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Improve Productivity of Assembly Line by Line Balancing

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Abstract: This study has been undertaken to study about how someone can improve productivity of any manufacturing plant by doing line balancing, as we all know in any organization if they want to compete the market competition they have to provide product with maximum quality, in minimum time and as minimum as possible price then and then you can make your different position than other organization. So, we can say that productivity of any plant is most important parameter. And we will see by this study that improving productivity is not very difficult, by implementing some small ideas we can see the drastic improvement in productivity. This study is carried out on a switch breaker assembly line which makes up to 250A breaker, and its name is DU250 line
Keywords: Productivity, Cycle time, Kaizen, line balancing, Takt time, Non value added motion

I. INTRODUCTION

T In any type of assembly line if the work load distribution is not proper or we can say that some stations have high amount of work and some station have very less work load then what will happens is that near the high amount of work load stations there will be an inventory of product will be generated because preceding station will give worked product to them but work content is very high so this station will not be able to complete work in time so inventory will be generated.

So, these types of stations will become bottle neck and the rate of production will be governed by these stations. These types of work load distribution also cause worker idleness and it is not appropriate in any organization

In this type of situation line balancing method can be very helpful for improving the productivity. This method can be applied in any type of assembly line.

II. PROBLEM

A After the study of DU250 assembly line it was clear that the work load is not properly distributed on every station, it causes low productivity, worker idleness generation if inventory between stations, due to high work content worker got tired and it was also a cause of low production, in early stage before these study assembly line was able to make approximately 250 to 300 breakers per shift. But the market demand was very high so they were running two shifts per day. Due to two shift labor cost was very high

III. LITERATURE REVIEW

Yanmin Sha et al [1] In his paper author has studied on the productivity growth of the chin's manufacturing industries, with studying the environment efficiency the Malmquist productivity index (MPI), and the Malmquist-Luenberger productivity index. From 27 different areas the data is collected. The efficiency of productivity is higher at the east region then the efficiency of other region the annual growth of MIP and MLPI is4.1% and 0.9%. But Nobody focus on effect of environment change on productivity, everybody focusses on the consumption of energy, china's government should improve the mechanism to evaluate the emission of co2. Technology improvement can contribute more in productivity improvement. Second the productivity growth of china was over estimated. This study finds the difference between studies about china's productivity growth in nonferrous metal forming industries with respect to region.

Ankita Saxenaa [2] Diversity means similarity and difference between employs in terms of age, cultural background, physical abilities and disabilities, race, religion, gender, and sexual orientation. In many multinational companies there are many employees are from different region have different cultures, different languages so obviously they have different mind sets so the way of problem solving is different. In this case many multinational company have high problem-solving techniques so they have high efficiency of problem solving. Many researchers have mentioned that diversity in company is very important but if it could not be managed properly then this can be become big problem to handle the diversity for management and to employs also. Because of different languages they can have some issues for working. There is some solution for it like by using same language, encouragement to employs, open all channels of communication between employs and employees

Francisco Rubio [3] In this paper author have developed a new method for programing the automation of the robots for production in the sense of kinematics and dynamics of robot parts to take minimum time to perform tasks and avoiding collisions. Then the methodology can be increasing the profitability of production lines by designing flexible manufacturing systems. it can support firms to stay competitive in rapidly changing markets, which also helps to gain high levels of quality and efficiency. Therefore, this study's algorithm probably improves the design and planning of the robot tasks.

Antti Kauhanen et al [4] it is known that the dispersion of productivity between branches of the same organization after taking data from the thirty-three branches of an US company they have seen that productivity dispersion is argued to be largely illusory and follows from measurement error in both inputs and outputs and second factor is measured productivity differences are suggested to be caused by unobserved differences in factors affecting productivity.

N Hoboubi et al [5] In this paper author says that the estimation of productivity is not reliable. Two factors affecting productivity measurement is (1) when production increases, inputs typically increase as well. Productivity growth is therefore less variable than output growth, it means that measurement errors will be relatively more important. (2) Revisions to published estimates of production and factor inputs tend to be less highly correlated than the published estimates themselves. It means when we start production the input will be high then the productivity also will be high due to high output. So, the constant productivity growth can be seen.

AA Hosseini et al [6] In this study they have focused on the relationship between job satisfactions, job stress with the productivity. After the study the conclusion is that with higher work stress the productivity of the worker will be less with respect to the productivity of the worker with the high job satisfaction. This study is very important form management to know supportive nature with the employs can improve the productivity of organization

Juthamas Choomlucksanaa et al [7] In this study they have implemented lean manufacturing tools like 5s, poka-yoke, kaizen etc. by these tools the seven wastes of the production reduced so the working became so much easier than the earlier method. So, the productivity can be reduced by implementing the lean tools at any firm.

Cristian Gelmereanua et al [8] The aim of this study is to develop a network which can predict the cycle time of high speed machining, productivity can be increased by increase the speed of the process, the main aim of this study is to increase the productivity and reduce the cost. Parts of ANN for modeling and predicting the milling machine cycle time is made of the aluminum ANN was designed the algorithm to involve increasing the cutting regime while machining takes place.

Cristian Gelmereanua et al [9] It investigate the effect of trading with china on the productivity and job losses, at this time the china is the cheapest goods manufacturing country, so other countries are importing the row materials from china so the labor work on those countries decreases so the productivity can be increases by trading with china but the employment will be decrease, and we can say that china is responsible for job losses in many countries.

Romain Duval [10] In this paper it is investigated that to increase productivity we have to increase the capacity of the hardware. By increasing the capability of hardware, we can reduce the bottle necks of the process so that production can be easily done. So the productivity will be increase. At the current example by implementing this method they have found that the bottle neck was the reheating furnaces, so by increasing the capability by implanting new burners they could decrease the cycle time so productivity increased

IV. RESEARCH METHODOLOGY

Method of line balancing is very simple, which is given below step by step

A. Video Record

In this step we have to take video of all station on which production will going to be done

B. Time study

Fin this step we have to do time study of the taken videos, by time study we can calculate the time taken by operator to do the required job, and we can also find the particular time to do specific activities. So that latter we can distribute them in all stations. Time study table of DU250 line is given below.

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Table 4.1 DU250 station cycle time

| STATION	STATION NAME	ACTIVITY	TIME (SEC)	TOTAL TIME(SEC)	OPERATOR
1	Arc chute cleaning	Opening arc chute	18.13		1
		Cleaning contact	31.17		
		Closing arc chute	30.23	79.53	
2	Contact assembly	Putting TAC actuator	7.00		1
		Engaging knob	2.80		
		Trip force test	28.06	37.86	
3	QC check	Quality check 1	101.00	101.00	1
4	MV test	MV testing	24.67		1
		Placement and removal of Breaker	7.46	32.13	
5	Back partition	Putting back partition	16.8	16.8	1
6	Terminal bolt	Placing bolt and tightening	18.52	18.52	1
7	Cover assembly	Inserting phase barrier	17.04		1
		Marking	8.2		
		Apply molycot	9.8		
		Cover Placement	12.4		
		Place nuts on Fixture	15.6		
		Screw placing and tightening	25.8	88.84	
8	HV test	HV test	20		1
		Placement and removal of Breaker	3.16	23.16	
9	Accessory test	Accessory test	52.32		1
		Cavity	15	67.32	
10	Labeling	Cleaning the breaker	22.24		1
		Fixing midcover on breaker	2		
		Tighten the screw	25.25		
		Labeling	25	74.49	
11	QC2	Quality check 2	53.5	53.5	1
12	Packing	Packing	38.58	38.58	1
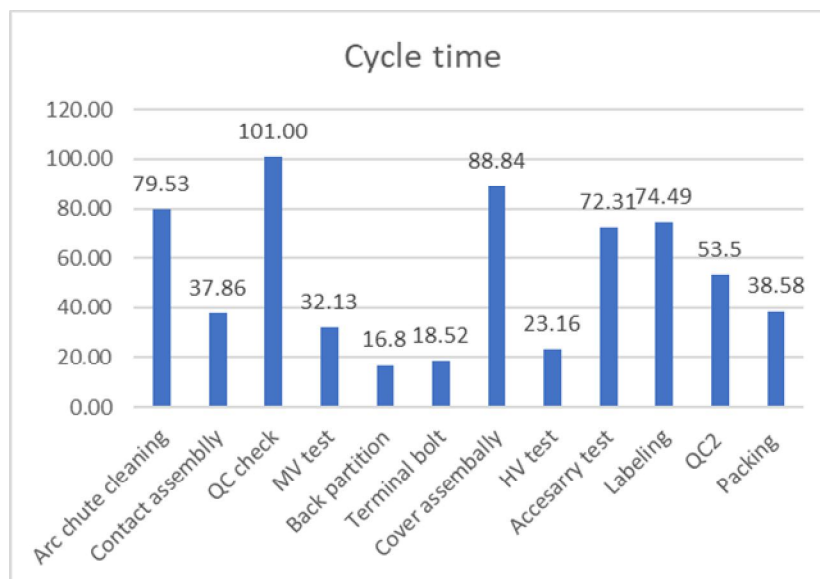
Fig 4.2 DU250 station cycle time
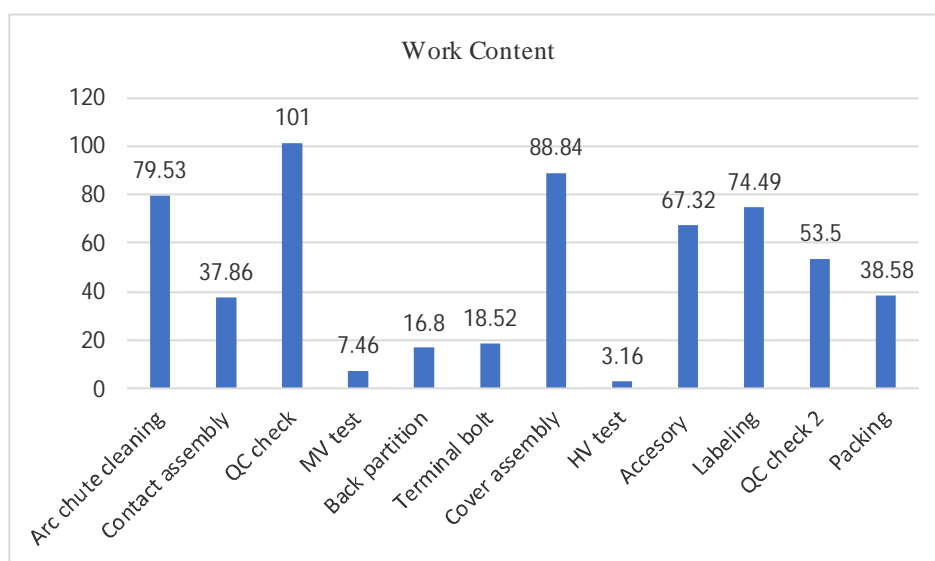
Fig 4.2 DU250 work content

C. Find Improvement Scope
1) Here we can see that the cycle time is more than the work content so we can say that during operation there will be some time when operator has nothing to do or we can say that operator is idle
2) The maximum time on station is QC check station which is 101 secs. And we cannot give QC activity to other station so all we can do is increase the operator
3) Second one is cover assembly station there are lots of activity which we can transfer to other station, these activities are shown in table 4.1
4) Some stations have very low work content so we can provide some work from high workload station

D. Find Takt Time
1) Now this line is making 250 to 300 breakers per shift, shift has 8 hours so if we want to make 500 breakers then all station must not have work content more than takt time

Takt time= (Total shift time)/no of breaker we wanted

Here, takt time=27000/500

=54 sec

Now we have to balance this line on 54 secs

E. Line Balancing

In line balancing method we can distribute work load on all stations equally, and for those work which we can not divide in two stations we can give extra worker to reduce the cycle time so that station cycle time can be reduced to less than the takt time. line balancing of DU250 line is given below

Table 4.2 Line balancing table

STATION	ACTIVITY	TIME (SEC)	OPERATOR
Station 1	Opening arc chute		
	Cleaning	49.3	1
Station 2	Closing arc chute		
	Putting TAC actuator		
	Engaging knob	40.03	1
Station 3	Trip force test		
	MV test (Manual activity)	35.52	1
Station 4	MV test	24.67	0
Station 5	Quality check	50.5	2
Station 6	Back partition		
	Placing bolt & tighten		
	Marking	43.52	1
Station 7	Phase barrier		
	Molycot		
	Cover placement	39.24	1
Station 8	Place nuts on fixture		
	Screw placing and tightening		
	Actual activity HV	44.56	1
Station 9	HV test	20	0
Station 10	Accessory	52.32	1
Station 11	Cavity placement		
	Cleaning the breaker		
	Fixing midcover	39.24	1

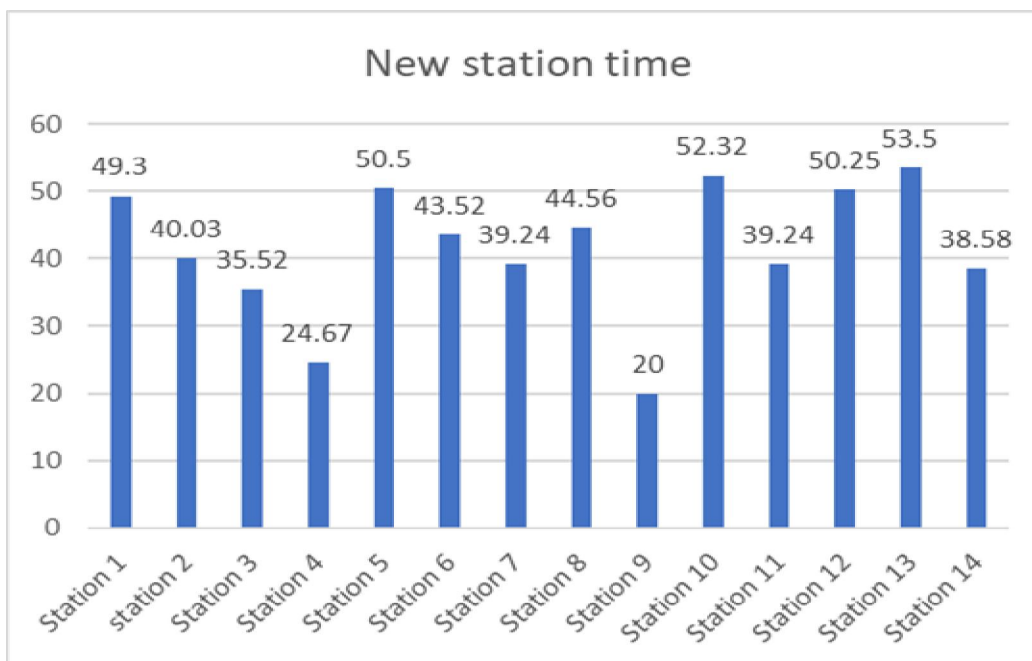| STATION	ACTIVITY	TIME (SEC)	OPERATOR
Station 12	Tighten the screw	50.25	1
	Labeling		
Station 13	Quality check 2	53.5	1
Station 14	Packing	38.58	1

Fig 4.3 New station time

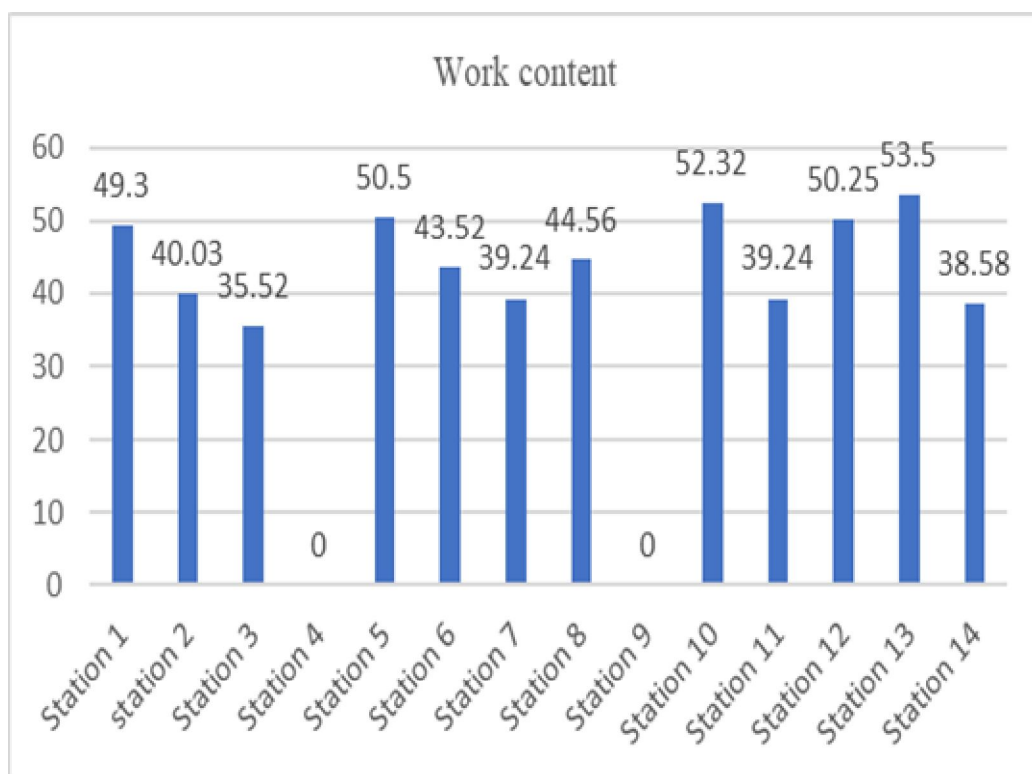Fig 4.4 Work content

1) Here we can see that on MV & HV test has no work content so no need of operator on those stations
2) Every station has less working time than takt time, so production of 500 breaker is possible
3) Max cycle time is on station 13 that is 53.5, so maximum production can be done is 504
4) Balancing efficiency is 77.60

V. RESULTS

After implementation line balancing production has been increase, this can be seen in below graph
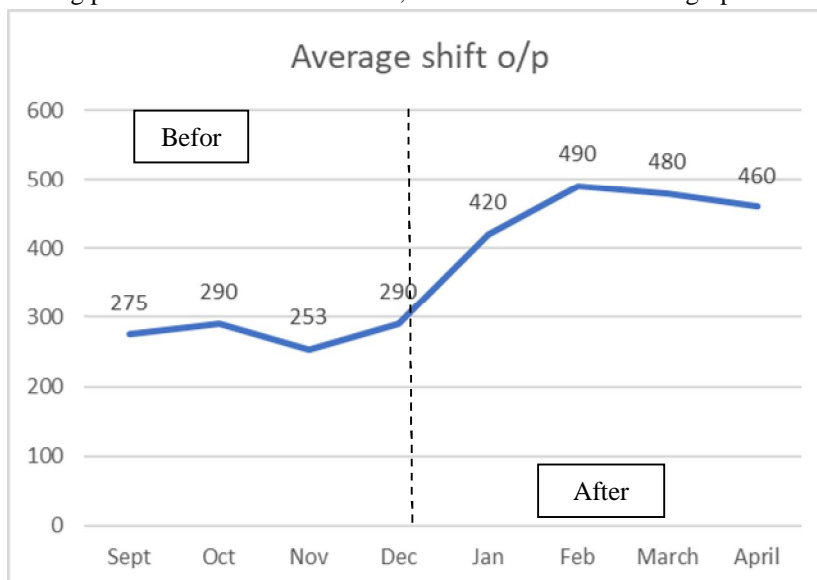
Here we can see that after January this line balancing was implemented so the production of the breaker is increased.

VI. CONCLUSION

Due to improperly balanced line productivity can be adversely affected. By this method of line balancing we can increase the productivity very easily, and balancing efficiency also can be increased

VII. ACKNOWLEDGMENT

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