International Journal of Applied Engineering Research ISSN 0973-4562 Volume 14, Number 16 (2019) pp. 3520-3525

Increasing Efficiency of Export Scooter Assembly Line in PT.X

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Abstract

Production Capability of Scooter Export Assembly Line PT. X was unable to meet market demand as an excuse to carry out efficiency improvement activities in the production line. In this study an analysis of line balancing was carried out on the production line and the use of motion analysis as a problem solving solution. The result is the new design of the production line with the acceleration of the conveyor speed from the previous 80 DM to 75 DM. From the results of the study it was found that the method can significantly affect the results of Line eficiency which increased by 5.85% and increase the number of Smoothness Index by 40.14 points.

Keyword: assembly line, line balacing, conveyor speed

INTRODUCTION

PT. X is one of the motorcycle manufacturers in Indonesia that sells its products not only domestically but also exported abroad. Increased Demand for the Export Market, especially for the scooter model, requires the company to optimize its production line..

Table 1: Motorcycle Sales [1]

	2018		2019	
Month	**Domestic**	**Export**	**Domestic**	**Export**
JAN	482,537	38,021	569,126	67,016
FEB	439,586	38,679	531,824	54,750
MAR	535,371	53,152	580,504	60,887
APR	580,921	44,271	598,372	52,397
MAY	589,304	52,321	561,657	75,876
JUN	375,034	31,435		
JUL	593,749	56,086		
AUG	568,056	55,339		
SEP	557,684	67,426		
OKT	610,322	70,68		
NOV	597,366	67,145		
DEC	453,178	52,866		
TOTAL	6,383,108	627,421	2,841,483	310,882

From the data above, it can be concluded that from January to May 2019 for Exports it has reached 310296 units, far surpassing the previous year's acquisition of 226400 units, which means there is an increase of 37.06%. It is not impossible at the end of the year to exceed the achievement of 2018. This is cofirmed by other AISI data which provides an overview of the increase in exports from year to year since 2013.

Table 2: Motorcycle Sales 2015-2018[1]

Year	Domestic	Export
2015	6,480,155	228,229
2016	5,931,285	284,065
2017	5,886,103	434,691
2018	6,383,108	627,421

Observations in the field that there is still a significant time difference between the speed of the conveyor and the work time of each process and the number of movements / activities of the operator that are less effective. In production a constant need is needed to increase motorcycle production time. One way to overcome line imbalance is to balance the line (line balancing). Line balancing is a method for balancing the assignment of several work elements from an assembly line to a work station to minimize the number of work stations and minimize the total waiting time (idle time) on the entire work station at a certain level of output [8].

PROCEDURE

The formulation of the problems proposed in this study was how to improve the efficiency of the Export Scooter Assembly Line at PT. X. To get a clearer picture of the problems that exist within the company, the writer will provide the following problem boundaries:

1. This research is only carried out at the Export Scooter Assembly Line (assembly) excluding final supply and inspection.
2. The ability to supply goods to the production line, final inspection and shipping logistics to consumers is not discussed in this writing.
3. The observed work operator is a work operator with an average level of ability and skill in completing work.

The objectives to be achieved in this study are as follows:Get the New design of the Export Scooter Assembly Line at PT. X which is optimal for increasing the amount of production at a time.

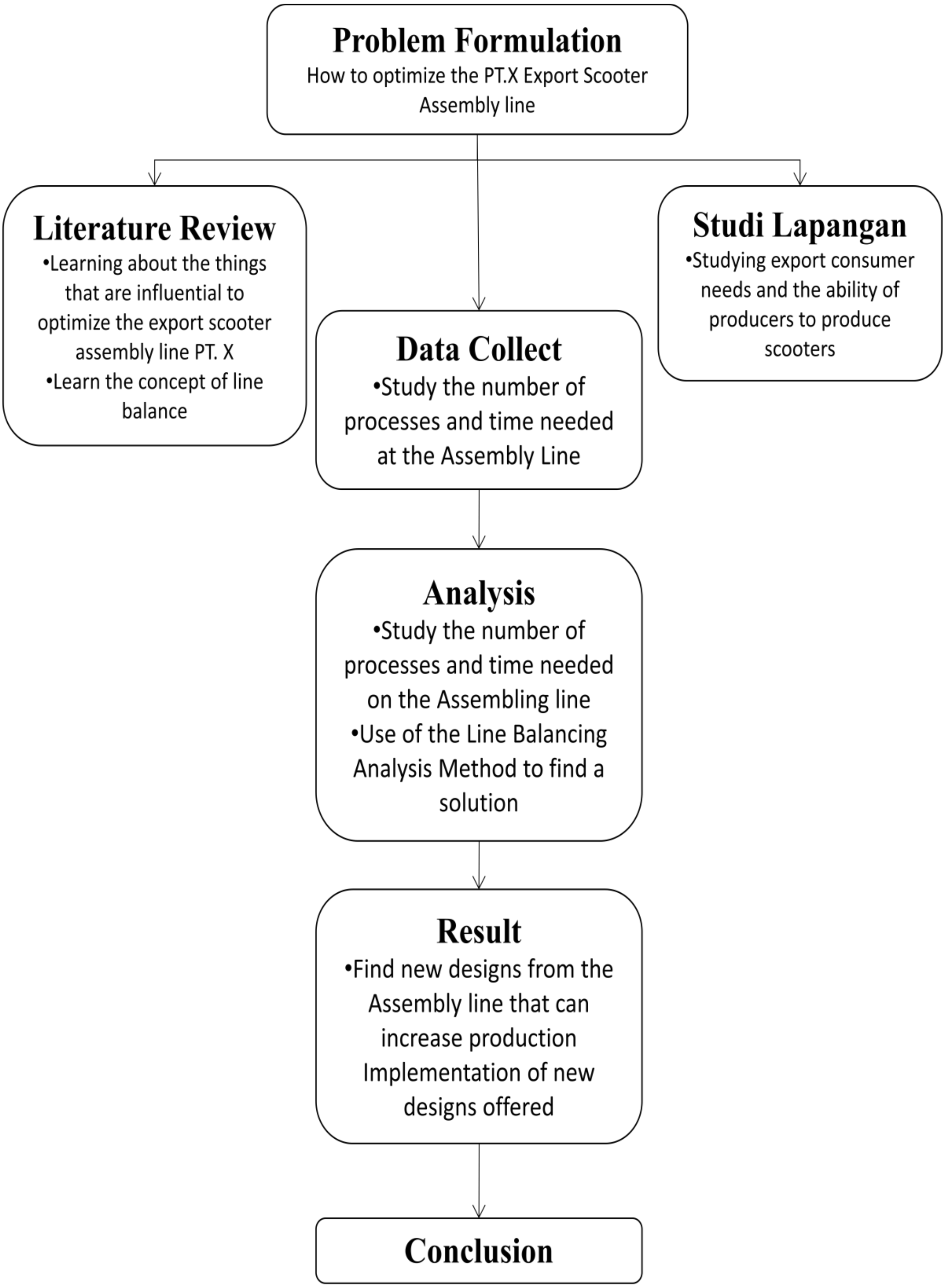

Figure 1: Research Flow Chart

RESULT AND ANALYSIS

The following are the data that can be taken from the scooter assembly line, As already written on the material restrictions at this time the writing of the research is only in the body assembly assembling scope not included with supply and Final Inspection. The scooter assembly process in the total body assembling has 72 stations. Actual Conveyor speed when the study was carried out was 80 DM. From the observation results, the data cycle time for each process is as follows:

Table 3: Process Assembly

NO	PROCESSS	CT (DM)	NO	PROCESS	CT (DM)
1	SMC1	71	37	MKI28	71
2	SMC2	75	38	MKI29	74
3	SMC3	72	39	SE1	74
4	MC1	74	40	SE2	72
5	MC2	75	41	SE3	74
6	MC3	73	42	SE4	72
7	MC4	74	43	K1R	77
8	MC5	73	44	K2R	73
9	MC6	75	45	MKA1	72
10	MKI1	74	46	MKA2	73
11	MKI2	77	47	MKA3	72
12	MKI3	70	48	MKA4	73
13	MKI4	72	49	MKA5	72
14	MKI5	72	50	MKA6	71
15	MKI6	74	51	MKA7	75
16	MKI7	71	52	MKA8	72
17	MKI8	72	53	MKA9	75
18	MKI9	71	54	MKA10	72
19	MKI10	72	55	MKA11	71
20	MKI11	73	56	MKA12	72
21	MKI12	72	57	MKA13	75
22	MKI13	73	58	MKA14	72
23	MKI14	72	59	MKA15	78
24	MKI15	74	60	MKA16	73
25	MKI16	72	61	MKA17	74
26	MKI17	71	62	MKA18	73
27	MKI18	72	63	MKA19	75
28	MKI19	73	64	MKA20	73
29	MKI20	72	65	MKA21	72
30	MKI21	72	66	MKA22	73
31	MKI22	72	67	MKA23	72
32	MKI23	72	68	MKA24	72
33	MKI24	73	69	MKA25	73
34	MKI25	71	70	MKA26	72
35	MKI26	73	71	MKA27	74
36	MKI27	72	72	MKA28	77

From the table above, the efficiency of the production line was

A. $Line\ Eficiency = \frac{5278}{5760} x100 = \mathbf{91.16\%}$

B. $Balance\ Delay = \frac{5760-5278}{5278} x100 = \mathbf{8.83\%}$

C. $Smoothness\ Index$

$$= \sqrt{((80-71)^2 + \ldots +} \ (80-77)^2) = \mathbf{61,45}$$

These processes when described in Precedence Diagrams are as follows:

Figure 2: Precedence Diagram

From Precedence Diagram, it is known that there are processes that are on the right and left of the conveyor so that to speed up the conveyor it is necessary to take into account both.

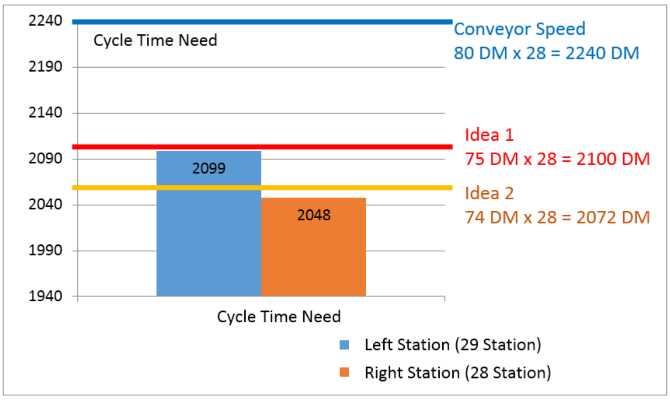

Figure 2: Graph of *Cycle Time related to Conveyor Speed*

The graph above shows that what will be used is idea 1 which is to change the speed of the conveyor to 75 DM. Ide 2 cannot be used because the total cycle time requirement in the Left Station Process cannot be fulfilled.

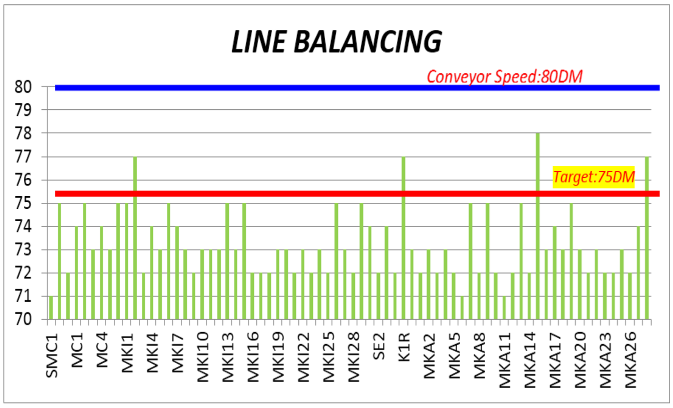

Figure 3: Line Balancing Current Form state

From the Line balance chart, it was found that the Station wass the bottleneck because having a CT (Cycle Time) above 75 DM.

Table 5: Process that exceed 75 DM

NO	PROCESS	CT
1	MKI2	77 DM
2	K1R	77 DM
3	MKA15	78 DM
4	MKA28	77 DM

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From the results of the analysis of work elements in each process related to the image above is an illustration of moving the sub-process to another process, this is done to balance CT in each process, so that no waste is wasted. More details are written as follows:

Table 4: Transfer of Work Element

From	Work Element	To
MKA 28	Open cover muffler &Open mainstand jig CT: 4DM)	MKA 26
MKA 26	Torque Bolt Board Footrest Tightening (CT:2 DM)	MKA 23

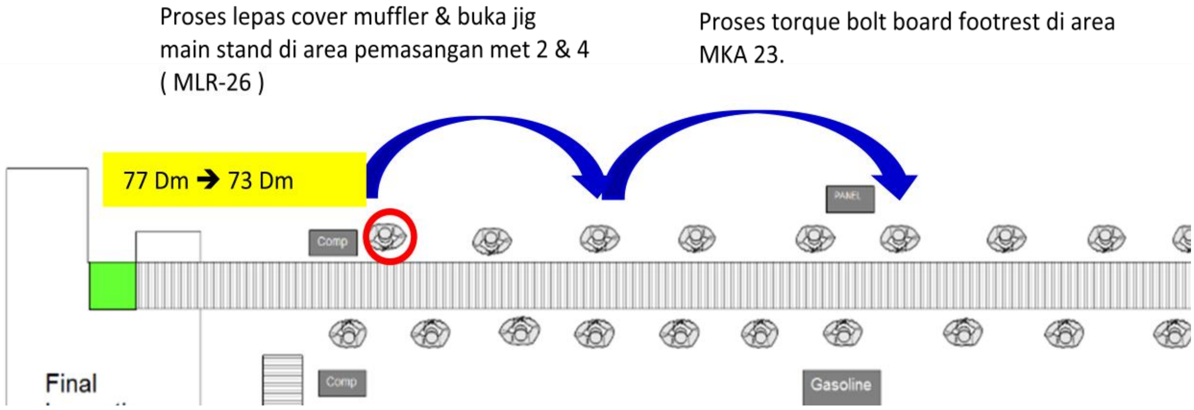
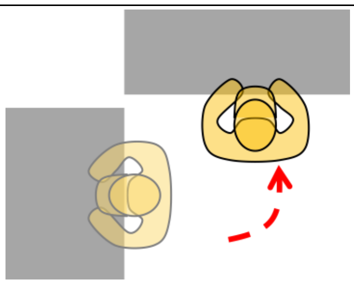
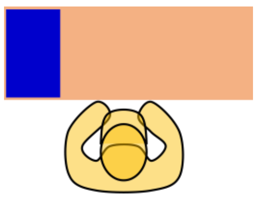


Figure 4: Transfer of Work Element Illustration

Apart from the above, the transfer of work elements is not possible to do on bottle neck process, it is done by using visual analysis of the movements of the operators in the process.

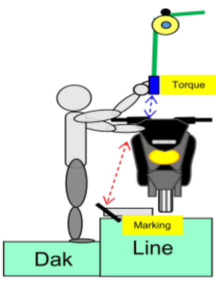
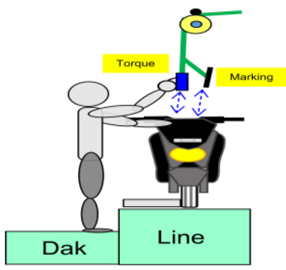
Although the K1R is not on a conveyor but excessive cycle time can interfere with other line balancing processes. From the observations, the researcher found that there was a motion loss while in the field, that the operator at the station had to turn around or turn around to do work.

Table 5: K1R Solution

Before	After
 CT = 77 DM	 CT = 73 DM

From the observation results at MKI2, the researcher found that there was a motion loss while in the field, that the operator at the station had to bend and take the marking to do the work, so the idea of this condition was to move the marking pen so that the operator did not need to bend to do the work

Table 6: MKI2 Solution

Before	After
 CT : 77 DM	 CT :73 DM

From the observations at MKA 15, the researcher found that there was a motion loss while in the field, that the operator at this station had to rotate tracker until several times

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Table 7: MKA 15 Solution

Before	After
 CT : 78 DM	 CT : 74 DM

After going through the improvement process, the line balancing becomes as follows:

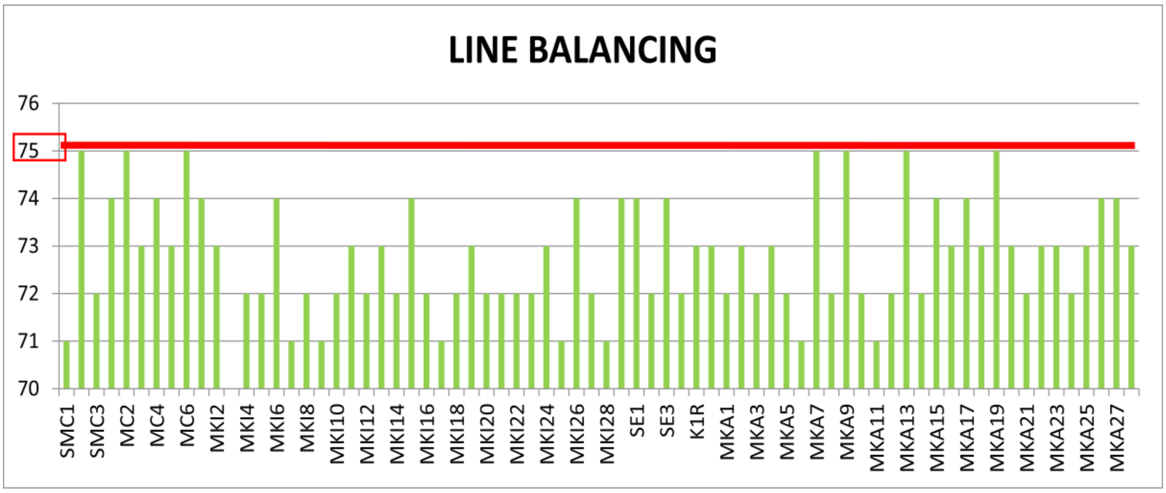

Figure 5: Line Balancing After Improvement

After improvement in the production line now the highest value of Line Balancing from Motor Production is 75DM line conveyor from the assy line body can be accelerated from the previous 80 DM to 75 DM. From the figure above, the Production Line Efficiency is obtained :

Table 8: Current Form state and After Improvement State comparison

	Current Form	After Improvement	Gap
Line efficiency	91,16%	97.01 %	5.85%
Balance Delay	8.83%	2.98 %	
Smoothness Index	61.45	21.51	40.14

From the results of the changes by accelerating the conveyor, Line Efficiency is obtained and the balance of Delay is better 5.85%. And can increase Smoothness Index by 40.14 points.

Changes in conveyor speed also theoretically increase the amount of motor production in the same time when compared to the initial conditions.

Table 9: Product Quantity Comparison

	Conveyor Speed		Products
	in DM	In second	units per hour
Current Form State	80	48	75
After Improvement State	75	45	80

CONCLUSION

From the observation and analysis process that has been passed in this study with Line balancing analysis we can find out the processes that can be optimized, problem solving for bottleneck processes can also be solved by motion analysis. The results of this study are the new design of a production line with an increase in efficiency is by accelerating the speed of the conveyor from the previous 80 DM to 75 DM .. From the Calculation results, it can be found that the method can significantly affect the Line eficiency results which increase by 5.85% and increase the Smoothness Index number by 40.14 points. Theoretically accelerating the speed of the conveyor can increase the production output by 5 units per hour.

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