from shift hours

458.87-40=418.87mins

Now for calculating no of tanks

= (time of duty / no of mins for 1 tank)

= 418.87/7 =59.83 =~**60tanks**

Thus for one shift before conveyor 60 tanks are manufactured.

After conveyors were installed

Again for 8 hours of duty =

= 8*60

= **480 minutes**

Total task time: - **13 minutes 08 seconds**

(After conveyor)

Bottleneck time here is 2 minutes

And process time for one tank =13min 08 seconds

Therefore total lead time =13.08+2

=15.08mins

Eliminating lead time for one tank after conveyors=

=480-15.08

= **464.92 minutes**

Again eleminating recess time utilized by workers =

=464.92-40

=424.92 mins

After conveyor one tank is forwarded and is out within 5.5 minutes

Thus no of tanks = 424.92/5.5

=77.25

=**78 tanks (Approximately)**

Now for one shift tanks manufactured = 78 Tanks

Additionally 18 tanks more will be manufactured.

Time saved from previous method = bottle neck time before conveyor – bottle neck time after conveyor

= 7 minutes-2minutes

= 5 minutes

Cost Calculations:-

Approximate cost / tank = 2200 Rs.

Before conveyor

No of tanks manufactured = 60tanks

Thus cost = 60*2200

= 1, 32,000/-

for 1 shift cost incurred =1,32,000/-

Thus monthly income incurred = 1, 32,000*26

= 34, 32,000/-

After Conveyor

No of tanks manufactured= 78 tanks

Thus cost = 78*2200

= 1, 71,600/-

for 1 shift cost incurred =1,71,600/-

Thus monthly income incurred = 1, 71,600*26

= 44, 61,600/-

Therefore monthly increment in income is

=44, 61,600-34, 32,000

=10, 29,600/-

Therefore monthly increment in income =**Rs 10,29,600/-**

Labour cost saving

Now 1 labour is reduced

1 labours daily wage = 250/-

So monthly wage is =250*26

=6500/-

Thus in companies income 6500/- per month is saved by reducing 1 labour.

CONCLUSION

The main purpose of this paper is to emphasize use of PMMF method to develop assembly line and balancing that line. With the study and analysis it is observed that PMMF method is suitable and proper for problem developed. Also with this method one can find best method to synchronize work stations for work flow and sequencing and thus bottlenecking time can also be reduced. Before lining of conveyors the tank manufacturing rate was about 60 tanks per shift which has been increased to 78 tanks per shift. In total increment of 18 tanks per shift is achieved by this adopted technique. Approximately percentage growth in productivity is 30%.Due to above adopted method monthly increment in income is increased by
10, 29,600/- also labour cost of 6500/- is saved per month.

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