Productivity Improvement of Brake Assembly Line by Process Analysis

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Abstract - Productivity is directly effects on profit and growth of an organization so, productivity improvement is very important for any organization to achieve organizational goal. In industries during production many problems occur like breakdown of production line, slow rate of production, improper handling of material, mental fatigue of workers, etc. So, reduction or elimination of all above problems increase the production rate as well as increase in profit. By identifying the problems they are solve by time study, method study and work study.

***Keywords* - Maximum cycle time, Line efficiency, Time study, Balance delay.**

I. INTRODUCTION

Assembly line is one of the most important part of any manufacturing industries like Automobile, Electrical component, Nano technology and some conventional process followed by industries. Unfortunately any kind of error occurs in assembly line it is difficult to balance due to which wastage of cycle time, breakdown product assembly line, under production occur. Therefore, line balancing plays an important role to any industries. For improvement in manufacturing sector various lean tools are essentials like 5S, Bottleneck analysis, continuous flow, JIT, Kaizen etc.

In the brake assembly industries assembly of product is one of the important area taken into consideration for improving productivity of line. During project work we studied different kind of parameters to propose a new brake assembly line to relative company for increasing their productivity and also considering with economic condition. In manufacturing organization many factors are present which influence productivity the most widely seen problem is to how to improve line efficiency. Find out the problems were solved by using method study, Time study, Line efficiency principles improvement was achieved by reducing cycle time of product carrying from analysis the work in assembly line.

II. LAYOUT OF ASSEMBLY LINE

Material flow path in assembly line is one of the important factors for any automobile industries because the ultimate aim of any manufacturing industries is to gain profit and increase the productivity.

Brake drum assembly line consists of following station:-

1. Spline Screw Pressing
2. Auto Torqueing
3. Orbital Riveting
4. Shoe Mounting
5. Set pin Assembly

6. Diameter Set & Centralizing
7. Wheel Cylinder Leak Testing
8. Final Testing
9. Quality

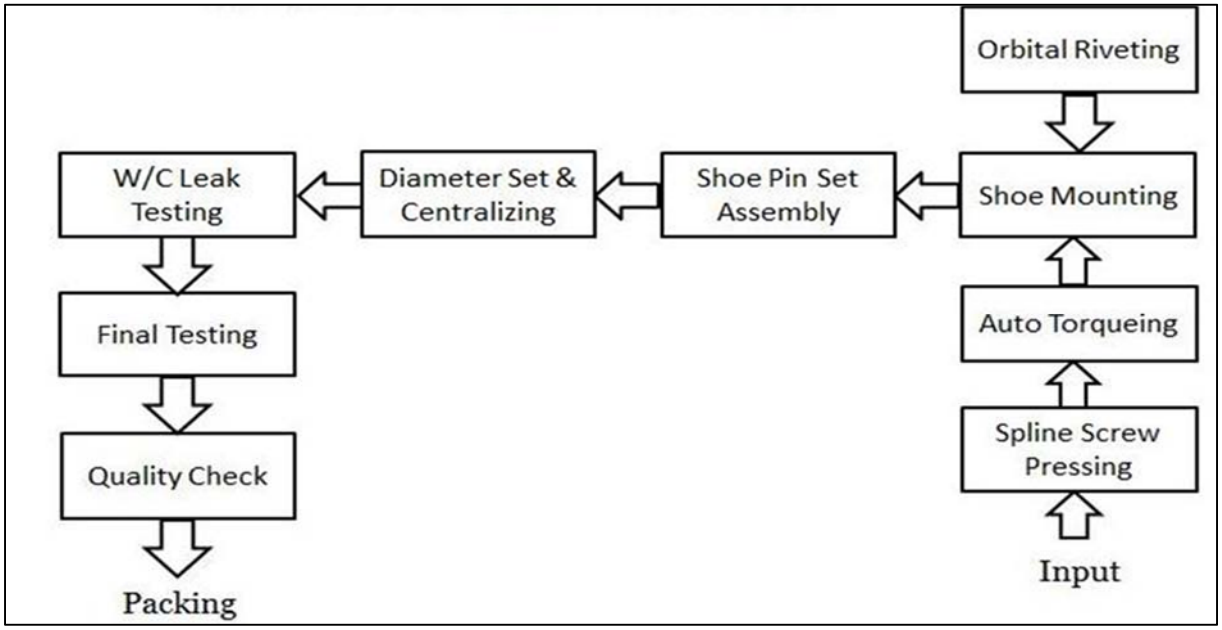

Figure 1 Layout of Brake Drum Assembly Line

III. OBSERVATION

TABLE I. Cycle Time of Work Stations

St.No. / Sr No.	1	2	3	4	5	6	7	8	9	
									1 worker	2 worker
1	29.18	36.46	15.81	24.05	26.40	14.19	34.70	14.50	30.95	26.46
2	23.04	38.92	26.15	24.85	26.30	15.57	31.50	16.23	34.93	32.09
3	22.51	37.58	20.57	22.05	21.71	14.92	32.72	17.56	33.23	20.40
4	23.80	38.05	23.34	21.30	25.78	17.61	31.48	17.77	28.55	29.52
5	29.58	39.15	20.37	21.05	21.56	18.52	31.04	15.33	29.50	27.30
6	22.04	37.92	21.57	22.07	22.15	13.94	32.88	16.29	33.93	21.40
7	30.18	35.46	14.81	20.83	27.04	15.88	32.98	13.50	31.95	32.09
8	30.58	39.15	27.15	21.77	19.70	19.07	31.50	18.56	30.50	25.46
9	21.50	36.58	21.37	21.03	26.09	16.09	31.53	14.33	27.55	26.30
10	23.80	39.05	22.34	20.98	23.34	14.28	32.04	18.77	33.23	30.58
Avg.	25.62	38.03	21.25	21.99	24.01	16.00	32.23	16.29	31.44	27.16

From above observation we have done following calculation.

A. Maximum Cycle Time (C_{max}):-

It is defined as Maximum time required completing one job at per shift.

$$C_{max} = \frac{\text{Available Time per shift}}{\text{Output required per shift}} \textbf{[1]}$$

$$C_{max} = \frac{\{[7\ Hrs \times 60] + 30\} \times 60}{550}$$

$$C_{max} = 49.09\ sec$$

No. of Station at Brake Assembly Line = 7

No. of Worker Working on work Station = 7

B. Balance Delay & Line Efficiency: -

Balance delay define as, it is a measure of line efficiency which result from ideal time due to imperfect allocation of work among station.

Following calculation we have done to get line efficiency and balance delay. As reference taken reading from Table No. 1

TABLE II. Calculations of Reading

Station Handle by Worker	Station No.	Work Elemental Time (Sec)	Station Time (Sec)	Ideal Time (Sec)
1	1,2	25.62 + 38.03	63.65	_
2	3	21.25	21.25	27.84
3	4	21.99	21.99	27.10
4	5,6	24.01 + 16.00	40.01	9.08
5	7,8	32.23 + 16.29	48.52	0.57
6	9	31.44	31.44	17.65
7	10	27.16	27.16	21.93
TOTAL			254.02	

Now, we are going to calculate line efficiency and it is given by formula as follow,

$$Line\ Efficieny = \frac{\text{Total station time}}{C_{max} \times \text{No. of station}} \times 100 \textbf{[1]}$$

$$Line\ Efficieny = \frac{254.02}{49.09 \times 7} \times 100$$

$$Line\ Efficiency = 73.92\ \%$$

Also, we can calculated Balance delay as follows,

Balance delay = 100 - 73.92 = 26.08 % [2]

C. Improved Production Line:-

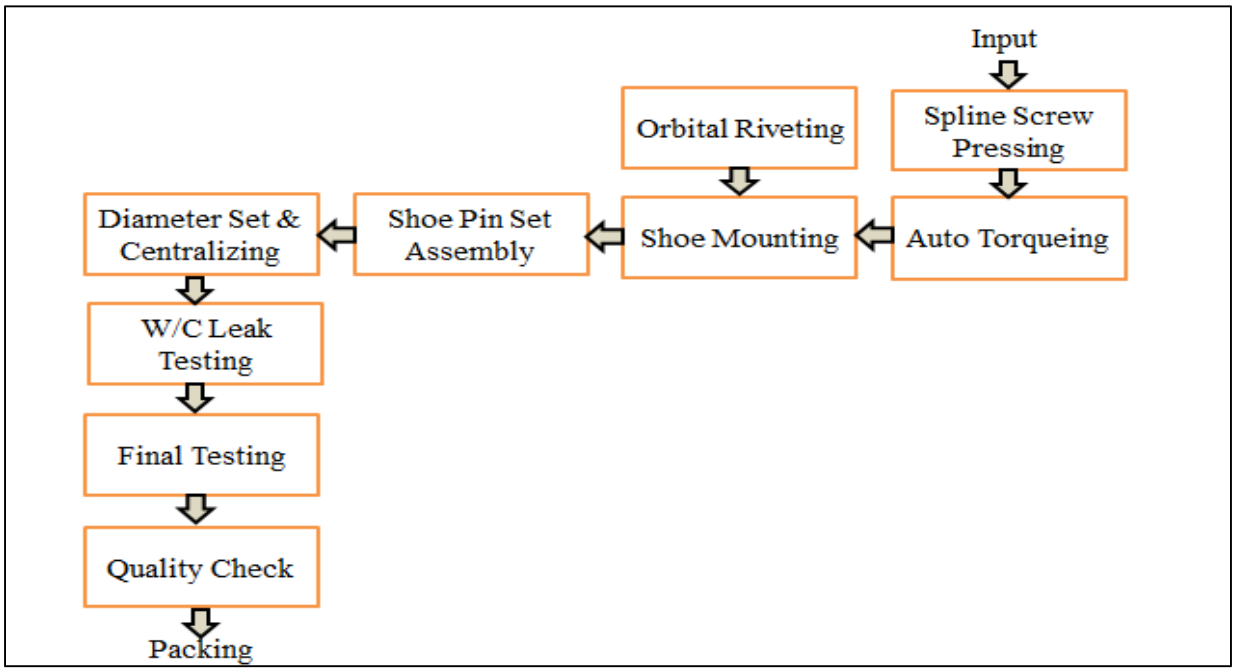

Figure 2 Improved Production Line

Now, we are going to calculate improved line efficiency and reduce balance delay which is shown as follows:-

a. Maximum Cycle Time: -

$$C_{max} = \frac{\text{Available Time per shift}}{\text{Output required per shift}}$$

$$C_{max} = \frac{\{[7\ Hrs \times 60] + 30\} \times 60}{550}$$

$$C_{max} = 49.09\ sec$$

b. Calculate No. of Work Station: -

$$\text{No. of work station} = \frac{\text{Total work content of all station}}{\text{Maximum Cycle Time}} \times 100 \qquad [2]$$

$$\text{No. of work station} = \frac{254.02 \times 550}{27000} \times 100$$

$$\text{No. of work station} = 5.17 \cong 6$$

It is important to minimize product work station for achieving optimizes production and better line efficiency. So, here we are also deals with product work station.

- No. of work Station = 6

From above calculation, we have seen that minimum no. of work station is obtained 6. So, that 6 number of workers working on 6 work stations.

- Balance Delay & Line Efficiency :-

By observing and studying product cycle time, simulations we are now, going to arrange work station and effective manage of cycle time as follows

TABLE III. Balance Delay & Line Efficiency Calculations

Station Handle by Worker	Station No.	Work Elemental Time (Sec)	Station Time (Sec)	Ideal Time (Sec)
1	1,3	25.62 +21.25	46.87	2.22
2	2	38.03	38.03	11.06
3	4,5	21.99+24.01	46.00	3.09
4	6,7	16.00+32.23	48.23	0.86
5	8,9	16.29+31.44	47.73	1.36
6	10	27.16	27.16	21.93
TOTAL			254.02	

Now, we are going to calculate line efficiency and it is given by formula as follow,

$$Line\ Efficieny = \frac{\text{Total station time}}{C_{max} \times \text{No. of station}} \times 100$$

$$Line\ Efficieny = \frac{254.02}{49.09 \times 6} \times 100$$

$$Line\ Efficiency = 86.24\ \%$$

Also from Table No 3 we can calculate Balance delay as follows,

Balance delay = 100 – 86.24 = 13.76 %

Total Efficiency Increased = (Line efficiency)$_{Th}$ – (Line efficiency)$_{Act}$

Total Efficiency Increased = 86.24 -73.92

Total Efficiency Increased = 12.32%

No. of product increased = Total Efficiency Increased × Total No. of Product Assemble per shift

No. of product increased = 0.1232 X 550

No. of product increased = 67.76 ≅ 6

No. of product increased = 68

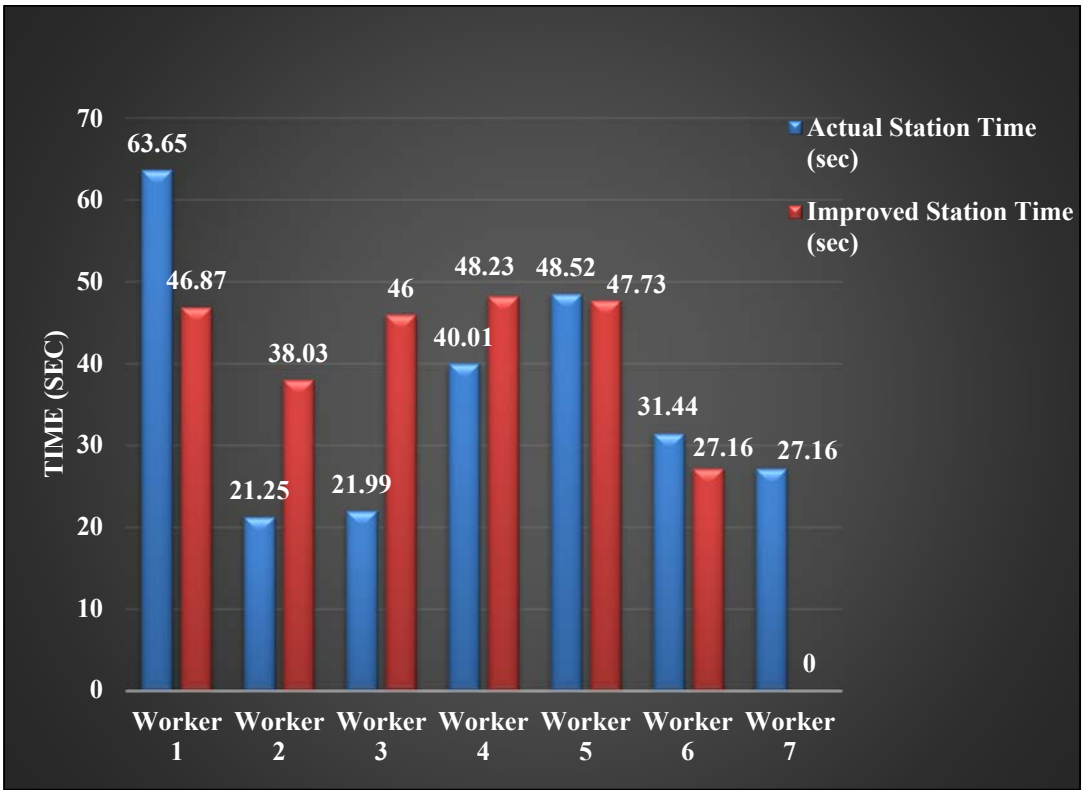

Figure 3 Graph of Comparison between Actual and Improved Station Time

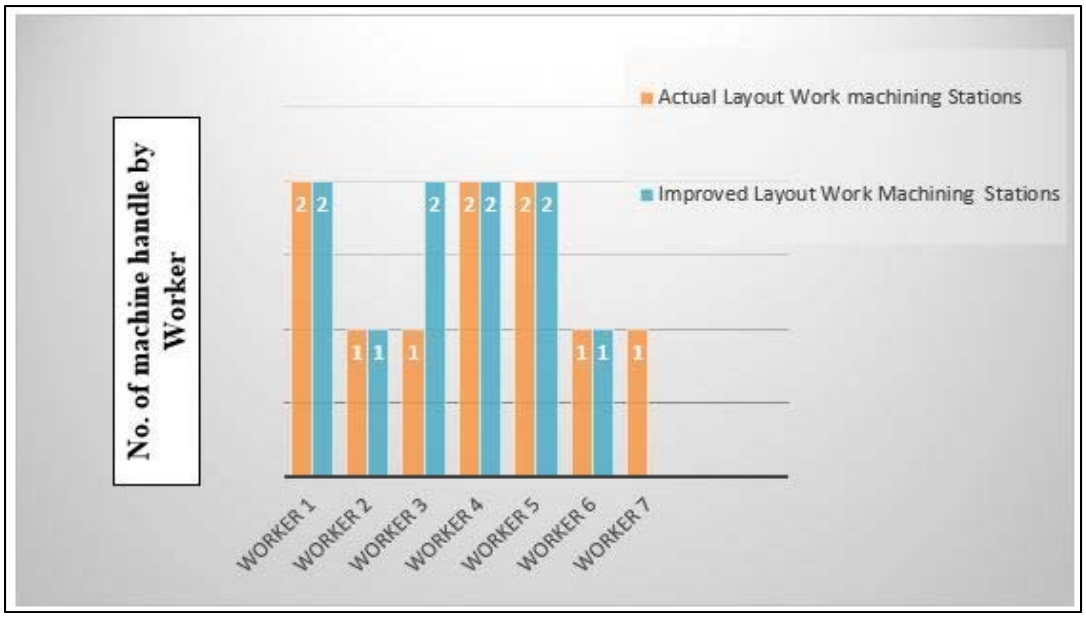

Figure 4 Graph of Man VS Machine

IV. RESULTS

A. Production Line

No. of product to be manufactured per month = 14000 units.

No. of worker per shift = 7.

No. of worker per day = 7× 2 =14.

Cost of manufacturing = 14× 10500

(Wages to worker)

= Rs. 1,47,000 /-

Production (product) per shift = 550 units.

$$No.of\ shift\ required\ to\ complete\ production = \frac{14000}{550}$$

$$= 25.45$$

No. of shift required to complete production ≅ 26 shifts

B. Improved Production Line

After improvement in the production line, reducing 1 worker and increasing 68 products per shift.

Total production = 550 + 68

= 618 units per shift.

Therefore,

$$No.of\ shift\ required\ to\ complete\ production = \frac{14000}{618}$$

$$= 22.65$$

No. of shift required ≅ 23 shifts

No. of worker per day = 6× 2 =12.

Cost of manufacturing = 12 × 10500

(Wages of worker)

= Rs. 1, 26, 000/-

Total cost saved by reducing One worker per shift = 1, 47, 000 – 1, 26, 000

= Rs. 21, 000/-

No. of shifts saved = 26 - 23

= 3 shifts.

Percentage Reduced in Labour Cost: -

$$Percentage\ Reduction\ in\ Labour\ Cost\ = \frac{Cost\ Saved}{Total\ Cost} \times 100$$

$$Percentage\ Reduction\ in\ Labour\ Cost\ = \frac{21000}{147000} \times 100$$

***Percentage Reduction in Labour Cost* =14.28 % monthly.**

Percentage Increase in Line Efficiency:-

$$Percentage\ Increase\ in\ Line\ Efficiency = (Line\ efficiency)_{Th} - (Line\ efficiency)_{Act}$$

$$Percentage\ Increase\ in\ Line\ Efficiency = 86.24 - 73.92$$

$$Percentage\ Increase\ in\ Line\ Efficiency = 12.3\%$$

TABLE IV. Tabular Comparison between Working Layout & Improved Production Line

Sr. No.	Parameters	Working Layout	Improved Working Layout
1.	No. of Workers	7	6
2.	No. of Brakes assembled per shift	550	618
3.	No. of Shifts to achieved Determine production	26	23
4.	Line Efficiency (%)	73.92	86.24
5.	Labour Cost (Annually)	1,764,000	1,512,000
6.	Balance delay (%)	26.08	13.76

V. CONCLUSION

From the above study it can be concluded that the process of assembly line can be improved based on line efficiency, work study, time study as well as effective utilization cycle time of various stations of assembly line. It will be modify the current layout by combine work stations also analyzing different observation parameters that was mention above also reducing the worker's fatigue too. Finally, we have done all calculations and analysis, we have also increased line efficiency by 12.32% and reducing labour cost of one worker per shift as well as target per month is achieved before 3 shifts than actual production line. By improving production line we can saved production cost of Rs.21, 000/- per month.

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