

CHAPTER 5

THE RESULT OF IMPLEMENTATION

5.1.: Process Chart after Improvement

Symbol	Description	Volume	Frequency	Distance	Time
○ → □ D ▽	1. Bring the plastic granule bags into the processing line	1 Bag	141.06 bags/day	0.023 m/bottle	0.0186 sec/bottle
○ → □ D ▽	2. A worker pours a bag of plastic granule in to the machine.	1Bag	141.06 Bags/day	0.0037 m/bottle	0.07969 sec/bottle
○ → □ D ▽	3. Cycle time of blowing Milk bottle	1 bag	-	0	0.265sec
○ → □ D ▽	4. A operator cut and dress a bottle and put it in a bag	-	-	0	0.252
○ → □ D ▽	5. Bring a bag of screened bottle to a storage place	-	-	0.011 m/bottle	0.00883 sec/bottle
○ → □ D ▽	6. Leave a bottle for setting of plastic structure one day	-	-	0	1 day/bottle
○ → □ D ▽	7. Bring a bag of bottle from a storage place to the silk screen room	-	-	0.056 m/bottle	0.034 sec/bottle
○ → □ D ▽	8. Silk Screening of the bottle	-	-	0.099 m/bottle	0.184 sec/bottle
○ → □ D ▽	9. Bring boxes of screened bottle from a silk screen room to storage places			0.0065 m/bottle	0.104 sec/bottle
○ → □ D ▽	10. Stock the finished product for one week			0	1 week/bottle
○ → □ D ▽	11. Bring Boxes of screened bottle from storage places to a truck			0.0670 m/bottle	0.0048 sec/bottle
Total	3 6 0 1 1		Total	0.267 m/bottle	1 week, 1day and 0.951 secs/bottle

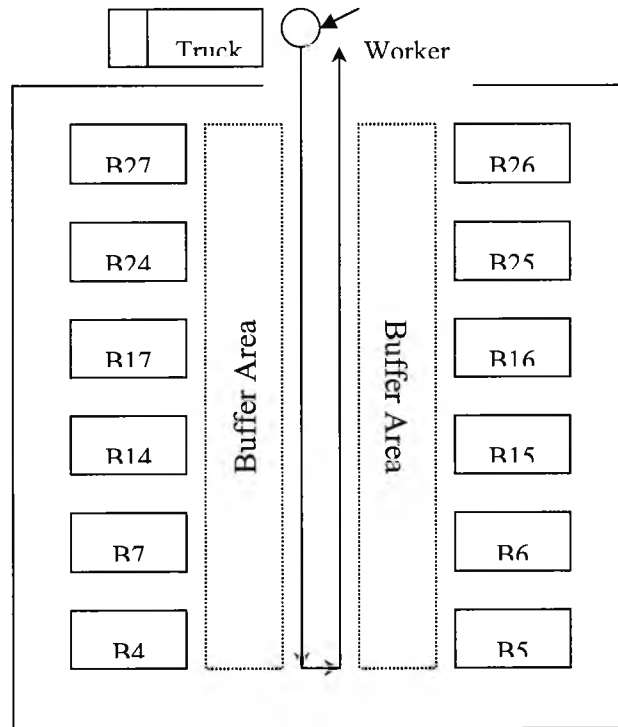
TABLE 5.1.: THE PROCESS CHART AFTER IMPROVEMENT

From a previous process chart, the method of calculation unit time and distance will be displayed as following;

Method of Calculation Process Chart of After Improvement

1. Bring the plastic granule bags into the processing line

A worker brings the plastic granule bags from the truck to a side of each machine in the processing line as following figure;



From the figure, we will find the distance and time that use in this activity;

Machine	Distance (m)
B27, B26	5.202
B24, B25	8.874
B17, B16	12.4695
B14, B15	16.218
B7, B6	19.737
B4, B5	23.562
Average	14.34

But the worker must comes back to the truck to pick up a new bag to the line so, the total distance will equal $14.34 \times 2 = 28.02$ meter.

No.	Amount of Plastic Granule Bag (Bags)	Time of loading (Minutes)	Time/bag (secs/bag)
1	182	95	31.32
2	333	82.5	14.86
3	320	150	28.13
	Average		21.49

From the data that loading 182 plastic granule bags into the processing line will consume the time total 1 hour and 25 minutes or 95 minutes.

$$\text{So, the average time per each bag} = \frac{95 \text{ minutes} \times \frac{60 \text{ second}}{1 \text{ minutes}}}{182 \text{ bags}}$$

$$= 31.32 \text{ second/bag}$$

Size of Bottle (cc)	Total bottles that are produced in one day	Amount of Bottles that are produced from one bag of plastic granule	Amount of Bag for produce each size of bottle/one day	
830	2271.428571	553	4.11	
450	22628.57143	826	27.40	
200	101285.7143	1506	67.25	
120	73428.57143	1736	42.30	
Average		1155.25	141.06	Bags/day

So, worker must bring the plastic granule bag 141.06 times per day and time of loading a plastic granule per bottle = $(21.49 \text{ sec/bag}) / (1155.25 \text{ bottles/bag}) = 0.0186 \text{ sec/ bottle}$ and distance = $(28.02\text{m/bag}) / (1155.25\text{bottles/bags}) = 0.023 \text{ m/bottle}$

2. A worker pours a bag of plastic granule in to the machine.

A worker consumes time in loading plastic granule into the 30 machines equal 52.50 minutes. So, the time that was used per machine = $52.50/31 = 1.41 \text{ minute/machine}$. And total distance is 47.12 meters.

If we want to calculate time and distance per one bottle, it can be found that each bag of plastic granule can be produced a plastic bottle as following table;

Size of Bottle (Cubic Centimeter, CC)	Amount of Bottle	Amount of Machine that produce each size	Weight	Average
830	553	3	$3/12=0.25$	$553 \times 0.25=138.25$
450	826	2	$2/12= 0.167$	$826 \times 0.167=137.94$
200	1506	4	$4/12=0.37$	$1506 \times 0.37=557.22$
120	1736	3	$3/12=0.25$	$1736 \times 0.25=434$
Total		12	1	1267.41

Thus, 1 bag of plastic granule can be produce 1267.41 bottles.

$$\text{And the time of loading plastic granule per one bottle} = \frac{1 \text{ min} \times \frac{60 \text{ sec}}{\text{min}} + 41 \text{ sec}}{1267.41 \text{ bottle}}$$

$$= 0.07969 \text{ sec/bottle}$$

$$\text{For the distance} = \frac{\text{Total Distance}}{\text{Total bottle}}$$

$$= \frac{47.12 \text{ m}}{1267.41 \text{ bottle}}$$

$$= 0.0037 \text{ m/bottle}$$

3. Cycle time of blowing Milk bottle

Size of Bottle (cc)	Cycle time of blowing a bottle (second)	Amount of bottle/day	Weight	Tme x Weight
830	19	159000	0.104	1.968
450	12	158400	0.103	1.238
200	12	709000	0.462	5.541
120	12	509000	0.332	3.978
Total	55	1535400	1.000	12.725
Average	13.75			

So, blowing one bottle average time equals 12.725 seconds
 But every cycle time, 48 bottles are produced at the same time,
 So, time of blowing one bottle will be

$$= \frac{12.725 \text{ sec } s}{48 \text{ bottle}}$$

$$= 0.2651 \text{ sec/ bottle}$$

4. A operator cut and dress a bottle and put it in a bag

Size of Bottle (cc)	Time/Bag (mins)					Average	Amount of bottle /bag	Weight	Time/bottle (secs/bottle)	Average time
	1	2	3	4	5					
830	15	12	12.07	14.5	13	13.31	130	0.11	6.14	0.68
450	15.5	18.18	19.4	17	16.8	17.38	200	0.17	5.21	0.88
200	30	29.2	32	30.5	31.9	30.72	350	0.30	5.27	1.56
120	35	30	33	31.8	34.2	32.80	500	0.42	3.94	1.67
						Total	1180	1		4.79

but there are 19 operators for cutting and dress a bottle, so there are 19 bottles are dressed at the same time.

So, time of cut and dresses a bottle equal;

$$= \frac{4.79 \text{ sec}}{19 \text{ bottle}}$$

$$= 0.2521 \text{ second/bottle}$$

5. Bring a bag of screened bottle to a storage place

Size of Bottle (cc)	From	To	Distance (m)	Time(Second/bag)					Average
				1	2	3	4	5	
830	Blow Molding Line	UV Room	66.34	50	52.5	51	53	50.6	51.42
450	Blow Molding Line	Silk Screen Room	11	19.63	13.38	11.1	20	22.3	17.28
200	Blow Molding Line	Warehouse	45.04	42	37	35	40	36	38.00
120	Blow Molding Line	Warehouse	45.04	35	38	40	41	34	37.60

Size of Bottle(cc)	Amount of bag/day	Weight	Time of delivery a bag	Time x Weight	Number of Bottle/bag	Time/bottle	From Blow Molding	Distance (m)	Distance x weight	Distance/ Bottle
							Processing Line to			
830	174.73	0.2418	51.42	12.4322	130	0.0956322	UV Room	66.34	16.0395	0.12338
450	113.14	0.1566	17.28	2.70525	200	0.0135263	Slik Screen Room	11	1.72209	0.00861
200	289.39	0.4004	38.00	15.2165	350	0.0434757	Warehouse	45.04	18.0356	0.05153
120	145.43	0.2012	37.60	7.56641	500	0.0151328	Warehouse	45.04	9.06359	0.01813
Total	722.69	1			Total	0.167767			Total	0.20165

But, there are 19 bags of bottle are delivered at the same time, so distance and time of transportation will be $=0.20165\text{m}/19$ bottle $=0.0106131$ m/bottle and 0.167767 secs/19bottle $= 0.008829$ secs/bottle

6. Leave a bottle for setting of plastic structure one day
7. Bring a bag of bottle from a storage place to the silk screen room

Calculation of Distance (meter/bottle)

Size of Bottle (cc)	To	Slik Screen Machine	Frequency (times/day)	Weight	Total Distance (m)	Amount of Bottle/bag	Distance per bottle
830	UV Room	12.50	174.73	0.24178	3.02	130	0.0232

Size of Bottle (cc)	To	Slik Screen Machine								Average (meter)	Frequency (times/day)	Weight	Total Distance (m)	Amount of Bottle/bag	Distance per bottle
		A1	A2	A3	A4	A5	A6	A7	A8						
450	Slik Screer Room	44.76	41.76	38.76	35.76	32.76	30.76	27.76	25.76	34.76	113.14	0.157	5.44	200	0.0272
200	Warehouse	5	4	3	2.5	2.5	3	4	5	3.63	289.39	0.4	1.45	350	0.0041
120	Warehouse	5	4	3	2.5	2.5	3	4	5	3.63	145.43	0.201	0.73	500	0.0015
										Total	547.96	1.00	6.89	550.00	0.0561

Calculation of Distance (meter/bottle)

Size of Bottle (cc)	To From	Slik Screen Machine					Average (second)	Frequency (times/day)	Weight	Total Time	Amount of Bottle/bag	Time per bottle
		1	2	3	4	5						
830	UV Room	10.41	10.15	11.28	11.5	11.68	11.00	174.73	0.24178	2.66	130	0.0205
450	Slik Screen Room	10.55	10.61	10.41	10.33	11.02	10.58	113.14	0.15655	1.66	200	0.0083
200	Warehouse	3.53	3.21	3.15	3.03	3.69	3.32	289.39	0.40043	1.33	350	0.0038
120	Warehouse	3.51	3.23	3.45	3.98	3.44	3.52	145.43	0.20123	0.71	500	0.0014
							Total	722.69	1		Total	0.0340

8. Silk Screening of the bottle

Time of Painting

Size of Bottle (cc)	Time/ Box (Second)	Number of bottle/bag	Time/Bottle
830	144	100	1.44
450	324	180	1.80
200	420	350	1.20
120	720	500	1.44
Average			1.47

but there 8 silk screen machine, so there are 8 bottle are screened at the same time.

So, time per bottle will be = 1.47secs/8bottle
 = 0.18375 secs/bottle

and distance per bottle will be

From \ To	A1	A2	A3	A4	A5	A6	A7	A8	Average
A1	56.6	54.6	52.6	50.6	48.6	46.6	44.6	42.6	49.6
A2	54.6	52.6	50.6	48.6	46.6	44.6	42.6	40.6	47.6
A3	52.6	50.6	48.6	46.6	44.6	42.6	40.6	38.6	45.6
A4	50.6	48.6	46.6	44.6	42.6	40.6	38.6	36.6	43.6
A5	48.6	46.6	44.6	42.6	40.6	38.6	36.6	34.6	41.6
A6	46.6	44.6	42.6	40.6	38.6	36.6	34.6	32.6	39.6
A7	44.6	42.6	40.6	38.6	36.6	34.6	32.6	30.6	37.6
A8	42.6	40.6	38.6	36.6	34.6	32.6	30.6	28.6	35.6

Average 42.6 Meter

Size of Bottle(cc)	Distance(m)	Weight	Distance x Weight	Amount of bottle per a t	Distance/Bottle
830	0.00	0.24	0.000	130	0.00000
450	42.60	0.16	6.688	200	0.03344
200	42.60	0.40	17.040	350	0.04869
120	42.60	0.20	8.563	500	0.01713
Total					0.09925

9. Bring boxes of screened bottle from a silk screen room to storage places.

Size of Bottle (cc)	From-To	Distance (m)	Time of Delivery (Second)					Average
			1	2	3	4	5	
830	UV Room-Warehouse	45.67	613.41	598.69	610.34	542.84	692.35	611.53
450	Silk Screen room - Warehouse	28	596.25	581.54	592.50	526.15	675.00	594.29
200	Silk Screen room - Warehouse	28	591.6	537.6	619.8	577.8	583.2	582.00
120	Silk Screen room - Warehouse	28	557.40	575.40	574.80	606.00	621.60	587.04

Size of Bottle (cc)	Delivery from slik screen room to	Frequency per day	Weight	Amount of Boxes per one times of	Amount of Bottle per a box	Amount of Bottle	Distance (m)	Distance x Weight (m)	Distance per bottle	Time (Sec)	Time x Weight	Time per bottle
830	Warehouse	7.571429	0.288372	30	100	3000	45.67	13.170	0.00439	611.5	176.348	0.058783
450	Warehouse	4.190476	0.159602	30	180	5400	28	4.469	0.000828	594.3	94.8499	0.017565
200	Warehouse	9.646259	0.367396	30	350	10500	28	10.287	0.00098	582	213.824	0.020364
120	Warehouse	4.847619	0.184631	30	500	15000	28	5.170	0.000345	587	108.386	0.007226
	total	26.25578	1				Total	33.096	0.006542	Total	593.408	0.103937

10. Stock the finished product for one week

11. Bring Boxes of screened bottle from storage places to a truck

Size of Bottle (cc)	Amount of Bottle in a box	Delivery from Storage Places to a truck	Amount of Boxes					Total time of delivery					Time per bottle					Average (sec/bottle)	Time x weight
			1	2	3	4	5	1	2	3	4	5	1	2	3	4	5		
830	100	Warehouse	76	89	56	100	85	15	18	10	20	15	0.118	0.121	0.107	0.120	0.106	0.115	0.033
450	180	Warehouse	40	13	11	79	40	10	3	3	20	10	0.083	0.077	0.091	0.084	0.083	0.084	0.013
200	350	Warehouse	118	48	70	17	35	25	10	20	4	10	0.036	0.036	0.049	0.040	0.049	0.042	0.015
120	500	Warehouse	20	70	43	122	56	4	16	11	30	13	0.024	0.027	0.031	0.030	0.028	0.028	0.005
																		Total	0.067

Size of Bottle (cc)	Delivery from Storage Places to a truck	Frequency per day	Weight	Amount of Boxes per one times of delivery	Amount of Bottle per a box	Amount of Bottle	Distance (m)	Distance x Weight (m)	Distance per bottle
830	Warehouse	7.571429	0.288371894	30	100	3000	28	8.07441302	0.00269
450	Warehouse	4.190476	0.159602038	30	180	5400	28	4.46885707	0.00083
200	Warehouse	9.646259	0.367395636	30	350	10500	28	10.2870778	0.00098
120	Warehouse	4.847619	0.184630546	30	500	15000	28	5.16965529	0.00034
total		26.255783	1.000000114				Total	28.0000032	0.00484

TABLE 5.2. COMPARING RESULT TABLE BETWEEN BEFORE AND AFTER PLANT LAYOUT IMPROVEMENT

Description	Before Improvement		After Improvement	
	Distance (m/bottle)	Time (sec/bottle)	Distance (m/bottle)	Time (sec/bottle)
1. Bring the plastic granule bags into the processing line	0.023	0.019	0.023	0.019
2. A worker pours a bag of plastic granule into the machine	0.004	0.080	0.004	0.080
3. Cycle time of blowing Milk bottle	0	0.265	0	0.265
4. A operator cut and dress a bottle and put it in a bag	0	0.252	0	0.252
5. Bring a bag of screened bottle to a storage place	0.0111	0.0090	0.0106	0.00883
6. Leave a bottle for setting of plastic structure for one day	0	1 Day	0	1 Day
7. Bring a bag of bottle from a storage place to silk screen room	0.121	0.111	0.056	0.034
8. Painting Color on a bottle	0.178	0.184	0.099	0.184
9. Bring boxes of screened bottle from a silk screen room to storage place	0.014	0.145	0.0065	0.104
10. Stock the finished product for one week	0	1 Week	0	1 Week
11. Bring boxes of screened bottle from storage places to a truck	0.013	0.100	0.0670	0.0048
Total	0.363	1 Week, 1 Day and 1.165 secs/bottle	0.267	1 Week, 1 Day and 0.951 secs/bottle
		Improve (%)	26.63	18.36

Description	Before Implementation				After Improvement			
	Distance (m/bottle)	Time (sec/bottle)	Number of Labour (man)	Labour Cost (Bath/day)	Distance (m/bottle)	Time (sec/bottle)	Number of Labour (man)	Labour Cost (Bath/day)
5. Bring a bag of bottle to a storage place	0.0111	0.009	19	260.47	0.0106	0.00883	19	255.55
7. Bring a bag of bottle to silk screen room	0.121	0.111	2	338.15	0.056	0.034	1	103.58
9. Bring boxes of screened bottle from a slik screen room to storage place	0.014	0.144954	5	1103.98	0.0065	0.103937	4	791.59
11. Bring boxes of screened bottle from storage places to truck	0.013	0.1	3	517.44	0.067	0.0048	2	346.08
Total	0.1591	0.364954	29	2220.04	0.1401	0.152	20	1496.80
				Improve (%)	11.94	58.47	32.58	32.58

The Result of Implementation

1. Lead Time of Production is not Reduced

From the nature of milk bottle processing, the processing lead time and transportation lead time happen at the same time, as seen in Figure 5.1. So, improving plant layout in order to reduce the time of transportation will not lead to reduction of production lead time. Even if the transportation time is reduced significantly, the production lead time will not be reduced. The production lead time might depend on another factor like downtime of machine lead time. So, it is an area recommended for further research for those interested in productivity improvement.

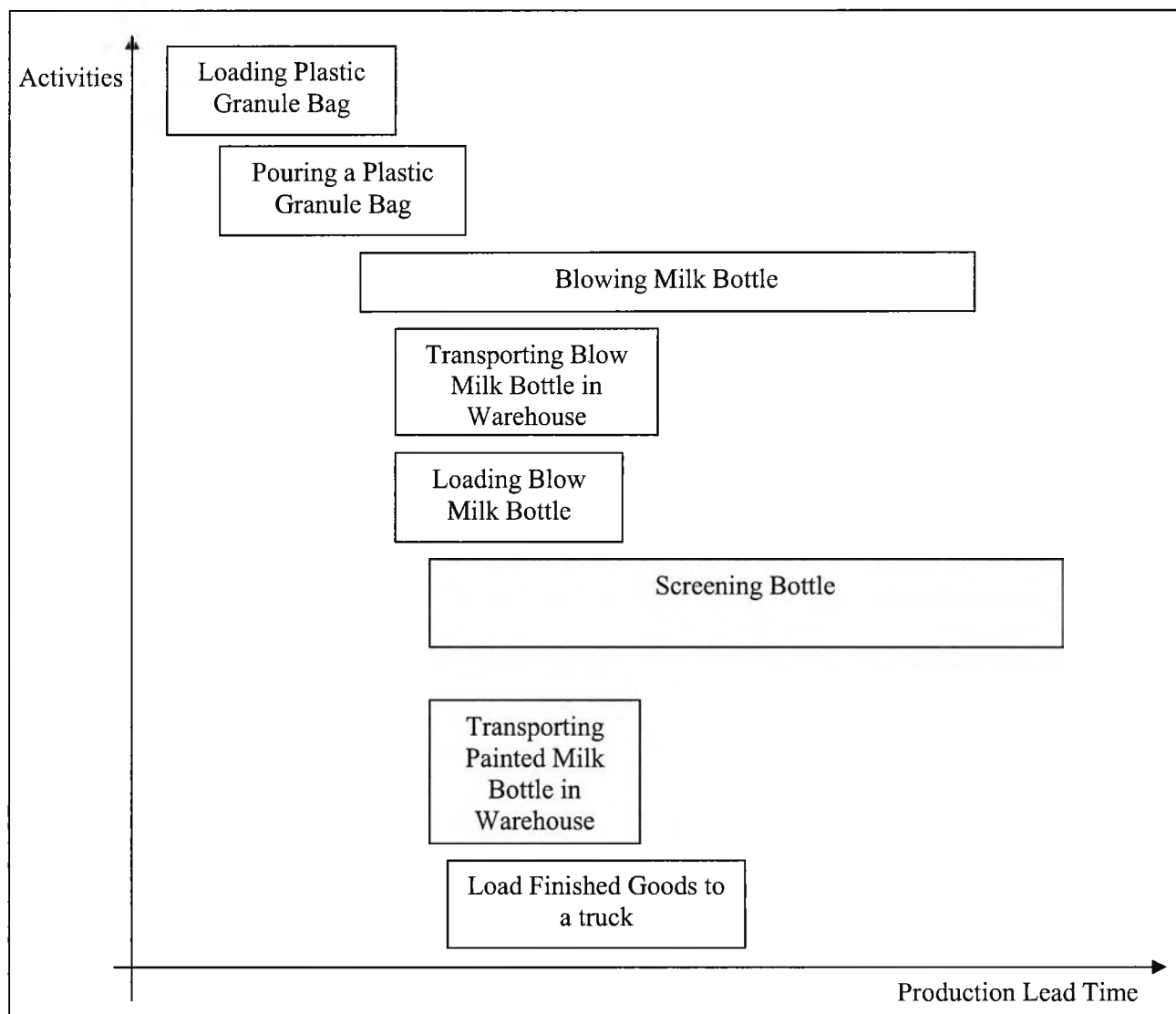


FIGURE 5.1: THE PROCESSING MILK BOTTLE PRODUCTION LEAD TIME

2. Unnecessary Activity Eliminated

From the improvement in the warehouse are of both work in process and finished goods, we can eliminate unnecessary workforce that is employed in material transportation. This results in savings of labour cost and delivery time. As seen in Table 5.2., the transportation time reduces from 0.3649 sec/bottle to 0.152 sec/bottle or by 58.47%.

3. Improve warehouse system and management

From the existing plant layout, the storage of both work in process and finished goods was not effective and the inventories were hard to be tracked and their quality hard to be control. In the new plant layout, the same kind of product will be kept in the same area, which make it easy to control and monitor. Moreover, the warehouse system was designed to be closer so that the risk of contamination can be reduced, resulting in increased quality of the product.

4. Increase Reputation of the company.

Implementing a new plant layout can increase reputation of the company by creating clean and close system workplace environment. Having a clean workplace environment improves the quality of the product. That improvement also meets the customer requirement. This can be seen from the fact that after implementing the new plant layout, customers did not complain about the same problem again. So, the reputation of the company increases as a result in dealing business together in the future.

5. Productivity Increased

From the effective warehouse system, we will reduce the risk of contaminate of the product that occurs from leaving the WIP for a long time. On the other hand, if the WIP is produced before the time it takes for the structure to set, it will lead to distortion of the silk-screened bottle. The new plant layout can improve the quality of product by making all the materials to be more visible. So, the risk of using improper bottle will be reduced.

6. Cost of Production Reduced

From the effective plant layout, the labour, equipment and material used in the factory will be reduced. The transportation cost will also be reduced. By a good plant layout, distance of delivery among each workstation is shorter. So, man and equipment used in the delivery is reduced. The labour cost was reduced from 2220.04 baht/day to 1,496.80 baht/day or by 32.58%. Moreover, the cost of cleaning forgotten bottle was eliminated. The amount used to be spend in cleaning cost was 1015 baht per month and lost opportunity in the sales of the product was 264,762 baht per month. So, the company can save on these spendings 265,777 baht per month. This means the decrease in production cost.